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Characterising learning in a demonstrator
community serving first-year chemistry
students at a South African university

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DOCTOR OF PHILOSOPHY

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This work is dedicated to my sons Neill and Ross
and to my parents Ellis and Maxie Langeveld

University of Cape Town

Abstract

Teaching assistants (or demonstrators as they are called at South African universities) have become indispensable to the delivery of teaching particularly to first-year students, due mainly to the growing need in tertiary institutions to balance increasing student numbers and needs with pressure on academic staff time and institutional resources. At most universities the role of teaching assistants falls to postgraduate students who are being trained in disciplinary research. In addition to funding their own studies, their participation in teaching activities is increasingly being recognised as preparation for possible careers in tertiary teaching. This study explored learning in a community of demonstrators in the first-year laboratories of a chemistry department at a South African university. A theoretical framework that views learning as participation in a *community of practice* was used to characterise demonstrators' engagement with their task of facilitating student learning. Learning as participation is more than engagement in the activities and practices of a social or professional group of people; it encompasses both *active participation* and the *construction of an identity* in relation to the group and its practices.

The study characterised demonstrators' participation in the laboratories before and after the implementation of an intercessionary process consisting of various measures aimed at improving practice. Qualitative data in the form of interviews, focus groups, reflective writing and laboratory observations formed the bulk of the data, and was focused on the demonstrator community rather than the first year students as a unit of inquiry. There was overall improvement in the quality of demonstrators' participation and practice in the laboratories over the course of the study, which I have been able to substantiate with global data collected from student and demonstrator cohorts before and after the intercession.

Three aspects of demonstrators' participation were investigated, namely engagement, imagination and alignment. These aspects have been woven into a qualitative interpretation of what learning in a demonstrator/postgraduate community might mean: from emerging conceptions about student learning and the learning of chemistry, to a deeper understanding of the meanings of professional behaviour and academic enterprise. I have shown that demonstrating entails so much more than "learning to teach" by highlighting the important learning that occurs around emerging professional identities and personal priorities and the struggle to find a balance between them.

The study also illustrates the value of communities of practice as framework for studies of postgraduate professional development. In particular, I have shown it ideal for providing a low-resolution "big picture" perspective on the participation of the demonstrators within which to identify areas for future work. Methodological findings include the use of electronic communication as a means of data collection.

The recommendations emanating from my study mainly address strategies for increasing postgraduate ownership of their teaching agenda on a variety of levels, ranging from the institutional level down to the coal face, where demonstrator meets student. Foremost in this regard is due acknowledgment for the value and importance of postgraduates' contribution, arising from the implementation of fair, transparent and consistent institutional frameworks for using and rewarding postgraduate students with teaching responsibilities.

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Acknowledgements

Completion of this study would have been impossible without the support, advice and assistance of a number of people whom I now wish to acknowledge.

Foremost, I would like to thank my two supervisors, Associate Professor Bette Davidowitz of the Department of Chemistry, University of Cape Town, and Professor Marissa Rollnick of the Marang Centre for Mathematics and Science Education, University of the Witwatersrand, for their faith in my abilities, and their invaluable insights and guidance. Their supervision was notable for extremely supportive, relevant and applicable advice and promptness of feedback, and I have found the working and friendly relationships that I developed with Bette and Marissa most inspirational.

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Thanks to the many students and demonstrators who participated so enthusiastically in this study. Here I have to single out two exceptional young women in the persons of Dr Manki Maoela and Ms Munkombwe Muchindo, who have at different times during the study been both my right and left hand, and my inspiration.

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Finally, I thank my parents who encouraged and supported me on a multitude of levels, my sons Neill and Ross for an abundance of hugs, kisses, and patience, and to my friend and partner, Desmond, who filmed the laboratory observations, captured the still photographs of students and demonstrators in the laboratories from the video footage, and held my hand throughout most of this long but deeply satisfying journey.

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Sadly, my dad passed away just days before my final examination results arrived. His absence from the ensuing celebrations and my graduation in December 2010 resulted in the journey ending on a bittersweet note.



Chapter 1

Introduction

This chapter introduces the study and its context, the research questions and framework that guided it, the researcher who performed it, the concepts and terminology that gave it meaning, and the chapters that provide its content and structure.

1.1 Introduction

Chemistry educators have long held the view that laboratory work benefits students' learning in chemistry (Hofstein & Lunetta, 2004; Tobin, 1990). At most tertiary institutions chemistry students are required to participate in weekly or biweekly practical sessions as part of their formal training. They may spend as much as half their contact time on practical activities in the laboratory, the main purposes of which are to develop laboratory skills and illustrate theory (Johnstone & Al-Shuaili, 2001). As chemistry educators, we want the laboratory experience to result in meaningful learning of the competences and attitudes that will best prepare our students for their careers as chemists.

Central to the laboratory experience is the role of the chemistry demonstrator (or TA as they are called elsewhere), who plays an integral part in facilitating the learning that takes place in the laboratory, under direction of an "expert chemist" in the person of the supervising lecturer or laboratory supervisor. According to the theory of situated cognition (Lave & Wenger, 1991) the student can be considered as *apprentice* to the demonstrator in the chemistry laboratory. The demonstrator as *practitioner* knows the laboratory and understands how it works. The *expert practitioner* (the lecturer) has a great deal of experience in the laboratory and oversees the apprenticeship (guides the learning that takes place in the setting). At the same time the demonstrator can be seen as serving an apprenticeship as novice educator, honing his/her craft by developing the competences required for effective teaching of those aspects of chemistry relevant to the students' laboratory experience (Bond-Robinson, 2005).

The study reported here explored demonstrator participation in an undergraduate laboratory community in the Chemistry Department at a historically black university (HBU) in the Western Cape, South Africa, namely the University of the Western Cape (UWC).

1.2 Rationale

At the time of first graduation, the average South African chemistry major will have spent up to 300 hours in the chemistry laboratory, yet anecdotal evidence confirms a common complaint among academics accepting students into post-graduate research programs: many of these students graduate without the ability to perform experiments independently. The literature (Berry, Gunstone, Mulhall, & Loughran, 1999; Hart, Mulhall, Berry, Loughran, & Gunstone, 2000; Hodson, 1990; Hofstein & Lunetta, 2004; Johnstone & Wham, 1982) substantiates that students achieve minimal learning in the laboratory considering the amount of time spent on laboratory work. Although many of the sources cited above concern secondary education, the arguments provided particularly by Hodson (1990) apply equally to chemistry education at the tertiary level. The end result is that students are attending laboratories and going through the motions of completing their practical work, but not learning much from the experience. According to a preliminary study performed on the first-year chemistry students at UWC at the start of the study (there is a full report in chapter 7) the students also did not derive much enjoyment from attending the laboratories. When considering how hugely resource-intensive laboratories are, it is important for their potential to be fully realised.

The content, context and mode of presentation of laboratory tasks have received extensive attention in the literature (Domin, 1999a & 1999b; Hodson, 1990; Hofstein & Lunetta, 1982; Johnston & Al-Shuaili, 2001). My interest tends towards improvement of the effectiveness of laboratory instruction by focusing on the human interactions involved in creating the optimal learning environment. The point has been made that the demonstrators are the primary facilitators of learning in the laboratory context described above; they are therefore considered a key point for intervention when aiming to improve the quality of the laboratory experience.

Many institutions recognise senior students' involvement in the training of undergraduates as a compulsory (albeit informal and non-credit-bearing) component of their professional training (Luft, Kurdziel, Roehrig, & Turner, 2004). South African tertiary chemistry departments draw their novice employees almost exclusively from the national pool of chemistry postgraduates, most of whom have been involved in student facilitation and other teaching activities. For many future chemistry lecturers these peripheral teaching activities will be the only preparation they receive for their academic careers (Holt, 1999), as a teaching qualification is not usually a prerequisite for appointment in academia. With this study I am hoping to contribute to the development of an understanding of the ways in which demonstrators' engagement in student facilitation and other teaching activities may open trajectories for them to enter the academic community.

1.3 Context of the study

1.3.1 *Locating the study*

The institution at which the study took place is a public¹ historically black university (HBU) situated in the Cape Peninsula region of the Western Cape, South Africa. It was established by the South African Government in 1960 as a constituent college of the University of South Africa (UNISA) (<http://www.uwc.ac.za/>) for people classified as *Coloured*² and named “The University College of the Western Cape”. In the ensuing 50 years the University of the Western Cape (UWC) has become a rated research university that offers degrees up to doctoral level. It is no longer formally associated with UNISA or any other institution of higher learning. The total number of registered students at UWC was around 14 000 in the final year of the study (2009); at this time roughly 20% of enrolments were postgraduate students (<http://www.hesa.org.za/hesa/index.php/about-us/universities>).

The first-year teaching laboratories in the chemistry department at the above institution (henceforth to be referred to as “the department”) provide the physical context for the study.

1.3.2 *First-year chemistry course offerings*

The institution offers four first-year courses in chemistry:

- *chemistry 114/124*: This course consists of two consecutive semester modules (CHE114 and CHE124) presented to students in the *Bachelor of Science* (B Sc) degree programmes in Chemical Sciences, Physical Sciences and Pharmacy. It is a prerequisite for students who want to continue with chemistry in the second year and beyond.
- *chemistry 116/126*: This course consists of two consecutive semester modules (CHE116 and CHE126) offered to students in Life Sciences degree programmes. This is a service course that terminates after the second semester and does not normally allow students access to second year chemistry modules.
- *chemistry 118 and chemistry 128*: These are terminating semester modules offered to dentistry and nursing students, respectively.

All chemistry courses at this institution have associated practical modules. The practice (currently but also throughout the study) has been to group students enrolled in the chemistry 114/124 and chemistry 116/126 modules together for their chemistry practicals. This group

¹ A public university is a university that is predominantly funded by public means. In South Africa the principal government bodies currently funding tertiary institutions are the Department of Higher Education and Training (DHET) and the National Research Foundation (NRF).

² The term **Coloured** refers to the modern-day descendants of slave labourers imported into South Africa by Dutch settlers as well as to other groups of mixed ancestry originating in the present-day Western Cape. They are the predominant population group found in the Western Cape Province.

provided the student context of this study, and the demonstrators selected to facilitate this group were chosen as the unit of enquiry. These groups will henceforth be referred to as “the first-year students” and “the demonstrator community”, respectively.

1.3.3 *The first-year practical course*

At the time of the study first-year chemistry practicals were offered on three weekday afternoons (Tuesdays, Wednesdays and Thursdays) and students were required to attend one 3-hour session per week, on one of the designated days. Student numbers in the first-year practical course varied between 320 and 360 throughout the study, which meant that roughly 120 students had to be accommodated in the laboratories on each of the three afternoons. Their course selections and timetables determined which afternoon session they were assigned, and so it was common for students enrolled for the same study programme (e.g., BSc Chemical Sciences) to be assigned the same afternoon. Laboratory and locker assignments were usually completed within the first two weeks of the first semester and students were required to remain with this placement throughout the year.

The experiments that make up the first-year chemistry practical course fit the description of expository type activities (Domin, 1999a & 1999b). They are closely prescribed, predicted outcome or “cook book” style experiments and are largely devoid of any real-world context. While it is acknowledged that they represent an approach to laboratory instruction that is considered to encourage lower rather than higher-order thinking, they are a historical remnant of having to cater for large student numbers with limited resources (Domin, 1999a; Lagowski, 1990). Though not relevant to this study, future plans for the practical course include a review of the existing experiments and the inclusion of at least some contextualised and open-ended investigations, in line with modern international trends to involve lower-division undergraduate students in working on authentic modern-day chemistry problems (Elliott, Stewart, & Lagowski, 2008).

1.3.4 *The first-year laboratory facilities*

Two to three undergraduate teaching laboratories are usually assigned for first-year chemistry practicals, each able to accommodate up to 64 students. Each laboratory is configured with four fixed laboratory benches running across the width of the laboratory. Up to sixteen students can be stationed around each bench.

Attempts were made throughout the study to cap the number of students at 120 per afternoon session, spread over two adjacent laboratories. At times, especially at the start of the study, student numbers warranted the use of a third laboratory on Wednesday afternoons which, because of timetable constraints imposed by the university, was in greater demand than the other two afternoons. Later in the study, more sophisticated internal placement procedures were introduced to override centrally imposed timetables.

This allowed for a more even distribution of students across the three afternoons, and obviated the use of a third laboratory on Wednesdays.

1.3.5 Recruitment and assignment of demonstrators

The way in which the demonstrators were assigned gradually changed during the study and will be discussed in some detail in chapter 5 under the heading *Procedural changes*. In the paragraphs that follow I will briefly describe the way in which the demonstrating programme operates, in order to provide a context for the chapters that follow. Figure 1.1 depicts pictorially the configuration of students and demonstrators in each laboratory.

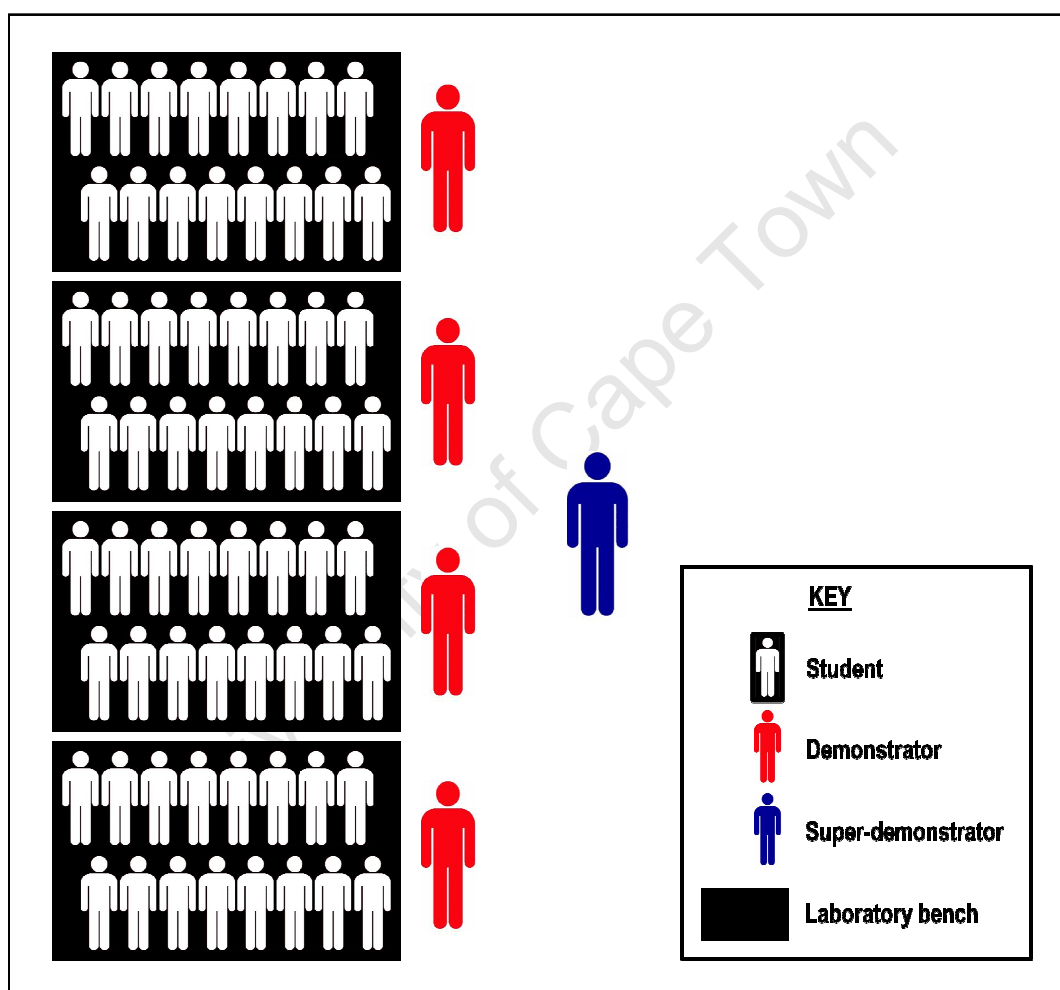


Figure 1.1 Assignment of demonstrators in each of the first-year laboratories

In South Africa, the academic year commences a few weeks after the start of each new calendar year. In the chemistry department, recruitment of demonstrators takes place within the first two weeks of each academic year, usually through the posting of printed advertisements in and around the department, and by word of mouth. Advertisements usually call for applications

for demonstratorships *and* tutorships³. Only chemistry students are considered for these positions and students who are actually registered in the chemistry department (as opposed to other academic departments at the institution) are given preference. Demonstrator training usually takes place two weeks into the first semester and practical sessions for the students commence in the third week.

Towards the end of the study each group of 16 students working at the same bench had one demonstrator assigned to them. Up to four benches were occupied per laboratory and that meant that there were up to four demonstrators on duty in each laboratory. These four individuals were directly involved in facilitation while a fifth (senior or super) demonstrator monitored the afternoon's activities, coordinated the demonstrators' duties and handled administrative issues. Since there were two laboratories in operation each afternoon, the cohort tallied 24 rank and file demonstrators (eight per afternoon, three afternoons per week) and two super-demonstrators (one per laboratory, three afternoons per week). The practical administrator (a senior postgraduate student appointed to administrate the practical marks) fulfilled the role of super-demonstrator in one of the laboratories. Each of the rank and file demonstrators was assigned one session per week, whereas the two super-demonstrators were on duty at every practical session throughout the week.

In addition, there were also two to three individuals who were not directly involved in demonstrating but handled the evaluation of students' practical worksheets. They were referred to as "markers" or marking demonstrators and did not attend the practical sessions at all. The markers were each given one afternoon's worksheets to assess according to instructions provided by the academic in charge. A system existed for capturing of marks and redistribution of practical worksheets to the students. The technical officer (a permanent staff member of the department and not a demonstrator) handled all the preparation work for the practical session, including preparing and testing the solutions, restocking glassware, calibrating and maintaining equipment and overseeing cleaning operations.

I want to conclude this section with a few additional remarks about the demonstrator community: Throughout the study the gender distribution among demonstrators was roughly equal. The cohort comprised senior undergraduate and post-graduate students and varied over the course of each year as some individuals resigned from demonstrating duty and were not always immediately replaced. The next paragraph expands on the idea of members moving through a community and the transitory nature of community membership.

³ At this institution two main types of part-time student facilitation jobs are available to postgraduate students, namely *demonstratorships* and *tutorships*. Whilst demonstrators facilitate learning in the laboratories, tutors facilitate small group learning during the supplemental instruction classes that we call *tutorials*. Tutorials are similar to so-called recitation or problem-solving sessions. Senior students (third years and honours students) are not usually considered for tutorships, mainly as a result of timetable issues. The tutorship programme will not be discussed further as it was not the focus of the study.

1.3.6 *The transitory nature of community membership*

Every new academic year sees a fresh intake of first-year students. This statement applies to higher education institutions across the board and is almost too obvious to belabour. Although some students may not pass one or both of their first-year chemistry modules, the associated practical modules in the department see an almost complete renewal of the first-year student cohort every year. The reason is that students who repeat the theory course are exempted from practicals provided they performed satisfactorily in the practical course during their first attempt, which is almost always the case.

Just as membership of the student cohort changes periodically, so does membership of the demonstrator cohort. One important difference is that the duration of membership tends to be longer in the latter cohort. Students become eligible for membership of the demonstrator community as early as their third year of chemistry study and they may remain members until they complete their doctoral studies. The duration of demonstrator community membership varies greatly from one individual to the next, depending mainly on the duration of their postgraduate enrolment in the department and related demands on their time. Postgraduate supervisors tend to encourage involvement in the demonstrator and tutor programmes at the start of the student's postgraduate journey, but tend to discourage it towards the end. It is probably safe to presume that the latter situation results from supervisors' demand for postgraduate output in the form of research papers and thesis chapters at this point.

The flow of members through a social community brings with it generational discontinuities (Wenger, 1998) that affect the community on multiple levels. Last year's newcomers become relative old-timers, and with their increasing experience their stature in the community grows. From within the old hands new super-demonstrators are chosen, and after a year or two one of the super-demonstrators succeeds the incumbent practical administrator when the latter completes his or her postgraduate degree and prepares to leave the institution.

During the study some demonstrator turnover occurred every year when new postgraduate and senior students joined the cohort and others left. It so happened that none of the individual demonstrators present at the start of the study still belonged to the cohort at the end of the study. This had noteworthy implications for the study that will be discussed in greater detail in chapter 6.

1.3.7 *The transitory nature of practice*

Academic work is cyclical in nature. Every academic year has a definite beginning and end. Hence every new academic year brings a fresh start and with it the opportunity to implement changes to outdated or obsolete academic practices. These changes may be small (for instance when students are expected to submit their pre-practical exercises at the door of the laboratory rather than have them collected by the demonstrators at their workbenches) or

significant (for instance when students are expected to submit flow diagrams when this was not part of the practice before). Change is very often motivated by changed circumstances. A sudden increase in student numbers in the first-year chemistry course, for instance, may require the use of an extra laboratory, and that would impact on how resources would have to be deployed across laboratories.

I make this point because it is important to bear in mind that, even without a research agenda to drive it, transformation is likely to occur gradually on some scale in every practice. The demonstrating practice in the chemistry department as it is at the time of writing this paragraph is already subtly different from the way it was at the end of the study. The fluidity and “open-endedness” of practice means that any attempt to characterise it would need to be pegged in time. I have used words such as “at the time of the study” and “throughout the study” to refer to aspects of practice as they were during the years of the study.

1.4 Articulation of the research problem and questions

The research proposed here differs from other studies of laboratory learning (Hodson, 1990; Hofstein & Lunetta, 2004; Johnston & Al-Shuaili, 2001) in that, rather than focusing on student learning, it concerns itself mainly with what and how the demonstrator learns in the laboratory.

In the first instance the study aims to characterise the nature of demonstrators’ participation in the first-year chemistry laboratory. Secondly, it will explore the extent to which demonstrators’ participation in the undergraduate laboratories is helping them to become better teachers.

My research questions are strongly embedded in the communities of practice work of Jean Lave and Etienne Wenger (1998). This work is rooted in three central constructs (engagement, imagination and alignment) that have been suggested by Wenger (1998 & 2000) for characterising *belonging* to a particular community of practice. In chapter 2 I offer a detailed account of how the first three research questions were derived from the theoretical framework developed for this study. They can be articulated as follows:

1. How do demonstrators engage with and within the community and what do they end up knowing from their participation?
2. What images do demonstrators construct of themselves, and how do they interpret their own participation within the community?
3. To what extent is demonstrators’ participation aligned with other processes within the community?

My fourth and final research question relates to the guiding assumption for this research project, namely that an intervention combining formal demonstrator training with guided reflective

practice would transform the way in which demonstrators participate in the laboratory, and that this would impact positively on the quality of learning in the laboratory:

4. How does an intervention in the form of a formalised training programme combined with demonstrators' guided reflections on their practice change their participation in the laboratory?

The following section briefly outlines how I intend to address my research questions.

1.5 General indication of the research design and methodology

The aims of this study were both exploratory (since it aimed to explore participation within the demonstrator community) and emancipatory (since it aimed to identify dysfunctional practices within the demonstrator community and provide impetus for change) and hence resonates with the assumptions of both the interpretive and critical realist paradigms (McNiff & Whitehead, 2006). For studies of this type, especially those guided by research questions that are exploratory and interpretive such as my own, empirical research designs using primary data are most appropriate (Mouton, 2001). My own research design can best be described as a mixed approach design: On one hand there is an ethnographic focus, exploring in detail the experiences and practices of a particular community. On the other hand there is the commitment to the empowerment of participants and the observation-intervention-observation sequence typical of action research studies.

In addition to having a mixed approach design, this study could also be regarded as falling into the category of mixed methods research (Johnson & Onwuegbuzie, 2004). Mixed methods research (*mixed research* and *multimethodology* are synonyms) is advocated (*ibid.*) as a third research paradigm with the potential to bridge the divide between the traditional qualitative and quantitative paradigms by including elements of both. Johnson and Onwuegbuzie (2004) argue that, in drawing on the strengths of both methodologies, the researcher is able to not only construct a more complete understanding of the researched problem, but also provide stronger evidence for conclusions through convergence and corroboration of findings. This is reminiscent of the synergetic notion that "the whole is more than the sum of its parts"⁴.

I will make clear in chapters 3 and 7 that my qualitative and quantitative data collections were not initially gathered for the same purpose. The qualitative data was collected with the intention of answering the research questions; it consists mainly of semi-structured interviews, journal notes, laboratory observations and the like and will represent the bulk of the research output

⁴ This quote is often associated with Aristotle (in *Metaphysics*). It refers to the notion that there may be some quantity with respect to which the whole differs from the mere aggregate. This quantity is sometimes referred to as *synergy*.

that I will be reporting on in the chapters that follow. I also collected some survey data (consisting of quantitative and qualitative data sets) with the primary purpose of investigating how intervention in the first-year laboratories changed the experiences of those (students and demonstrators) participating in the laboratories. This data was not intended to answer the research questions but rather to provide a broader context for the qualitative findings. I have dedicated a separate chapter (chapter 7) to the survey data where I have used it to (i) show the changes in participants' experiences of the laboratory course, and (ii) support some of the claims made on the strength of the qualitative findings.

1.6 Thesis outline

My thesis is presented as eight chapters. In the first (the present) chapter I introduce myself and my research. In Chapter 2 I offer a summary of the relevant literature that shaped my thinking about the project. In particular I review the published research on laboratory learning, and demonstrators as facilitators of laboratory learning. In the same chapter I go on to develop a theoretical framework for my study based on the notion of learning as participation in the practices of social communities. Chapter 3 is the conventional 'methodology' chapter in which my research design and methodology are set out, and my data collection instruments, practices, methods and analyses are discussed. This chapter also deals with issues of ethics and contains a reflection on the quality of the research data. The 'action research' element (observe-intervene-observe) of my research design is reflected in chapters 4 to 6. I use narratives to construct characterisations of the demonstrating practice before (chapter 4) and after (chapter 6) an intervention aimed at transforming the practice. The intervention itself (chapter 5) is sandwiched between chapters 4 and 6. Chapter 7 deals with my quantitative data, and compares survey results collected before and after the intervention in order to provide a clearer picture of how changes in the practice of the community have affected student and demonstrator experiences of the laboratories. Chapter 8 concludes the thesis. Here I summarise the main findings of the study and relate them to the literature, before discussing their implications for future practice.

1.7 Positionality and the researcher

In social research the term *positionality* refers to the specific position of the researcher, not only as it is described by demographic variables such as race, gender and background, but also in terms of his or her beliefs, attitudes and understandings of the world we live in and the people we live with. An important potential source of error in interpretive research is researcher bias (Mouton, 2001) and for this reason it is important for the researcher to make his or her position

clear, and state how this may have influenced his or her interpretations of the research results. This is what I hope to do in the paragraphs that follow.

1.7.1 *My personal background*

In this paragraph I want to inform readers how my past and present experiences influenced the selection of my research topic. I am a white female and I live with my family in Somerset West, South Africa. I was born in the region known as the Cape Peninsula but spent most of my life in Pretoria, the capital city of my country of birth. My favourite school subject was art and for quite some time I seriously contemplated a career as an artist. However, when the time came to enrol at university I was offered a comprehensive bursary to study mathematics and chemistry on the basis of my matric results. This was the proverbial “offer I could not refuse” that saw me embarking on a career in science instead. After a short stint as an analytical chemist in industry I returned to the University of Pretoria to complete my master’s degree in analytical chemistry. Shortly afterwards I accepted a lecturing position at the University of Pretoria. Despite my extensive training as a chemist I never really enjoyed practising chemistry. Perhaps this is the reason I never managed to make any significant progress on any of the chemistry research projects I started in my attempts at doctoral study during my early academic career. I would always find happy distraction in my teaching activities and my involvement in institutional transformation initiatives which were receiving much attention at historically white universities (HWUs) in South Africa throughout the nineties. During this time I also bore my two sons who were happy distractions themselves. My interest in chemistry education was already very keen, but my lack of educational training excluded me from postgraduate studies in education at the time. As a result, my dabbling in educational research never saw any real exposure beyond the occasional presentation at a regional conference or institutional seminar.

At the turn of the present century I relocated to the Cape to be close to my elderly parents and other family members who had also over the years returned to their region of birth. Professionally, I spent some time in a technical capacity at the University of Cape Town where I managed the first-year chemistry laboratories. This is where my interest in the role of the demonstrator in the undergraduate laboratory experience began, and where the time was finally ripe for me to embark on my last attempt at doctoral study. Since then I have moved to UWC where I am once again lecturing. Over the years, I have gravitated towards teaching first-year chemistry to the exclusion of all other more advanced courses, and the result is that I am now considered to be a “first-year specialist” at my institution and outside of it. It is from this professional perspective that I have chosen to involve myself in research into the learning that occurs in the chemistry laboratory particularly at first year level.

1.7.2 *My personal world-view*

Krieger (1991: p1) asserted that “we ought to acknowledge, more honestly than we do, the extent to which our studies are reflections of our inner lives.” In life and work, I am a pragmatist. I try to approach problems from multiple viewpoints and levels of understanding and I believe that the best solutions are holistic, interactive and unifying.

Professionally, my early training as analytical chemist introduced me to the positivist methodologies common in disciplinary scientific research. My research journey on the other hand, has introduced me to interpretive ways of thinking about research. Throughout the twentieth century the positivist and interpretivist paradigms represented two opposing camps; this was particularly the case in the joint fields of social and behavioural science (Sechrest & Sidana, 1995) and the two distinct methodologies, qualitative versus quantitative, were also drawn into the contest. The fundamental ontological, epistemological, and axiological (related to value judgments) differences between the two camps, and their contrary approaches to reasoning and reporting style, have led purists to support assertions, such as the *Incompatibility Thesis* (Howe, 1988) which contends that quantitative and qualitative methodologies should not be mixed. Conversely, pragmatists are essentially proponents of integrating qualitative and quantitative research methods (Onwuegbuzie & Leech, 2004; Creswell, 2009; Aldridge, Fraser, & Huang, 1999) and capitalising on their collective strengths to better understand social phenomena, regardless of the research paradigm used. The first of these authors argue that the quantitative-qualitative divide in social research should be abandoned in favour of a distinction in terms of *exploratory* and *confirmatory* methods. This distinction permits both qualitative and quantitative methods to be used within the same methodology; this allows for much greater flexibility, and for holistic strategies towards problem-solving that are simply not possible with a mono-method research. These are exactly the reasons why I am attracted to pragmatic research, and why I have chosen to use a mixed-methods approach. Willems & Rausch (1969: cited in Onwuegbuzie & Leech, 2004) likens the pragmatic approach to being armed with a bifocal lens (i.e., both quantitative and qualitative data), rather than a single lens. This means that pragmatic researchers are “able to *zoom in* to microscopic detail or to *zoom out* to indefinite scope” (Onwuegbuzie & Leech, 2004: 771).

Like Wenger (1998: 8) I believe strongly that our frameworks of understanding are shaped by our values and life experiences:

...the concepts we use to make sense of our world direct both our perceptions and our actions. We pay attention to what we expect to see, we hear what we can place in our understanding, and we act according to our world views.

This belief is a modern restatement of Nietzsche's *perspectivism* according to which all interpretation is mediated by perspective. Max Weber conceded that *values* precede

perspectives, and built on the philosophy forwarded by Nietzsche by insisting that, once values and perspectives have been established, the duty of the social scientists is to honour the ideal of objectivity (Portis, 1986). Weber's agenda recognises that absolute objectivity is an impossible ideal; the best we can hope for is objectivity relative to a specific viewpoint. There is no neutral place from which to observe social reality, and so my goal throughout this study has been to approximate "objectivity" by deliberately considering the results of my study from a number of different angles.

1.7.3 *My role in the study*

In addition to the primary role of participant researcher, I fulfilled a number of other roles related to the study that I have already alluded to. As is often the case in participatory research, this complicated the research process and occasionally created tension. In this section I give consideration to these complications, and how they may have influenced both my choices and interpretations during the study.

Two main areas of tension existed for me in the context of my role in the research, the first being the tension between my roles of researcher and "boss" and the second, the tension between my roles of researcher and mentor to my research subjects, the demonstrators in particular.

I mentioned earlier that I was lecturer and coordinator of the CHE114/124 modules in the academic department where the study took place. Some 18 months into this study I assumed charge of the first-year practical course associated with the CHE114/124 and CHE116/126 modules. Where my position as academic staff member already placed me in a position of authority with respect to the demonstrators and students, my role as coordinator of the practical course brought with it additional and more direct dimensions of control. Power dynamics are a form of *insider-outsider tension* (Minkler, 2004) that may contribute to a resistance dialectic between the outsider research partner and community participants. As new lecturer in the department, and belonging to a different (historically dominant) cultural group, I unquestionably started out as "outsider" to the demonstrator community. I write about the difficulties experienced at the start of the study, which I attribute to a weak trust relationship between the postgraduate community and management of the department, in later chapters. At the start of the study and before I had gained the trust of the demonstrators, they were probably focused on my association with the department which led them to view me as an outsider; "one of them" rather than "one of us". Even though the demonstrator community eventually opened up to me (whether I actually achieved "insider" status is uncertain), I had to remain sensitive of power dynamics (McNiff & Whitehead, 2006) and its potential to create tensions with my primary role of participant researcher throughout the study.

I struggled to separate my researcher role from that of academic mentor to the demonstrators in the study, specifically during interactive data collection activities such as interviews and focus group discussions. My job as academic mentor was to lead them in the endeavour of creating a learning space for the first-year students in our collective charge. Being a chemistry educator is a central and robust element of my own identity. Kvale (1996: 6) stresses that a “research interview is not a conversation between two equal partners, because the researcher defines and controls the situation”. Here is where I was sometimes caught in a conflict between my roles as researcher and as mentor and colleague to the interviewee. Occasionally during interviews and the focus group discussion I had to fight the urge to get drawn into reciprocal conversations. Once or twice (to my initial dismay) I lost the fight, as is evident from the following excerpt from the focus group with demonstrators. The discussion had moved to the importance of demonstrators knowing their students’ names, and one of the demonstrators had made the point that not knowing a student’s name creates distance between the demonstrator and student. A long pause in the discussion followed, during which I slipped out of the researcher role and into mentor mode:

Karen: And it’s a big thing ... for a student ... because it means that (the) student is recognized as someone. And you...

I caught myself for a moment, but then immediately reverted back to “have my say”:

Karen: The whole idea is not for me be talking (laughs) ...

Karen: ...but I have learnt that success at varsity is not only about passing your exams. It is about adjusting to the challenges. And if you adjust to the challenges your marks will reflect it because you will have less worry about ... so it’s very important ... to feel at home.

In the discussion segment captured in the excerpt above I was participating in a double role: as researcher on the one hand, and as mentor sharing the interests and concerns of my demonstrator colleagues, on the other. Addleson (1994: 60 in Swantz, 1996) calls this “double participation”. Swantz, in a position paper on participatory research, commented on the challenge of separating research from personal goals of mutual sharing. Her research on women’s issues in Tanzania, which she calls her “quest for living knowledge”, spanned 30 years and during this time she came to question on a profound level the concept of “the other”, referring to the distance between researcher and researched, as required by standard research practice. She writes (1996: 126):

“In mutual sharing, questions are asked and answers are given in both ways. Such communication provides information and inspires a dialogue that results in new combinations of ideas and knowledge. Ideas emerge more readily if the researcher has been an insider in the community.”

In conclusion, I wish to summarise some of the key issues that I consider worth raising when reflecting on the implications of my position on the research experience (in which I borrow rather heavily from Swantz (1996:134)).

- Is there self-deception in double-participation: as colleague/mentor/person-in-charge sharing/guiding/directing the interests and experiences of the demonstrators, but also as researcher promoting a particular agenda?
- Are the demonstrators genuinely involved in the research, or am I purposely creating opportunities for intercommunication only as a way of camouflaging the existing power differentiation?
- In the context of this study, I am not only conceived to have “superior knowledge” but I also control economic power. Is this true of all “developmental studies”?

The merit of these questions lies not in knowing their answers, but rather in their ability to generate reflection on these and related issues. I attempted to deal with these issues by remaining responsive to them throughout but especially during the interpretive phase of the study.

1.8 Terminology

South Africa’s history as a former British colony has left it with the heritage of having English as its language of commerce and science⁵. Word-processing software available in South Africa and internationally offers users a choice of English language versions, but British English (English – UK) and to a lesser extent American English (English – US) are most commonly used for academic writing. In keeping with this tradition I have opted to use British English as the language for this thesis. Many of the terms used throughout the thesis may be foreign to readers who are unfamiliar with the South African higher education context. For this reason I have listed these terms below, alongside a brief definition of each, and some of their international equivalents commonly encountered in the literature where available. I have made a distinction between terms that are specific to the context of the study (table 1.1) and general terms used in the South African tertiary context (table 1.2).

The word *demonstrator*, for instance, used in South Africa and Australia, has an American (and European) equivalent in the term *teaching assistant* (TA). The American *graduate* student would be called a *postgraduate* student in South Africa. The South African B Sc degree (Bachelor of Science) is a first general degree in science that may be completed in a minimum of three years. This degree may be followed by the B Sc Honours degree which can be

⁵ In addition to English there are ten other official languages in South Africa, as well as a number of “recognised” languages.

completed in a minimum of one year. Most universities will only accept students for M Sc (Master of Science) programmes when they have successfully completed the B Sc Honours degree. A master's qualification is usually a prerequisite for enrolment into a doctoral programme, but some universities will allow deserving master's projects to be upgraded to doctoral projects under certain circumstances. This is the exception rather than the rule, however, and at the institution where the study took place it is not a common occurrence.

Table 1.1: Clarification of some context specific terms used

Term used	Equivalent terms and meaning
Marker	<p><i>Marking demonstrator; marking demi</i></p> <p>A postgraduate student (usually someone with some demonstrating or preferably teaching experience) appointed to evaluate students' practical work according to guidelines laid down by the academic staff member in charge of the practical course.</p>
Practical administrator	<p><i>Head tutor; practical manager; laboratory manager</i></p> <p>The postgraduate student heading the entire demonstrator cohort. The incumbent also administrates the record of marks awarded to students for practical tasks.</p>
Practical coordinator	<p><i>Academic staff member; the lecturer</i></p> <p>In the present context this refers to the academic staff member responsible for coordinating and overseeing the practical course. All levels in the demonstrator hierarchy answer to the incumbent who is usually also extensively involved in first-year lectures.</p>
Super-demonstrator	<p><i>Chief teaching assistant, chief TA</i></p> <p>A senior demonstrator heading the team of demonstrators working in a particular laboratory. There are as many super-demonstrators on duty as there are first-year laboratories operating on a given afternoon.</p>

In addition to the terms that are specific to the context of the study clarified in table 1.1 above, I will be using some general terms. They are summarised in Table 1.2 below.

Table 1.2: Clarification of some general terms used in the South African tertiary context

Term used	Equivalent terms and meaning
Academic staff member	<i>Faculty, professor</i> Member of the lecturing staff of an academic department.
Postgraduate student	<i>Graduate students</i> Postgraduate students are students enrolled for postgraduate degrees. In South Africa this refers to any further degree programme following the first degree, and includes B Sc Honours, M Sc (masters) or Ph D (doctoral) degrees.
Demonstrator	<i>Teaching assistant (TA), graduate teaching assistant (GTA), laboratory teaching assistant (lab TA), lab tutor; demi (slang)</i> Senior or postgraduate student appointed to assist students in the laboratories during scheduled practical sessions.
Department	<i>Academic department, school</i> A division within a faculty or school that is responsible for a given subject.
Faculty	<i>Graduate school; institute</i> In South Africa the term <i>faculty</i> refers to a collection of related academic departments at an institution of higher learning such as a university. It is probably best understood with the aid of an example: The Faculty of Science at UWC includes the academic departments Chemistry, Physics, Earth and Water Science, Biotechnology, Medical Bioscience, Biodiversity and Conservation Biology, Pharmacy, Mathematics and Computer Science.
Head of department	<i>Departmental chair or chairperson</i> The person, usually a senior academic staff member, who heads an academic department in a permanent or revolving capacity.
Historically Black University (HBU)	<i>Historically black institution (HBI); historically disadvantaged university</i> An institution of higher education in South Africa that was established during apartheid with the intention of serving the black community.

Table continues on following page

Term used	Equivalent terms and meaning
Tutor	<p><i>Teaching assistant (TA), graduate teaching assistant (GTA), peer mentor</i></p> <p>In the South African context this term refers to a senior or postgraduate student appointed to assist students during adjunct activities such as tutorials (problem-solving sessions, discussion sessions, or recitations) and optional help sessions. Their focus is on providing assistance with <i>theoretical</i> rather than practical matters, in other words with supporting students' mastery of the theoretical content of their chemistry course.</p>
Undergraduate	<p>The <i>undergraduate</i> years are those spent as an <i>undergraduate</i> university student, in other words completing the first degree.</p>
Work-study	<p>A university programme that provides part-time on-campus jobs for students with financial need.</p>

University of Cape Town



Chapter 2

Literature review and theoretical framework

In this chapter I review a selection of the literature related to laboratory work in science education in general and chemistry education in particular, and the involvement of senior students as facilitators of learning in undergraduate laboratory instruction. I cite works on traditional and modern views on science learning before going on to develop a theoretical framework for my demonstrator study that is grounded in communities of practice theory.

2.1 Introduction

Teaching assistants (TAs) or demonstrators are a common feature in undergraduate teaching laboratories (Bond-Robinson, 2005; Bond-Robinson & Bernard Rodrigues, 2006; Luft *et al.*, 2004; Travers, 1989) both locally and elsewhere, where they play a prominent role as instructors in introductory laboratory courses. To most chemistry lecturers it would be difficult to imagine coping with the demands of large groups of undergraduate chemistry students in the laboratory without the assistance of a team of demonstrators to draw on (Park, 2002 and 2004; Luft *et al.*, 2004).

In the words of Royce W Murray (1996: 709A), one of the top 250 cited chemists worldwide during the period 1981-1999:

“Graduate and undergraduate education in chemistry in the United States meet squarely at the teaching assistant... When it is played well, the TA’s role is worthy of great praise and can have a life-time influence. The quality of the laboratory experience is frequently the key to an undergraduate student developing a lifelong love affair with instruments and molecules.”

The literature reviewed in this chapter represents an overview of the articles, books and other resources addressing the areas of knowledge that I consider to be most relevant to this study. The nature of the study was to explore and lay a foundation for the characterisation of postgraduate participation in laboratory teaching activities. During their involvement in the training of undergraduates, demonstrators *learn to teach* and at many universities this is a recognised component of postgraduates’ professional development (Bond-Robinson, 2005; Garcia-Barbosa & Mascazine, 1998; Luft *et al.*, 2004).

Three domains of educational research have been drawn upon for this study namely theories of learning, learning in the laboratory context, and postgraduate students as facilitators of undergraduate learning.

Following Wolcott (1990), I have mostly kept to a general overview of each domain, except for those sections where I considered a more comprehensive discussion appropriate. In the development of the narrative chapters (chapters 4 and 6) that essentially represent the “results and discussion” section of this thesis, I have included many additional literature references where I considered such references applicable to the discussion. I believe that this will facilitate overall reading of the thesis because it contributes to the flow of the writing by shifting some of the density and complexity away from the literature review to where it is more pertinent.

2.2 Overview of the literature study

Since a prime focus of the study is laboratory learning, I will commence with a section in which some of the more prominent writings dealing with laboratory work in science education are considered, starting from a historical perspective and including the purpose, modes of presentation of laboratory curricula, and suggestions for evaluating the quality of laboratory courses.

The second section of the review covers some of the literature on postgraduate involvement in undergraduate teaching, starting from a general perspective and moving towards a more specific consideration of postgraduate involvement in undergraduate science laboratories, covering aspects such as demonstrator deployment and training. From the perspective that demonstrators are learning to teach, I considered it important to also look at what has been written about the differences between the instructional styles and teaching know-how that distinguish novice teachers from experts.

In the third section of the review I draw on the abundant literature on educational theory – starting with early constructivist notions and moving through situated views of knowledge – to lay the foundation for the social learning perspective that underpins my chosen theoretical framework.

The final section of this chapter describes the development of the theoretical framework for this study, which is grounded entirely in communities of practice (CoP) theory. In addition to an introduction to the most salient writings on communities of practice, I will include a definition of key concepts for the study, refine a conceptual framework, and explain how this was used for viewing the research data and answering the research questions identified in chapter 1.

In summary I will give an overview of the salient points emerging from the literature review and show how these have informed and influenced the empirical part of the study.

2.3 Learning in the laboratory

2.3.1 A historical perspective

In some respects the teaching model used for students in laboratories today is almost as old as chemistry itself. Elliott *et al.* (2008) explored the historical roots of laboratory work starting with the inception of the first teaching laboratories established by Baron Justus von Liebig in the early nineteenth century in Giessen, Germany. Figure 2.1 is a reproduction of an artwork showing Liebig at work with students in his laboratory.

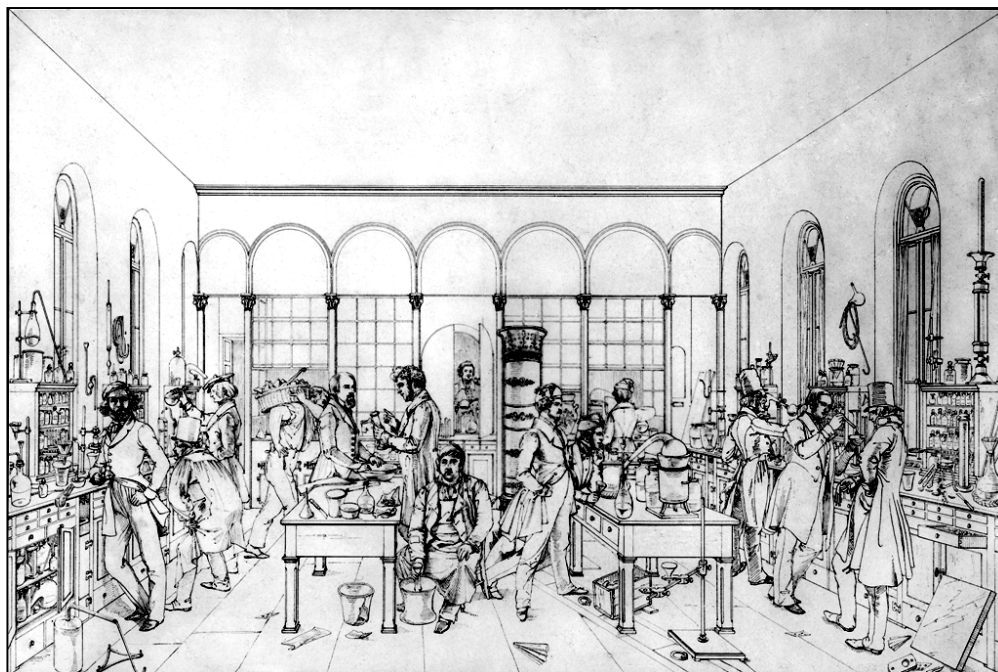


Fig 2.1 The teaching laboratory of Justus von Liebig¹

In these laboratories, designed exclusively for analytical work rather than synthesis or other types of chemical experiments, students were taught to do basic analyses using apparatus and procedures that were designed – by the baron himself – for the purpose of increasing efficiency. What is fascinating is that the students *did not learn directly from Liebig, but rather from older students acting as mentors to small groups of novices*. When the older students were not supervising their apprentices they worked on original problems supervised by Liebig. Only once the novices had successfully worked their way through a collection of prescribed analyses of 100 substances of known composition were they considered sufficiently competent to work independently and given beginning students of their own to mentor.

¹ Reproduction of a steel engraving, presumed to be by Wilhelm Trautschold (1815-1877), ca. 1840; copyright © Süd-Chemie AG, 2010. Liebig looks in through the window at the back of the laboratory.

2.3.2 *The purpose of practical work*

Beginning students in Liebig's early teaching laboratories spent countless hours developing their analytical skills. In the process they became expert analysts capable of producing internally consistent data (Elliott *et al.*, 2008) before being allowed to move on to the next phase of their training. At this point they were given real research problems to solve, and this situation is still reflected in the training of modern postgraduate students working in university chemical research laboratories today.

In more recent history science educators have been divided on the issue of the objectives of labwork (Swain, 1974). A comparison (Bradley, 2005) of six studies of science teachers' rankings of the importance of a list of similar objectives showed wide disparities, with relative consensus on just two items namely "To verify facts and principles already taught" and "To fit the requirements of practical examination regulations". For a fuller discussion on the purpose of labwork in the school science curriculum see Bradley (2005: chapter 2). My own discussion will serve mainly to highlight the general shift in thinking about the intended aims and purposes of laboratory work articulated in the science and chemistry education literature of the past 40 years or so.

Learning in the laboratory forms an integral part of the greater endeavour of learning to "do chemistry" (Elliott *et al.*, 2008; Pickering, 1980; Tobin, 1990), and its purpose has been most simply summarised (Johnstone & Al-Shuaili, 2001) as: "to teach hand skills and illustrate theory". The work of Kerr, (1964) who compiled a list of ten aims for practical work, has often been cited in this respect in ensuing years and has been both expanded (Gunning & Johnstone, 1976) and distilled (Shulman & Tamir, 1973) into different versions of the following general classification of goals for laboratory instruction in science education:

- To develop creative thinking and problem-solving ability;
- To promote aspects of scientific thinking and the scientific method;
- To develop conceptual understanding and intellectual ability;
- To develop practical competencies and skills (manipulative, observational, interpretational and planning); and
- To arouse and maintain interest, attitude, satisfaction, open-mindedness and curiosity in science.

Affective goals such as interest and enjoyment of the subject (*attitudes to science*) and a sense of reality for scientific phenomena (*scientific attitudes*) have been considered (Gardner & Gauld, 1990) to be at least as important as those relating to the acquisition of knowledge and skills.

Domin's list (1999a) of specific learning outcomes shown below for the general chemistry laboratory, integrates Shulman and Tamir's (1973) goals with those of Gardner and Gauld:

- conceptual understanding;
- retention of content knowledge;
- scientific reasoning skills;
- higher-order cognition;
- laboratory manipulative skills;
- a better attitude towards science; and
- a better understanding of the nature of science.

The first decade of the twenty-first century has seen researchers in chemistry education questioning both the content and pedagogy of chemistry learning and teaching (Hofstein & Mamlok-Naaman, 2007), and the undergraduate chemistry laboratory has not escaped scrutiny (Cooper & Kerns, 2006; Elliott *et al.*, 2008). Many prominent researchers in chemistry education (Cooper & Kerns, 2006; Hofstein & Mamlok-Naaman, 2007; Lunetta, Hofstein, & Clough, 2007) now emphasise the centrality of *inquiry* to the achievement of scientific literacy, both in general and especially also in the context of practical work. To the latter end recent years have seen initiatives to provide undergraduate students with “real research experiences” with the purpose of integrating the development of laboratory skills into the experience of working on authentic modern-day chemistry problems (Elliott *et al.*, 2008). Though uncommon in first-year chemistry courses in South Africa (B. Davidowitz, personal communication, 2006; G. Green, personal communication, 2008), US initiatives such as the NSF Undergraduate Research Collaboratives (URC) initiative, the Research Experience to Enhance Learning (REEL) project (<http://www.ohio-reel.osu.edu>) and similar multi-institutional initiatives such as Purdue University’s Centre for Authentic Science Practice in Education (CASPiE) (<http://www.purdue.edu/dp/caspie>) are examples of programs aimed at providing first and second-year students with authentic research experiences that have been infused into their chemistry curricula.

2.3.3 *Laboratory curricula*

Traditional laboratory instruction has long been recognized (Garnett & Hacking, 1995; Gunstone, 1991; Hodson, 1990; Hofstein *et al.*, 2005; Lazarowitz & Tamir, 1994; Lunetta *et al.*, 2007; Tobin, 1990;) for having potential as an effective medium in helping students construct knowledge and develop skills. In addition, appropriately designed laboratory activities enhance constructive social interactions and a positive learning environment (Lazarowitz & Tamir, 1994; Lunetta *et al.*, 2007). At the same time there have been criticisms leveled at laboratory work for being confusing and unproductive (Hodson, 1990) and for failing to deliver on the promise of

augmenting student learning with understanding (Berry *et al.*, 1999; Hart *et al.*, 2000; Hodson, 1990; Hofstein & Lunetta, 2004; Johnstone & Wham, 1982).

A content analysis (Meester & Maskill, 1995) of first-year chemistry practical manuals from 17 universities in England and Wales showed that, at the time of the study, explicitly stating the aims of labwork tasks was not common practice. In addition the authors found that controlled, predictable experiments were the order of the day. Domin (1999a & 1999b) proposed a taxonomy for categorising Chemistry laboratory instruction styles in terms of three descriptors namely *outcome*, *approach* and *procedure*. Four different styles of laboratory instruction were thus identified namely: expository, inquiry, discovery and problem-based. Each style affects the learning environment in distinct ways and therefore addresses different learning outcomes. Of these four instructional styles, *expository* instruction remains the most popular but also the most criticized. The “cookbook” nature of this style of instruction offers low-cost, time-efficient learning experiences, but at the cost of the development of higher-order cognitive skills. All three of the above-mentioned alternatives to traditional laboratory instruction have greater potential to promote higher-order cognition; but are time-consuming and place greater demands on both instructor and students. In particular, inquiry-type laboratories have been shown (Hofstein, Navon, Kipnis, & Mamlok-Naaman, 2005) to improve high-school chemistry students’ ability to (i) ask more questions and (ii) ask “better” questions (referring to the cognitive level of the questions).

2.3.4 *Quality of laboratory work*

The traditional way of investigating the quality of laboratory work is to evaluate student learning in relation to the learning objectives of the laboratory task (Lazarowitz & Tamir, 1994; Psillos & Niederrerr, 2002). Many critical reviews of studies to investigate the educational effectiveness of laboratory work as measured against cognitive, affective and practical goals have appeared (Blosser, 1980; Hodson, 1993; Hofstein & Lunetta, 2004; Lazarowitz & Tamir, 1994). A dual approach to investigating laboratory effectiveness has been proposed (Millar, Tiberghien, & le Maréchal, 2002; Psillos & Niederrerr, 2002) that combines the aforementioned traditional approach with an evaluation of student actions during the laboratory task in relation to the intended design features of the task. Thus, the proposed twofold model contends that the effectiveness of laboratory work has two foci namely: (i) what students learn about ideas and scientific procedures (termed Effectiveness 1), and (ii) how students intervene in the real world of the laboratory and handle laboratory entities (Effectiveness 2). A profile for exploring the effectiveness of specific laboratory tasks for achieving specific learning objectives has been based on this twofold model (Millar *et al.*, 2002).

Quality learning in the laboratory results at least in part from effective teaching. The next section will consider the role of teaching assistants in higher education, starting with a general look at international efforts to prepare postgraduates to teach in the tertiary context. This will be

followed by a more specific consideration of the use of postgraduate *science* students as facilitators of learning in the *laboratory* which has more direct bearing on my study.

2.4 Postgraduate students as facilitators of student learning

A feature of higher education since the early 1800s (Eble, 1987; Elliott *et al.*, 2008), recent years have seen postgraduate TAs becoming indispensable to the delivery of teaching (D'Andrea, 1996; Park, 2002 & 2004; Lambert & Tice, 1993) particularly to first-year students, due mainly to the growing need for balancing increasing student numbers and needs with pressure on academic staff time and institutional resources (Park, 2002; Shannon, Twale, & Moore, 1998). In North America and increasingly also in the UK TA posts are recognised and given status in the higher education system (Park, 2004). At some South African institutions demonstrators are paid part-time employees, albeit without employment benefits such as unemployment or medical insurance, or pension provision (G. Green, A. Mantyi, E. Murray, M. Potgieter, personal communications, 2010).

In this section I review literature that I found useful for gaining perspective on the use of postgraduate students as facilitators of learning in higher education. After briefly dealing with the many different terms used to denote postgraduates with teaching responsibilities in higher education, I will cite research on the preparation of postgraduates for their role as teachers, starting from a general perspective. This is followed by a synopsis of the pertinent research on the deployment of science postgraduates in undergraduate laboratories, moving through the more common models for demonstrator deployment to aspects of discipline-specific demonstrator training, such as duration and content of training programmes and training resources. From the viewpoint that postgraduates with teaching responsibilities can be likened to novice teachers when they enter the academic environment, I look at the differences between novice and expert teachers, focusing mainly on what some education researchers recognise as the “magical ingredient” that makes a good teacher, namely pedagogical content knowledge (PCK). I conclude the section with important inclusions on demonstrator effectiveness and instructional style.

2.4.1 Terminology revisited

Postgraduates with teaching responsibilities in higher education are referred to in the literature by many different titles. The *UK Council for Graduate Education* report: *Preparing Postgraduates to Teach in Higher education* (Holt, 1999) mentions references to all of the following: *postgraduate teaching assistants* (PGTAs), *graduate teaching assistants* (GTAs), *teaching assistants* (TAs), *teaching fellows* (TFs), *visiting lecturers* (VLs), *part-time lecturers* (PTLs), *part-time tutors* and *demonstrators*. Literature sources from the US use the terms

teaching assistant (TA) and *graduate teaching assistant* (GTA) almost exclusively regardless of the duties and responsibilities assigned to a particular TA or group of TAs. The same generic term is used even when referring to TAs assigned to teaching duties in undergraduate laboratories (Bond-Robinson, 2005; Herrington & Nakhleh, 2006; Luft *et al.*, 2004; Travers, 1989). In the South-African context the term most commonly used when referring to TAs assigned to undergraduate laboratories is *demonstrators* (Davidowitz, personal communication, 2006; own experience). The term *tutor* refers to a TA assigned to assist students during tutorials, which are small group problem-solving or recitation sessions. I have given some attention to the issue of terminology in chapter 1 (section 1.8).

2.4.2 *Preparing postgraduates to teach in higher education (a general perspective)*

An American Chemical Society (ACS) publication titled *Preparing Future Chemistry Faculty* (2001) acknowledges that “The PhD in chemistry usually prepares individuals for careers in basic research. The degree does not typically prepare these highly skilled research professionals to be faculty members.” Yet, for many doctoral graduates who end up in academia these activities would represent the only preparation they received for the teaching function they have to fulfil in their careers (Gerdeman, Russell, & Eikey, 2007; Keller & Smith, 2006; B. Davidowitz, personal communication, 2006; D. Marshall, personal communication, 2010; own experience).

In the interests of quality undergraduate and postgraduate provision, preparing postgraduate students to teach in higher education has become a matter of growing interest across the developed world over the past two decades (D’Andrea 1996; Park, 2004; Sprague & Nyquist, 1989). New models of (post)graduate education are emerging (American Chemical Society, 2001; Coppola, Banaszak Holl, & Karbstein, 2007; Gerdeman *et al.*, 2007; Park, 2002 & 2004; Trautman & Krasny, 2006) aimed at preparing (post)graduate students for teaching in addition to their training for careers involving research. Most models appear to involve students being given teaching roles to fulfil under mentorship of an experienced faculty member.

In North America and the UK the issue has also been identified as a funding priority by both government and charities. A report titled: *Preparing Postgraduates to Teach in Higher Education* (Holt, 1999) provides a useful summary of practices in North America (the US and Canada) and the UK around the start of the twenty-first century. This report identifies the focus in North America to be on pre-service development that is increasingly being adopted into course-work offered to students enrolled for postgraduate study. This focus has been translated into the Preparing Future Faculty (PFF) initiative (Cody & Hagerman, 1997) described on its official website (<http://www.preparing-faculty.org/>) as:

“... a national movement to transform the way aspiring faculty members are prepared for their careers. PFF program(me)s provide doctoral students, as well as

some master's and postdoctoral students, with opportunities to observe and experience faculty responsibilities at a variety of academic institutions with varying missions, diverse student bodies, and different expectations for faculty...".

Since its inception in 1993 as a partnership between the Council of Graduate Schools (CGS) and the Association of American Colleges and Universities (AAC&U), PFF programmes have been implemented at more than 45 research universities in the US. In selected disciplines implementation occurred through relevant professional associations; Chemistry departments at 5 US institutions² were selected by the American Chemical Society to participate in the initiative.

In the UK the picture is somewhat different (Holt, 1999) in that the emphasis tends to be on *in-service* rather than *pre-service* provision. The movement towards standardising accredited programmes of study for university teaching through the Higher Education Academy (HEA) culminated in the UK Professional Standards Framework (Higher Education Academy, 2010) for teaching and supporting learning in February 2006.

At the time of writing I had not found evidence in the literature of any accredited South African programmes to prepare postgraduate students for teaching at university. However, some South African universities offer postgraduate teaching qualifications for staff (M. Rollnick, personal communication, 2010). I am aware that in-house training programmes for demonstrators and tutors exist in many different academic departments at different SA universities (G. Green, A. Mantyi, E. Murray, M. Potgieter, personal communications, 2010) although I have not made a systematic enquiry to this effect.

The next section deals specifically with those TAs with teaching responsibilities in undergraduate science laboratories.

2.4.3 *Postgraduate facilitators of learning in the laboratory context*

The laboratory learning experience is planned, controlled and coordinated by course faculty but the demonstrator remains the primary facilitating agent in this particular learning environment, often having more student contact than the lecturer in charge (Bond-Robinson & Bernard Rodrigues, 2006; Luft *et al.*, 2004). Demonstrators may be employed in several different ways to facilitate learning and assist students.

2.4.3.1 *Demonstrating models*

There appears to be at least three ways in which demonstrators are deployed in tertiary science laboratories. I have named these demonstrating models the "roaming demonstrator", the "small

² Duquesne University, CUNY-Queens College, University of California-Los Angeles, University of Massachusetts-Amherst, and University of Michigan.

group facilitator” and the “circuit laboratory”, and will briefly explain what is meant by each in the subsections that follow.

The “roaming demonstrator” model

This model describes the situation where a small number of demonstrators are assigned to a particular laboratory and jointly assist all the students working in the laboratory. As few as two (D. Marshall, personal communication, 2010), but more often four to five demonstrators may collectively assist laboratory groups of up to eighty students. The demonstrators “roam” the laboratory and tend to connect only with those students who put their hands up for assistance. Departments are more likely to serve this model where there is a shortage of suitable candidates to employ as demonstrators, or a shortage of funds to employ sufficient demonstrators (*ibid.*). This was the prevailing demonstrating model in the first-year chemistry laboratories at the start of this study, and I will show later (chapter 4) that interactions between the demonstrators and students in the laboratories tended to be superficial.

The “small group facilitator” model

At some institutions both local and international, laboratory instruction takes place in small groups of between 15 and 25 students to one demonstrator (B. Davidowitz, personal communication, 2006; M. Mocerino, personal communication, 2008). The demonstrator remains in charge of the same group of students for the duration of the laboratory course and close facilitator-student relationships may form over time. The configuration described here may vary from one institution to the next in terms of the degree of responsibility vested in and initiative expected from the demonstrator. At some institutions demonstrators may be expected to brief their own group of students at the start of the practical session (Davies, 1978; B. Davidowitz, personal communication, 2006), and at others the students may be briefed collectively by an academic or senior demonstrator, either in the laboratory or in a lecture venue (own experience, UWC). Towards the end of my study, the small group facilitator model had been adopted by the demonstrator community at UWC, and demonstrators and students responded positively to the change (chapters 6 and 7).

The “circuit laboratory” model

This model represents laboratory courses in which students complete a circuit of different experiments over a number of sessions. The model tends to prevail in instrument-intensive courses where student access to specialised instrumentation may be limited due to insufficient resources (B. Davidowitz, personal communication, 2010). At most South African tertiary institutions this would be the case. Demonstrators then tend to be attached to a particular instrument or technique rather than to a group of individual students, and students do the “roaming” – from one experiment and associated demonstrator to the next – as time

progresses. Chemistry departments may take advantage of the research interests and expertise of demonstrators when determining where they should be deployed. A demonstrator whose field of specialisation is analytical chemistry, for instance, may be assigned to a practical aimed at teaching instrumental analysis. Over time the demonstrator may become very familiar with the operation and idiosyncrasies of a particular piece of instrumentation, and develop considerable trouble-shooting acumen. This model tends to be more commonly employed in upper division chemistry courses rather than with first-year students (*ibid.*).

2.4.4 *Demonstrator training*

At many tertiary institutions senior chemistry students' involvement in the training of undergraduates is recognized as a compulsory (albeit informal and non-credit bearing) component of their professional development as science practitioners (Bond-Robinson, 2005; Garcia-Barbosa & Mascazine, 1998; Luft *et al.*, 2004). However, these teaching experiences sometimes tend to be peripheral and lack practice in actual lecturing, course development and planning, and assessment (ACS, 2001). This appears to be true also in the South African context (B. Davidowitz, personal communication, 2006; G. Green, personal communication, 2008; own experience).

2.4.4.2 *Job training or career preparation?*

Most but not necessarily all institutions employing TAs appear to offer some form of TA professional development in teaching and learning (Holt, 1999; Park, 2004). There is much variation in format and duration of training programmes; at one end of the spectrum are the short-format demonstrator training workshops lasting up to one day, or even less, that are more typically the trend at South African institutions (B. Davidowitz, personal communication, 2006; own experience). Training workshops of intermediate duration last in the order of 3 to 5 full days (Main, 1994; M. Mocerino, personal communication, 2008). Demonstrator workshops of short and intermediate duration tend to focus on dealing with hazardous situations, basic first aid, demonstrators' responsibilities and rights, and facilitating student learning in the laboratory (M. Mocerino, personal communication, 2008), in short: the procedural aspects of student facilitation. They seldom contain substantive sections on effective pedagogy in science education (Luft *et al.*, 2004) and so I would argue that they have a short-term focus – they are intended to prepare TAs for the *job* of facilitating students in the laboratory, rather than the relatively more long-term goal of preparing (postgraduate) students for a *career* in chemistry teaching.

Some of the longer training workshops may consist of a general training phase for TAs in all disciplines, followed by a chemistry TA phase designed to address the specific needs of chemistry TAs (Holt, 1999; Park, 2004; Roehrig, Luft, Kurdziel, & Turner, 2003). In addition to the topics covered in short-format training workshops, they may also include pedagogical

aspects such as practising student tutoring, presenting pre-laboratory lectures and assessment activities. The literature also contains examples of even more comprehensive training courses that run over several months and are credit-bearing (Bond-Robinson, 2005; Bond-Robinson & Bernard Rodriques, 2006; Mazlo & Kelter, 2000). Offerings at this end of the spectrum fall into the category of programmes that take a career-preparation rather than job-training approach to professional development. A more general discussion of training initiatives that prepare postgraduate students for the responsibilities of tertiary teaching jobs was given in section 2.4.2 above.

The work of Bond-Robinson and Bernard Rodriques (2006) merits special mention here; their laboratory teaching apprenticeship programme focuses on developing the TA both as manager of the laboratory environment as well as teacher of chemical concepts and runs over a period of several months. Their programme is described as cognitive apprenticeship with a strong focus on developing TAs to teach chemical knowledge by guiding students' thinking.

2.4.4.3 *Training and other resources*

Many examples of demonstrator/TA handbooks and other resources can be accessed online. Since a systematic review of all that is on offer in this respect lies outside the scope of this study, I will refer to a small selection of generic TA handbooks (Lambert & Tice, 1993; MSU TA, 2009-10; Royse, 2001), TA manuals from the sciences and engineering (Balaraman, Fleming, Lacey, Khan, & Nowicki, 1995; Wankat & Oreovicz, 1993) and chemistry and biochemistry (Bunce & Muzzi, 2004; Emerson, Sawrey, & Essenmacher, 1996; Petryk, 2000). In 2006, 42,3% of all doctoral candidates in Chemistry in the US were international students (American Chemical Society Committee on Professional Training Special Report, 2008), and so it is not surprising that there are also TA handbooks aimed at international TAs (Ronkowski, 1999).

At least one peer-reviewed publication is dedicated solely to those aspects of professional development that prepare students for the multiple roles they will play as professionals upon leaving university: *Studies in Graduate and Professional Student Development* (formerly titled: *The Journal of Graduate Teaching Assistant Development*) is described on its official webpage (http://www.newforums.com/news_JGPSPPage.asp) as a "peer-reviewed book series designed to provide a platform for the discussion of the research, issues, and programs that address the professional development of graduate and professional students". The series highlights:

- Research on teaching, professional development, curricula, assessment and evaluation, training, certification, and career planning and outcomes;
- Research on effective disciplinary and interdisciplinary programs and workshop designs, implementation and evaluation for teaching and learning;
- Research on the transition from graduate school to full-time faculty positions;

- Basic research on teaching and learning.

I will now change course slightly in order to summarise research that has dealt with the differences between the instructional styles and teaching know-how that distinguish novice teachers from experts. I consider this relevant because demonstrators and other postgraduates with teaching duties are entering the academic community as novice teachers, often performing the same role as full-time academics, albeit with less pay, job security and status (Park, 2002). Their development parallels many aspects of novice classroom teachers' professional preparation to teach in primary and secondary schools (Bond-Robinson, 2005), and it therefore makes sense to give attention to the differences between the professional styles of novice and expert teachers when aspiring to explore the elements that best facilitate student learning in the laboratory.

2.4.5 *Differences between novice and expert teachers*

2.4.5.1 *Instructional style*

Studies into the differences between novice and experienced school teachers (Martin & Baldwin, 1993) and novice and experienced university lecturers teaching medical students (Glass, Kim, Evens, Michael, & Rovick, 1999) found novice educators far more likely than experts to inform students directly, rather than employing indirect or *eliciting* teaching strategies that require students to think more deeply about their own learning.

An important contribution to the literature dealing with the educational and instructional environments of graduate teaching assistants (GTAs) is found in a recent study (Luft *et al.*, 2004) of a GTA community in the US spanning three scientific disciplines (chemistry, physics and biology). This study found that GTAs had limited perceptions of their students' motivation and ability, and that their instructional styles were likely to be directive and instructive, especially if this was also true of the style of presentation of the practical curriculum. An interesting link may be made to another study (Cooper & Kerns, 2006) which found students to perceive slightly different roles for their TAs depending on the instructional style of the laboratory curriculum. Cooper and Kerns (2006) studied the effects of changing the instructional format of an organic chemistry laboratory course on university students' attitudes and perceptions. They found students to perceive a more supervisory and leading role for their TAs ("making sure we don't blow anything up" being a response that typifies this perception) in traditional, verification style laboratories. Open-ended laboratory tasks encouraged them to see their TAs more as guides ("making me ask questions and learn").

Next, we look at another difference between novice and expert teachers; namely pedagogical content knowledge or PCK.

2.4.5.2 Pedagogical content knowledge (PCK)

One of the more prominent concepts to emerge from the context of educational research in the last two decades has been that of pedagogical content knowledge (PCK). First introduced by Shulman (1986) as an integrated form of professional knowledge consisting of pedagogical knowledge interwoven with subject content, the notion of PCK has since developed (Van Driel, Verloop, & De Vos, 1998; Van Driel, De Jong, & Verloop, 2002) into its present recognition as a tacit element of one's teaching experience that would appear to develop over time. It represents the many particulars that good teachers of a given subject know "about the content, that are relevant to its teachability" (Geddis, 1993). Encompassing all aspects of teachers' knowledge and beliefs of what best facilitates student learning of a given content, PCK has been considered both difficult to articulate and topic-specific (Loughran, Mulhall, & Berry, 2004). These authors have represented PCK as using tools such as Content Representations (CoRes) and Professional and Pedagogical experience Repertoires (PaP-eRs). Some examples of analysis of (De Jong, 2000; Geddis, 1993) and resources for the development of PCK (Brooks, Cohen, Abuloum, Langell, Markwell, Emry, Crippen, & Brooks, 2007) in secondary level chemistry education can be found in the literature. The work of Bucat (2004) is pertinent to chemistry teaching at the tertiary level, and earlier work by Clermont, Borko, and Krajcik (1993 & 1994) on the identification and development of PCK in chemical demonstrators has more specific bearing on this study. Mentoring has been shown to have potential benefits for the development of PCK in novice chemistry teachers (Van Driel *et al.*, 1998; Van Driel *et al.*, 2002).

Bond-Robinson (2005) attempted to identify hierarchical levels of pedagogical *Chemistry* knowledge (PChK) exhibited by graduate teaching assistants (GTAs) in the undergraduate Chemistry laboratory. Knowledge associated with responsive mentoring practice is classified as type PChK-0, procedural knowledge as type PChK-1, with the higher levels (PChK-2 and PChK-3) assigned to "transforming" knowledge, related to guiding the student towards conceptual thinking and meaning making (Bucat, 2004). Of these categories only type PChK-0 does not require content knowledge and might therefore be generalisable or non-specific; the others are very strongly dependent on procedural and content knowledge and are therefore discipline-specific. Bond-Robinson (2005: 99) rank orders the difficulty in acquisition of forms of PChK as follows: PChK-0 < PChK-1 < PChK-2 < PChK-3, thus implying that the higher levels are harder to attain. Interestingly, there is an apparent contradiction in this strongly cognitive conceptualisation and other work (Frykholm & Glasson, 2005) that view the development of PCK through the lens of teaching apprenticeship.

Bond-Robinson (2005: 99) found the TAs in her own study to seldom progress beyond PChK-1, that is the "tangible, observable level of concrete objects" in their interactions with students. Characterising PChK in a demonstrator community offers a way of tracking the progression of

individual demonstrators over time, and it may also offer a means of identifying individuals with leadership potential and/or special aptitude for teaching.

2.4.5.3 Progressing from novice to expert teacher

Luft and coworkers (2004) recommended that science GTA training programmes should draw on educational research that describes and explores the process of learning to teach science. In the context of teacher training, the “professional growth approach” (Clarke & Hollingsworth, 2002; Guskey, 1986) has been advocated as having greater potential for changing teaching practice than earlier models aimed at teacher mastery of prescribed skills and knowledge. This approach recognises teachers as “active learners shaping their professional growth through reflective participation ... in practice”. Kane and co-workers (Kane, Sandretto, & Heath, 2004) investigated a number of excellent university lecturers in sciences and found purposeful reflective practice to be central to these individuals’ integration of different dimensions (subject knowledge, skills, interpersonal relationships, research/teaching nexus, and personality) of themselves as teachers as well as their understanding and improvement of their own practice. Shulman (2002: 38) suggests a possible mechanism in the following quote:

“Critical reflection of ones’ practice and understanding leads to higher-order thinking in the form of a capacity to exercise judgment in the face of uncertainty and to create designs in the presence of constraints and unpredictability”.

The difficulties and tensions that we experience in our day-to-day teaching provide the fodder for our reflections, and creative decision-making around these challenges moves our practice to higher levels. This has important implications for developing demonstrating practice. Lack of ownership of the teaching process – in which they traditionally have little influence over what is taught and how – has been identified as a “key tension” for many TAs (Park, 2002: 57). Demonstrators are not likely to reflect on their teaching unless they “own” it, and allowing them ownership of at least part of the process, combined with opportunities in which they are encouraged to reflect on it, may contribute to moving demonstrating practice forward.

It is important also to seek out the voices of students (both undergraduate and postgraduate) in the literature, and for this reason I want to conclude this section with a selection of articles that helped shaped my understanding of the student perspective on demonstrator participation.

2.4.6 Undergraduate and postgraduate student perspectives

2.4.6.1 TA effectiveness

A US study (Herrington & Nakhleh, 2003) centred teaching effectiveness in the laboratory on the quality of laboratory instruction as facilitated by teaching assistants. This study categorised students’ and TAs’ perceptions of the attributes of an effective laboratory TA (demonstrator) into

three themes namely: *knowledge* (about procedures, techniques, safety, chemistry concepts, how students learn, and teaching), *communication skills*, and *affective qualities* such as concern, helpfulness, availability and approachability. The nature of the interactions between students and TAs were found critical to the learning environment in the laboratory (Cooper & Kerns, 2006; Herrington & Nakhleh, 2003).

2.4.6.2 *Benefits and problems of using TAs to teach undergraduates*

A survey of students, TAs and faculty at a research university in the UK (Park, 2002) found the three groups to have varied perceptions of the advantages and disadvantages of using TAs in the teaching of undergraduates. An effective TA programme is perceived to enable small-group teaching solutions for handling large classes, offer work experience and financial support to postgraduates, and free academic staff to pursue their disciplinary research interests. Perceived concerns include ensuring quality assurance of their academic offerings (for departments) and exploitation in terms of remuneration and workload (for demonstrators). The author stresses the need for a

“fair, transparent and consistent framework for using and rewarding GTAs ... a key element in this framework is the need for unambiguous definition of the role, responsibilities and rewards of being a GTA” (p58).

These opinions are echoed in the large-scale study by Luft and co-workers (2004) cited earlier.

At this point it becomes necessary to turn to the prolific literature on educational theory to lay the foundation for the theoretical framework of my study. The next section proceeds with a summary of individualistic Piagetian notions of learning and the situated and social perspectives that developed out of them in the final decades of the twentieth century.

2.4 Theories of learning pertinent to this study

2.4.1 *Constructivist models of learning*

Learning, viewed from a radical constructivist perspective, is not a spontaneous process; rather it is provoked by situations (Piaget, 1964). Early postulates from this genre (Piaget, 1964; von Glasersfeld, 1992a & 1992b) contended that an individual's actions on objects lead to the formation and ongoing development and transformation of cognitive structures. Learning occurs when existing cognitive structures or schemes are challenged and modified as a result of internal mental activity rather than transmission; this internal, individual process of constructing knowledge about the natural world has been referred to as *equilibration* (Driver, Asoko, Leach, Mortimer, & Scott, 1994). When students observe and interact with real objects and materials from the natural world in the laboratory, one fundamental purpose is to help them construct links

between the domain of real objects and observable things and the domain of ideas (Millar *et al.*, 2002). In the laboratory the role of the demonstrator is to facilitate student learning by purposefully guiding the construction of the necessary understanding beyond simple personal experience and knowledge (Hodson & Hodson, 1998). If demonstrator learning is indeed recognised as a feature of their involvement in the laboratories the laboratory manager or responsible academic might fulfil the role of facilitator, and research into demonstrator learning would typically focus on the demonstrator as unit of context analysis.

The use of facilitators in the laboratory suggests that learning in this context could also be viewed from a social constructivist perspective (Driver *et al.*, 1994). Novices (first-year students) are introduced to the laboratory practice by more skilled members (demonstrators) and learning creates a *zone of proximal development*, ZPD, (Vygotsky, 1978) in which development of skills and competences takes place through interaction and cooperation (Cobb, 1994). This perspective is useful also for considering how novice demonstrators develop their teaching skills in the laboratory: they are introduced to laboratory teaching practice by a mentor (an academic or senior demonstrator) and skills and competences develop within the ZPD created between the mentor and novice. Research from this perspective would focus on the teacher-learner dyad as unit of analysis.

2.4.2 *The situated nature of knowledge*

Cognitive perspectives place ideas, views, beliefs and knowledge in the mind of the individual learner. This view has been criticised (Kirshner & Whitson, 1997; Orgill, 2007) for separating knowledge (and other forms of contemplative activity) from lived experience and sociocultural context. Recent years have seen the emergence of new theories that recognise learning as an adaptive process involving the learner in context. "Situated cognition" or "situated learning" are names given to theories of this type; they argue that learning and cognition are situated and contextualised, and that activity, concept and culture are interdependent (Brown, Collins, & Duguid, 1989). The situated nature of knowledge is supported by cognitive apprenticeship theory (Brown *et al.*, 1989; Collins, Brown, & Newman, 1989), a pedagogical model that embeds learning in activity within a specific social and physical context. Cognitive apprenticeship has distinct parallels with craft apprenticeship in that it can be viewed as a guided learning process in which the learner learns by doing, under the mentorship of an expert or master. Thus the learner enters a particular community of practice and its culture (Wolcott, 1983) in order to learn the appropriate ways of using the tools (knowledge, algorithms, routines, decontextualised definitions and specialized equipment) of the community.

2.4.3 *Communities of practice*

Social learning theory recognises the observational and modeled nature of learning that occurs in social communities and learning systems (Macklin, 2007). This author contends that the

community of practice (CoP) “provides a theoretical framework for research designed to understand how observing and modeling behaviours help newcomers become indoctrinated into the group” (p210). CoPs have also been described (Wenger, 2000: 229) as the “social containers of the competences that make up (a social learning) system”. Barab and Duffy (2000) describe communities in the following terms:

- The members of a community share goals, understandings and practices, and a common cultural and historical heritage.
- When individuals join communities they become part of an independent system.
- Communities have the ability to perpetuate its practice as newcomers work alongside more experienced members.

Newcomers within a CoP engage at first in legitimate peripheral participation (LPP) and through growing involvement eventually gain access to ways of knowing that lead to full participation within the community (Lave & Wenger, 1991). LPP differs from craft apprenticeship in that it focuses on changing participation and identity transformation in a community of practice. Thus learning involves the construction and transformation of an identity within the community; becoming a full participant, a certain kind of person (Gee, 2000; Lave & Wenger, 1991; Wenger, 2000). In the context of science learning, the research component of (post)graduate chemistry education has been shown to bear a close resemblance to the key attributes of cognitive apprenticeship theory (Carr-Chellman, Gursoy, Almeida, & Beabout, 2007; Stewart & Lagowski, 2003). The structured laboratory investigations that are so often a feature of traditional undergraduate science programs, on the other hand, do not (Bowen, 2005). As a consequence of a variety of differences between classroom and scientific communities, the decontextualised symbolic mastery of scientific practices and tools as represented in these programmes do not adequately prepare students to engage in independent scientific research activities. Communities of practice theory alone would therefore probably not be the best perspective for viewing *student* learning in the laboratories.

Sfard (1998) described the aforesaid models of learning in terms of two metaphors, namely the acquisition metaphor and the participation metaphor. Constructivist notions of learning analyse knowledge growth in the learning process in terms of concept development. They all point to a gradual acquisition or accumulation, by development or by construction, of knowledge-as-commodity, and thus belong in the *acquisition* metaphor. By contrast, learning models such as situated cognition that fit into the *participation* metaphor conceive of learning as a process of becoming a member of a certain community. Sfard makes a strong case for considering both metaphors in new educational research, as each has something to offer that the other cannot provide. Such models of learning may integrate the two metaphors into a notion of an acquired, but situationally transferable property of the learner. Integrating metaphors has interesting implications for this study: while the general focus of demonstrator learning-as-participation lies

firmly within the participation metaphor, specific foci (which will be discussed in the next section) such as the *accumulation of a shared demonstrating experience* speaks to the acquisition metaphor.

During the course of the development of this thesis I will return often to the notion of the demonstrator cohort as community of practice, and will draw extensively on communities of practice theory in the analysis and discussion of my research results. In the section that follows I will show how I have used the ideas contained in a model originally proposed for organisational studies (Wenger, 2000) to construct a framework for this research project.

2.5 Theoretical framework

2.5.1 *The teaching laboratory as community of practice (CoP)*

Social theories of learning focus on learning as social participation (Lave, 1996), and view learners as active participants in the practices of social communities who, through their participation, transform their own identities in relation to these communities. Learning is viewed as participation rather than the acquisition of knowledge, and knowing involves active and competent participation in the social community of which the learner is a member. The learner moves towards ever greater competence, constructing an identity in practice (Lave & Wenger, 1991; Wenger, 2000).

2.5.1.1 *Wenger's four elements of learning*

The components characterising the learning process include: *meaning* (learning as experience), *practice* (learning as doing), *community* (learning as belonging) and *identity* (learning as becoming) (Wenger, 2000). The interconnectedness of these components as characterised in the type of participation that postgraduate TAs and demonstrators engage in the laboratory will soon become clear.

The term *meaning* offers a way of talking about demonstrators' ability to experience their participation in departmental teaching activities as meaningful. *Practice* is a way of talking about the shared resources, frameworks and perspectives that represent the undergraduate chemistry laboratory with its associated culture and tools (knowledge, algorithms, routines, decontextualised definitions and specialized equipment). The *community* of practice described by those who interact with and within the community provides the context within which learners at all levels of mastery (students, demonstrators and academics) construct and transform their *identities* through participation and engagement. Here, the term *identity* refers to being recognised, by self and others, as a "certain kind of person" (Gee, 2000), a chemistry demonstrator or emerging academic, for instance.

2.5.1.2 *The fifth element*

In addition to Wenger's (1998) four elements of learning Graven (2004) identified a fifth element namely *confidence*, in the context of mathematics teacher learning. She contends that confidence is "both a product and a process of learning" (p177) and places it alongside the other four elements, arguing that it is interrelated and interconnected "rather than subsumable within meaning, practice, identity and/or community" (p208). The concept of confidence offers a way of talking about 'learning as mastery'. *Mastery* is described as involving the emergence of confidence

"in relation to one's professional knowledge ... and experiences, one's participation in professional activities, one's membership in a range of professionally related communities and one's identity as a professional ... teacher." (p185)

From the theoretical perspective above demonstrators' engagement in student facilitation and other teaching activities over time allows them to gain access to ways of knowing that lead to full participation within the community. This eventually contributes (at least in part) to the transformation of (at least some) post-graduates into professional educators. If learning is participation, then it can be argued that engagement in practice should result in at least some change in performance. Wenger (2000) cautions, however, that the prospects for learning may be distorted, that is, participants may very well learn undesired practices in communities that have become stagnant.

2.5.2 *Definition of key concepts*

I will now introduce a number of key constructs that I found useful in the development of my conceptual framework. The first triad of constructs (*enterprise*, *mutuality* and *repertoire*) can be used to describe *competence* in a community of practice, and the second triad (*engagement*, *imagination* and *alignment*) describes aspects or modes of *belonging* to a community of practice.

2.5.2.3 *Dimensions of progress in a CoP*

Competence within a community of practice can be defined by combining three elements namely *joint enterprise*, *mutuality* and *shared repertoire* (Wenger, 1998). In non-stagnant communities these elements serve as dimensions of progression.

The first of these, *enterprise*, represents the level of learning energy present in a community of practice. It refers to how well the community recognises and addresses gaps in its knowledge and remains open to new ways of knowing. Competence in this dimension is represented by sufficient understanding of the practice to be able to contribute to it.

The second element, *mutuality*, represents the depth of social capital in the community. In essence it refers to the extent to which community members work interdependently towards a shared goal. Competence in this dimension is to be a trusted partner in interactions within the community.

Lastly, *repertoire* represents the degree of self-awareness the community has about the shared repertoire of communal resources such as language, concepts, routines and tools that it is developing. To what extent does the community reflect on its own state of development from multiple perspectives and use this self-awareness to move forward? Competence in this dimension is to have access to this repertoire and to be able to use it appropriately.

2.5.2.4 Modes of belonging to a CoP

Wenger (1998) also captures different forms of participation within communities by outlining three distinct modes of belonging, namely *engagement*, *imagination* and *alignment*, all of which usually coexist in some combination in every social learning system. The interplay of these modes of belonging provides an explanation of participation within a community of practice:

Engagement: When we *engage* with each other our individual experiences of who we are within the community are shaped and we learn how the community responds to our actions.

Imagination: Belonging allows us to construct an *image* of ourselves within the community and develop a sense of self and a personal interpretation of our own participation.

Alignment: Ensuring that our activities are *aligned* with other processes, perspectives, interpretations and actions within the community produces synergy for the realisation of higher goals.

These three modes of belonging resonate with Gee's notion of A- or affinity-identity, relating to experiences shared in a set of common endeavours or practices of affinity groups, such as the community of demonstrators (Gee, 2000). An individual's alignment with a particular affinity group may be a matter of choice (Gee uses the example of a *Star Trek* fan club) or it may be institutionally imposed or created, as is the case with 'communities of learners' (Brown, 1994) in which knowledge is distributed across the group, its practices and its tools and technologies.

2.5.3 Conceptual framework for the research

The ways in which Wenger's three modes of belonging outlined above may interact with the three dimensions of progression outlined in the previous section provides a general framework for evaluating participation in a community of practice. In table 2.1 below, Wenger's (2000) general framework (table 1, p231) has been converted into nine propositions describing the desired features of an ideal CoP within the laboratory context.

Later on in this thesis, the nine propositions contained in the matrix below will be used for analysis of the research data. I will use these propositions as intellectual “bins” (Miles & Huberman, 1994) for the gathering of constructs present in the data. In the context of case study research, “binding the case” (applying boundaries on the case) and structuring the analysis according to a predetermined set of propositions has been recommended for providing structure to a narrative report and for placing limits on its scope (Baxter & Jack, 2008; Yin, 2003).

Table 2.1: Framework for evaluation of demonstrator participation in the laboratory

Dimensions of progress	Enterprise (learning energy)	Mutuality (social capital)	Repertoire (self-awareness)
Modes of belonging			
Engagement	Demonstrators identify the gaps in their (and their students’) knowing and work (together) to address them.	Events and interactions exist that provide for discussion of issues and development of trust amongst demonstrators, students and the lecturer.	A shared demonstrating experience has accumulated with potential for further development.
Imagination	Visions of the potential of the community inspire participation amongst demonstrators.	Demonstrators know about the meanings that participation in the laboratory makes in their and their students’ lives.	There is a language that talks about the community in a reflective mode.
Alignment	Demonstrators have articulated a shared purpose; they subscribe to it, and feel accountable to it. Leadership is distributed widely in the CoP.	Clear definitions of the roles, norms, codes of behaviour, shared principles and negotiated commitments and expectations exist and are upheld in the community.	Methods, standards and routines exist to define good demonstrating practice, and these are upheld and transmitted to new generations.

2.5.4 How the framework relates to the first three research questions

The model proposed above (table 2.1) poses a number of relevant questions, which may be used to explore and describe *competence within the community* (using the dimensions of progression, horizontal axis) or *belonging within the community* (using the vertical axis, modes of belonging), or indeed both. Since the aims of this study centre on what and how the demonstrator learns in the laboratory, I will attempt to capture demonstrator learning-as-participation in terms of the three modes of belonging set out in the model (vertical axis).

When the first mode of belonging (engagement) interacts with the horizontal (dimensions of progression) axis, the questions in the first row of the table (see below) are of relevance for describing how demonstrators' participation translates to their eventual knowing:

- *How do demonstrators identify the gaps in their (and their students') knowing and work (together) to address them?*
- *What events and interactions provide for discussion of issues and development of trust amongst demonstrators, students and the lecturer?*
- *To what extent have shared demonstrating experience accumulated and with what potential for further development?*

The convergence of the three questions above gives rise to my first research question, namely:

How do demonstrators engage with and within the community and what do they end up knowing from their participation?

Applying the second mode of belonging (imagination) to the dimensions of progression axis the second area of relevance explores how demonstrators interpret their knowing and transform their identities through participation:

- *What visions of the potential of the community are inspiring participation amongst demonstrators?*
- *What do demonstrators know about the meanings that participation in the laboratory makes in their and their students' lives?*
- *What language is there to talk about the community in a reflective mode?*

The synthesis of the three questions above produces the second research question, namely:

What images do demonstrators construct of themselves, and how do they interpret their own participation within the community?

Lastly, the third mode of belonging (alignment) applied to the dimensions of progress frames the synergy of the collective demonstrating experience within the community:

- *Have demonstrators articulated a shared purpose; how widely do they subscribe to it, and how accountable do they feel to it? How distributed is leadership?*
- *What definitions of roles, norms, codes of behaviour, shared principles and negotiated commitments and expectations hold the community together?*
- *What methods, standards and routines define demonstrating practice? Who upholds them? How are they transmitted to new generations?*

By combining the ideas held in the questions above, the third research question can be synthesised, namely:

To what extent is demonstrators' participation aligned with other processes within the community?

The fourth research question (**How does an intervention in the form of a formalised training programme combined with demonstrators' guided reflections on their practice change their participation in the laboratory?**) did not derive directly from the framework but rather emerged from the findings of the baseline study performed at the start of the study to identify a point of departure for the research. This has been discussed in some detail elsewhere (chapter 7) in the thesis.

2.6 Summary

This chapter has described research related to laboratory learning in chemistry, demonstrators as facilitators of student learning in chemistry and demonstrator learning about teaching (in general and in chemistry). A section on education theory was included to provide an introduction to the theoretical perspective that underpins this research.

My analysis of the purpose of laboratory work shows that instructors' goals for student learning in the laboratory remained essentially unchanged in the period 1960 – 1990. Expository laboratory instruction remained popular for large groups of students, but presented problems in encouraging higher-order cognition. In the 1990s laboratory curricula began to diversify into variants other than the traditional verification laboratories, with discovery, problem-based and inquiry learning becoming more prominent. The start of the twenty-first century saw a sea-change in chemistry education research with thought-leaders advocating a shift to inquiry-based learning both in the classroom and in the laboratory. In the US this has led to government-funded initiatives to involve undergraduates in authentic research experiences as part of their university chemistry curricula.

Postgraduate students are used extensively and in a variety of ways to facilitate undergraduate learning, and their involvement is well recognised as beneficial to all stakeholders. Most universities that make use of postgraduate TAs provide training, and the last decade has seen institutional appreciation of postgraduates as a valuable human resource blossom into large-scale initiatives such as the national PFF programme in the US aimed at preparing postgraduates to teach in higher education. Training initiatives for postgraduates facilitating learning in the laboratory lie on a spectrum that ranges in comprehensiveness from job-training (short-format training courses) to career-preparation (usually as part of inclusive preparation programmes such as PFF). The more sophisticated models encompass teaching (of chemical concepts) and management (of chemical environments) as their core curriculum, giving credence to the recommendation that research into the training of teachers should also inform demonstrator training programs. I included in my review a section on research into the

differences between novice and expert teachers for its value to inform about the *transformation* of novices into expert teachers, which is an important objective of this research project.

In summarising selected fundamentals of science education research, I had hoped to introduce the reader to the relatively unknown (at least amongst chemistry academics) tenets of social learning theories that are so important for understanding how demonstrators learn to become teachers (lecturers) by participating in peripheral yet authentic teaching activities. This overview of science education research also served to establish a foundation for the development of my theoretical framework in the latter part of the review.

Finally, I wish to explain how the literature review has informed and influenced the empirical component of my study. Student learning was not a focus of the research project beyond the initial stages of the study. It so happened that, during the development of my research proposal, my research focus narrowed to demonstrator learning. Nonetheless, I still needed to understand student learning in the laboratory in order to understand demonstrator learning, since demonstrators' main function in the laboratories is to help students learn about chemistry from the experience of performing the practical activities. The literature on demonstrating practice and demonstrator training models helped me to (i) develop an understanding of how demonstrators can be empowered to facilitate student learning, and (ii) make choices about effective strategies for demonstrator training. I explained earlier that, according to social theories of learning, participation in a community of practice *embodies* learning. But how to evaluate demonstrator participation and decide whether it is meaningful or not? The value of the Wenger model as theoretical framework lay in helping me to develop a way in which to characterise demonstrator learning-as-participation. The nine propositions contained in the framework, when phrased as questions (see the paragraph entitled *How the framework relates to the first three research questions* above), became useful for selecting methods for data collection. For instance, the first proposition phrased as a question becomes: *How do demonstrators identify the gaps in their (and their students') knowing and work (together) to address them?* Once structured in this way it was clear that I could observe demonstrators while they interacted with students, and ask them questions about their strategies for identifying and solving student problems, in order to collect data about this aspect of their participation.

In the corpus of literature on demonstrator or graduate teaching assistant participation in science laboratories, I am not aware of any studies that have investigated demonstrator learning from a communities of practice perspective. For this reason I believe that this project may lay a foundation for future research in this area.



Chapter 3

Research design and methodology

This chapter charts the methodology employed during the experimental part of the study. Here I tell the story of the gradual unfolding of my research process and elaborate on the ways in which the actual research differed from the way in which it was originally envisioned.

3.1 Introduction and chapter overview

During qualitative research it is not uncommon for initial ideas to disintegrate and re-aggregate, shrink and expand, and generally undergo various cycles of refinement until they finally settle into more comfortable (and often very different) versions of their former selves (Rubin & Rubin, 1995). I hope to give the reader a sense of this process in my conceptualisation of the research design and defence of my choice of methodology. I will explain my decision to perform a set of semi-quantitative surveys in order to establish the issues my study needed to address. This will be followed by an overview of the methods used for collecting data, and a section in which sampling issues and fieldwork practice are discussed. At this point I will offer a graphical timeline for the data collection process. Data capturing and editing will be discussed briefly before going on to a description of how the data were coded and analysed. I will devote the final sections of the chapter to discussions of ethical matters, the quality of the research data and limitations of the study.

3.2 Guiding assumption and initial plans for the study

The guiding assumption for this research project was that an intervention combining formal demonstrator training combined with guided reflective practice would transform the way in which demonstrators participate in the laboratory. I initially saw the study following a classical action research design consisting of two data collection cycles, separated by an intervention phase. Action research traditionally involves repeating a cyclical process (McNiff & Whitehead, 2006) of (i) planning and implementing a change, (ii) observing the effects and consequences of the change, and (iii) reflecting on these in order to plan further action.

A customary design feature in action research is usually some form of intervention, carried out or imposed upon the unit of enquiry. The intervention phase following the first action cycle of my

study was originally envisioned as the implementation of a formal demonstrator training programme. This would be combined with a period of guided reflective practice in which, it was hoped, demonstrators could be encouraged to participate. The expectation was that the intervention would change the way demonstrators participate in the laboratory, and that an anticipated and associated positive impact on the quality of learning in the laboratory would be evident in the data of the second research cycle.

3.3 Methodology

Paradigms are axiomatic systems characterised essentially by their differing sets of assumptions about the phenomena into which they are designed to enquire.

(Guba & Lincoln, 1982: 233)

3.3.1 *Conceptualisation of the research design*

Henning (2004) identifies the three foremost paradigms in social science research as positivist, interpretivist and critical. McNiff and Whitehead (2006) use slightly different terms, namely: technical rational (empirical); interpretive and critical realist. My early training as analytical chemist introduced me to the methodologies of the rational paradigm, and the primacy (within its context) of objectivity, causal relationships and the quest for “truthful” generalisable knowledge (Mouton, 2001). These were the notions of research with which I started my preparations for this study. Very soon after the start of my research journey however, I was introduced to interpretative ways of thinking about research which helped me realise that I wanted to engage on an individual basis with the subjects of my research, rather than view them merely as sources of data, as a positivist viewpoint would. Hence, my study straddles both the interpretive and critical realist paradigms in that: (i) it aims to explore participation within a community of practice in terms of definitions and interpretations negotiated by the participants themselves (interpretive), and (ii) attempts to identify dysfunctional practices within the community, thus providing impetus for change (critical realist) (McNiff & Whitehead, 2006).

Action research is a methodology sometimes considered to lie within the critical theory paradigm and has been recommended (Robson, 2002) for evaluative studies aimed at improving understanding, developing one’s own learning and influencing the learning of others. In the context of action research Robson (*ibid.*) qualifies improvement in terms of occurring in a *practice*, the *understanding* of a practice by its practitioners and the *situation* in which the practice takes place. McNiff and Whitehead (2006: 38) locate action research outside critical theory, arguing that the former developed from the latter but went beyond it to what these authors refer to as *living theory*; a form of action research in which the researcher “hold(s) themselves accountable for their learning and their influence in the learning of others”.

My study fits well with the aims of yet another interpretation namely *emancipatory action research* which has been articulated (Zuber-Skerrit, 1996) as: (i) technical and practical improvement of a particular social situation in a system; (ii) participants' better understanding of and transformation within the system; and (iii) changing and improving the system itself. Emancipatory action research has been separated into two camps (Kemmis & McTaggart, 1998), the first of which emphasises reflective practice in the tradition of Schön (1983) and interprets action research to be about improvement of professional practice at the local level. The second camp advocates the use of critical theory in the tradition of Carr and Kemmis (1986) and views action research as part of a broader agenda for educational and societal change.

The research reported here aimed to explore and improve participation within a small community of practice described by the first-year chemistry laboratories at the tertiary institution where the study was located, and as such resonates with the reflective tradition. Insofar as the study was also committed to the empowerment of all the participants within the community it also has some roots in the critical tradition. Whichever notion one wishes to align with, emancipatory action research remains a situationally responsive methodology that assumes participatory, collaborative inquiry and offers participants an authentic voice (Cohen, Manion, & Morrison, 2000).

Participatory action research (PAR) has been described as a dynamic process involving active co-research, by and for those whose practices are being researched (Wadsworth, 1998). Wadsworth identifies four conceptual parties to research: (i) the *researcher(s)*, (ii) the *researched*, (iii) those experiencing the problem the research is intended to resolve (also called the *critical reference group*), and (iv) the *researched for*: those who would benefit from better information about the situation. Apart from the identity of the researcher in my own study, which is obviously myself, the *researched* might be the community of demonstrators, the *critical reference group* might be the first-year students in the laboratory and the *researched for* might be the institution and department where the study is located. It is not uncommon for the four conceptual categories of participants to overlap to some extent, as turned out to be the case in this study. It could be argued that the *researched* include not only demonstrators but also students, since student voices are also present amongst the data. The same could be said for the *critical reference group*: it includes not only first-year chemistry students but demonstrators as well, since both communities are experiencing related problems that the research aims to resolve.

3.3.2 *An adapted action research design*

The actual research process turned out to be considerably more convoluted than the simple action model first imagined, due mainly to two contributing factors. The first was the reluctance of demonstrators to participate in the research in the early stages of the project, which led to a

small amount of data for what would have been the first data collection cycle. One consequence of this was that it was not possible to match up data from before the intervention with data that was collected afterwards. Secondly, the “intervention” itself turned out to be so much more than its initial definition, that it can in hindsight best be described as an intercessory process or series of negotiated steps that, instead of being implemented in a single event, grew and transformed over an extended period of time. Chapter 5 will deal with the intercessory process in greater detail.

Data collection for the “second research cycle” overlapped and to some extent informed the intercessory process in a way that is not uncommon in flexible design studies (Yin, 1989: 127). In addition, the negotiated nature of the intercessory process is suggestive of PAR when considered against the essence of the latter as captured by Wadsworth (1998: 13) in the following quote:

“Essentially participatory action research is research which involves all relevant parties in actively examining together current action (which they experience as problematic) in order to change and improve it.”

The author stresses the notion of critical reflection when he further qualifies his definition as follows:

“They do this by critically reflecting on the historical, political, cultural, economic, geographic and other contexts which make sense of it.”

Although the project did not fully follow a PAR approach, it was designed and conducted with participatory values in mind. Elements of ethnographic research are also present in the design. Hammersley and Atkinson (2007: 3) see ethnography as

“involv(ing) the ethnographer participating, overtly or covertly, in people’s lives for an extended period of time, watching what happens, listening to what is said, and/or asking questions through informal and formal interviews, collecting documents and artifacts – in fact, gathering whatever data are available to throw light on the issues that are the emerging focus of inquiry.”

Ethnographic research designs typically involve studying relatively small numbers of research participants in considerable depth and as a result, have the potential to produce detailed insight of participants’ life-worlds (*ibid.*; Henning, 2004).

The key research questions of this study are exploratory and descriptive in nature (aimed at finding the answers to what demonstrators actually do in the first-year laboratories), and are therefore best addressed using a flexible research design based on methods generating qualitative data (Cohen *et al.*, 2000). I will discuss the qualitative methods used for data generation shortly, but first I would like to include here a brief report on a piece of work

performed right at the beginning of my study, when I was unsure how to proceed and wanted a sense of how students were experiencing their interactions with the demonstrators in the laboratories. I have called this exercise *Establishing a baseline* and will be reporting on it again in greater detail in chapter 7.

3.3.3 *Establishing a baseline*

In an attempt to establish a point of departure for the study, I collected global data of the student and demonstrator cohorts at the start of the study. In particular I was interested in determining a baseline of student and demonstrator expectations and experiences of the laboratory sessions. As I had hoped, the exercise brought to light several interesting issues that helped me to pinpoint where the greatest misalignments between participants' expectations and experiences were to be found. The global data that I refer to here were collected using twin surveys performed on (i) the student cohort at the start of the study and (ii) the demonstrator cohort some six months later. Then, almost as an afterthought, the twin surveys used to establish the baseline were repeated towards the end of the study (some three years after the baseline study) on the student and demonstrator cohorts in the laboratories at that time. My initial intention with the baseline study was not to use it comparatively but, since I had the opportunity to collect after-the-intervention sets of data, I will contrast these with the baseline data later in chapter 7. I found the survey data extremely useful in providing a broader context for the story told by the qualitative data of this study. The reader will find an extensive discussion of the findings in chapter 7 titled: *A broader context for the study: Survey data about Baseline and Beyond*.

3.4 **Data collection methods and fieldwork practice**

Henning (2004) uses the term "progressive" when referring to studies that are flexible in the sense that they do not use pre-determined instruments to capture data. She recommends using semi-structured interviews, documents, and participant observation as the principal qualitative methods of flexible research designs. In line with his recommendations, I have used semi-structured interviews (including one focus group discussion), documents (my own journal notes and demonstrators guided reflections) and participant observation (video recordings of selected laboratory sessions) to collect the data for my own research. I will elaborate on how these techniques were employed in the sections that follow.

3.4.1 *Semi-structured interviews*

According to Kvale (1996: 1) "the qualitative research interview attempts to understand the world from the subjects' point of view". Since my second research question had a strong focus on the *meanings* that engagement and participation make in the demonstrators' lives, I chose

interviews as my principal means of data collection. More specifically I chose to use semi-structured interviews, the flexibility and adaptability of which offer opportunities for modifying the line of enquiry as interesting issues emerge (Robson, 2002). I formally interviewed four demonstrators from the community under investigation, and used the first interview to pilot the interview schedule. Robson (2002) recommends augmenting interviews with focus group discussions to provide checks and balances and to help identify and explore collective understandings in the community. I held a focus group discussion with three different demonstrators from the same community in the hope that this would go some way towards addressing reliability concerns due to lack of standardisation associated with the use of interviews. Demonstrator interviews and the focus group discussion were conducted in private in my own office. I also interviewed all four novice lecturers (see description of sample below) in their own offices, again using the first interview as pilot. All interviews and the focus group discussion were digitally recorded behind closed doors, and later transcribed to text files. I supplied each interviewee with a transcript of their interview afterwards, and cleared up all unintelligible interview segments at this time. The interview schedules of the demonstrators and novice lecturers are attached as appendices 3.1 and 3.2 respectively and sample interview transcriptions as appendices 3.3 and 3.4 respectively. The schedule for the focus group discussion is attached as appendix 3.5.

3.4.2 *Documents*

The documents that were incorporated into my collection of data included demonstrators' guided reflections, my own research notes, documentation pertaining to demonstrator training (the demonstrator manual and training program) and printed briefing notes supplied to demonstrators at the start of each laboratory session.

I want to include in this section an instrument that was part survey, part reflective tool. I have discussed this tool under the heading *Reflective survey*. Even though this experimental tool was distributed to the entire cohort of demonstrators it was intended as a qualitative rather than a quantitative instrument, designed to generate and capture individual demonstrator's reflections rather than global data. For this reason I have discussed it with the qualitative data collection methods rather than with the global semi-quantitative data that I will return to in chapter 7.

3.4.2.1 *Guided reflections*

When first conceptualising the project, I had in mind using reflective journals (of demonstrators) as part of the planned intervention. They were a strategic inclusion intended to encourage reflection, and ultimately (in close conjunction with a demonstrator training program) effect a change in demonstrating practice, along the lines of the professional growth approach (Clarke &

Hollingsworth, 2002; Guskey, 1986) that recommends “reflective participation in practice”¹. I also intended to use these journals as a method of data collection but found the process of generating momentum for the journal writing task difficult. I then had the idea of using writing prompts to guide demonstrators’ reflections, starting a sentence and asking the demonstrator participants to finish it. The writing prompts were used in two ways during the study.

In the first instance, during the fourth year, towards the end of the study, writing prompts were distributed to a small sample of individual demonstrators on a weekly basis to which they were required to respond by email. Three sets of writing prompts were sent out over a period of six weeks. I have called demonstrators’ responses to the prompts *guided reflections* and an example of such a prompt and the demonstrators’ responses is attached as appendix 3.6. Four demonstrators were included in this part of the study, three of whom were also included the focus group discussion mentioned earlier.

Secondly, an extension of my experimentation with writing prompts to guide participant reflection resulted in a reflective survey that merits separate discussion, and will be the topic of the next paragraph.

3.4.2.2 *Reflective survey*

The reflective survey was born out of my concern that my data collection did not contain enough data of a reflective nature. I was really worried that I would not have data to address questions like: *What do demonstrators know about the meanings that participation in the laboratory make in their and their students’ lives?* (See chapter 2; *How the framework relates to the first three research questions*). I then had the idea of grouping a number of writing prompts into a survey instrument to see whether this would be of use in generating the kind of demonstrator reflections that I had in mind. I tentatively named the instrument *What it means to be a demonstrator* (WiM2baD), attached as appendix 3.7. I asked two senior demonstrators to read through the instrument and they confirmed verbally that, as far as they were concerned, the prompts were presented in a clear and unambiguous way that demonstrators would be able to understand.

3.4.2.3 *Researcher’s journal notes*

I have included in this component of the collection of data my own notes penned throughout the study. I am reluctant to call them journal notes, as I wrote intermittently rather than regularly, whenever I felt the need to record an observation or insight. Reading back through these notes, they have both a factual and a reflective quality to them. A number of informal conversations

¹ In chapter 5 guided reflections will also be discussed briefly as an element of the intervention.

with students and demonstrators that I wrote up as research notes afterward are also included in this part of the collection. A sample is attached as appendix 3.8.

3.4.2.4 *Training materials and briefing notes*

I have included in my data collection the training materials handed out at the demonstrator training sessions at the start of each academic year and the demonstrator briefing notes relating to each practical session that were distributed to demonstrators throughout the academic year. I did not analyse these data, but included them because they provide evidence of codes of behaviour and other negotiated commitments and expectations that have bearing on the study. I have attached examples as appendices 3.9 to 3.12.

3.4.3 *Laboratory observations*

Lastly, the final component of my collection of data is made up of laboratory observations during the final year of data collection (2008). Research question 1 explores how demonstrators' engagement within the community translates to their eventual knowing. The concern with engagement implies that action of some sort is involved, and that observational methods of enquiry would yield useful data (Cohen *et al.*, 2001). A total of ten three-hour laboratory sessions were recorded as video footage. Four laboratory sessions (Experiments 2 to 5) were recorded at the start of the academic year on four consecutive Thursdays. Six additional laboratory sessions were recorded during the second semester. They were the final six sessions of the second semester, and represented all three weekly sessions (Tuesday, Wednesday and Thursday) of the penultimate and final experiments of the second semester.

Since I was initially unsure of what I would be looking for in the footage, my instruction to the cameraman was to follow the demonstrators (who were easily recognisable in their red coats) and film their interactions with each other and with the students. My hope was that the footage of the first few sessions would give me and the cameraman both some ideas on how to improve our fieldwork practice.

I left the transcription of the video footage until all my other data had been transcribed and analysed, and found the transcription process very labour-intensive. Throughout the process I had to discard hours of footage of demonstrators walking away from the camera, which I considered to be an unproductive use of my time. After a cursory inspection of the recorded footage I made the decision not to transcribe all of it. At this point I already had a considerable amount of other data that I deemed useful, and so I chose to use the video footage to confirm macro-aspects of practice captured in the recordings rather than fine detail.

The reference system used for my research data has been attached as Appendix 3.13.

3.5 Sampling and fieldwork practice

This section deals with the individual voices contained in the qualitative research data. I have included details about the cultural groups that these individuals belong to in my description of the demonstrator sample; I considered this inclusion relevant since the issue of race and education remains sensitive in the post-apartheid South African context.

3.5.1 Population statistics

Some statistics² germane to the discussion that follows and pertaining to student numbers distributed across race groups have been summarised in table 3.1 below. The table reflects participation (numbers and percentages of enrolments) in the following cohorts for the years 2007 and 2008: chemistry demonstrators, chemistry postgraduates, first-year (Y1) students in the laboratory course of the study and Y1 students enrolled in the B Sc Chemical Sciences programme.

Table 3.1: Numbers and percentages of chemistry enrolments across race groups, 2007/2008

Cohort	Year	Coloured	African	Asian	White	Other
Demonstrator	2007	2 (12%)	15 (88%)	0	0	0
	2008	5 (23%)	17 (74%)	0	1 (4%)	0
Postgraduate (Hons, MSc, PhD)	2007	19 (30%)	32 (50%)	10 (15.5%)	1 (1.5%)	2 (3%)
	2008	19 (28%)	33 (49%)	8 (12%)	5 (8%)	2 (3%)
Y1*	2007	102 (32.5%)	149 (48%)	34 (11%)	17 (5.5%)	10 (3%)
	2008	133 (40.5%)	140 (42.5%)	32 (10%)	15 (4.5%)	8 (2.5%)
Y1 (Chem Sc)	2007	11 (37%)	17 (57%)	0	1 (3%)	1 (3%)
	2008	16 (38%)	24 (57%)	1 (2.5%)	0	1 (2.5%)

*This data represent the number of first-year students in the practical course. The total number of first year students was higher (there are other first-year chemistry courses offered at UWC but their practical components are separate from the one studied – see chapter 1).

First I would like to explain the significance of the distinction made between Y1 and Y1 (Chem Sc) enrolments: the former group includes all students in the laboratory community served by the demonstrator cohort, and the latter – a subgroup of the former – includes Y1 students enrolled in the B Sc Chemical Sciences programme. Only students from the latter group have

² Statistics provided by the Management Information Systems division, UWC.

the potential to eventually feed into chemistry postgraduate (and demonstrating) programmes, in addition to students transferring from other institutions at some point during their studies (transfer is most likely to happen at masters or doctoral level.) Compared to the Y1 group the Y1 (Chem Sc) group has far fewer Asian and White students. These race groups tend to be wealthier on average and prospective students from these groups therefore mainly apply to the more expensive but better resourced historically white institutions (HWIs) for general programmes such as B Sc (Chem Sc). Enrolments in specialised degrees such as Dentistry, Pharmacy and Natural Medicine (all of which require at least one Y1 chemistry module), unique to UWC and not offered at any of the other institutions in the Western Cape swell the numbers in these race groups in Y1.

Secondly, comparing the cumulative Y1 (Chem Sc) and postgraduate statistics over the two years, the ratio of Coloured to African students in the postgraduate programme (1 : 1.7) was in the same range as the ratio in Y1 (Chem Sc) (1 : 1.5). Not surprisingly for a HBU, the Coloured and African groups predominated in both the undergraduate and postgraduate programmes. Interestingly, the postgraduate programme attracted a significant number of White and Asian students who had graduated elsewhere.

During Apartheid, there were four racial classifications for the South African population: White, African, Asian, and Coloured. This classification system was the basis for segregating the population in terms of areas of residence, schools, and basic economic and political rights. I have distinguished between "Black South African" students and "foreign Black" students in this section. Both groupings are included in the "African" demographic and I make the distinction purely because foreign students are increasingly being attracted to UWC and other South African tertiary institutions. Foreign students pay considerably more for their tuition because their statistics are excluded from funding formulas used by the South African government to determine financial contributions to tertiary institutions. Hence those in the postgraduate chemistry programme almost all contribute to demonstrating and tutoring, for the sake of (among other things) the financial reward.

Lastly, it is interesting to compare the demonstrator and postgraduate statistics. I have mentioned elsewhere (chapter 1) that only chemistry postgraduates are eligible for demonstratorships, which would make the demonstrator cohort a subgroup of the postgraduate cohort. The demonstrator cohort consisted almost exclusively of Coloured and African students. Comparing the cumulative demonstrator and postgraduate statistics over the two years, Coloured students were much more poorly represented in the demonstrator cohort (1 : 4.5) than their representation in the postgraduate cohort (1 : 1.7) predicts, all things being equal. This is not unexpected considering that Africans are by far the poorest race group on average in South Africa, and African students are therefore more likely to need financial support as offered by part-time employment such as demonstrating and tutoring.

3.5.2 *Selecting demonstrator participants*

In choosing participants for an action research study McNiff and Whitehead (2006) recommend involving those who are interested in the research and who are prepared to give of their time to become participant researchers in the project. Mindful of this recommendation, I extended an invitation to all first-year demonstrators to join the study, hoping to recruit a large enough group of volunteers from which to select my research participants. However, as I mentioned earlier, none of the demonstrators were interested in joining the study in its initial stages. Thus I continued to extend the invitation at regular intervals until finally, in my fourth year at the institution, four individuals overcame their reservations and volunteered to join the study. The first to volunteer was a Black South African male - a doctoral student who had been a member of the demonstrating community for some years. I was especially grateful for his willingness to participate as he knew the history of the community, and hence was a potential source of information about the demonstrating practice of the early community, before the start of the study. In order to mine this information to the best of my ability, I chose to interview this particular demonstrator, whom I decided to call Paki³.

The other three demonstrators to volunteer were respectively: a third-year student, an honours student and a master's student. All three were Black South African males; two were novice demonstrators while the third (the master's student) had just over a year of demonstrating experience. These three demonstrators were earmarked for a focus group discussion, and their collective responses went into the creation of the demonstrator Mncedisi⁴, a composite character that I used in the narratives employed to characterise demonstrator participation pre and post intervention in chapters 4 and 6 respectively.

Next, I focused on demonstrators who sought me out for conversation during the practical sessions, thus providing me with an opening to invite them to be interviewed for the study. In this way three demonstrators were selected, one could argue, for reasons of convenience. The first of these was the demonstrator who would later take over the role of practical administrator, whom I have named Nofanele⁵. When I interviewed her she was a rank and file demonstrator,

³ IsiXhosa is the dominant African language spoken in the Western Cape where the study is situated. For this reason I have chosen isiXhosa names for most of the black demonstrators that took part in the study. I chose names with meanings that reflect some aspect of each demonstrator's character and/or participation in the community. For instance the name *Paki* means "witness" and was chosen to reflect the fact that this student was the first to break the silence and speak out about his experiences as first-year demonstrator. Later I will say more about his motivation for participating, because it is of particular interest for the study.

⁴ *Mncedisi* means "helper" and reflects the fact that novice demonstrators like the three young males who were combined into this particular character are more likely to be part of the rank and file of the demonstrator community.

⁵ *Nofanele* means "suitable" and her name reflects the fact that she was chosen to replace Thandeka (see 8 below).

but some time towards the end of the study she took over the reigns of the community. She was a foreign Black female doctoral student, new to the demonstrating community at the time of our interview, but not new to demonstrating altogether, as she had been involved in demonstrating at the institution where she had completed her undergraduate and early postgraduate studies. I chose to include her since she communicated well, and I had noticed that she displayed an unusual measure of proactivity in her interactions with students. I was interested to explore the origin of her apparent insight in dealing with students. The second demonstrator to be selected in this way was also a foreign black postgraduate student, but male. I have named him Bakari⁶. He came to speak to me one afternoon during the practical session and mentioned that he had been a high school science teacher in his country before coming to South Africa to pursue his master's degree. I asked to interview him because I thought it might be interesting to add to my collection of research data the perspectives of someone who had been trained as a teacher but had no demonstrating experience.

The final demonstrator to be selected was a White male honours student, whom I named Sandy⁷, who had been a first-year in the laboratory course at the start of the study. This demonstrator was perhaps even more of a 'convenience' inclusion than the previous two individuals. Sandy and I drove to university in the same car several days a week and we often spoke about his experience of the practical course and of demonstrating to the first-years. He was at once confident, articulate, perceptive and outspoken, and from him I could get both a student and a demonstrator perspective of the laboratory experience with which to enrich my collection of data. At the same time, as he was the only white demonstrator in the cohort at the time, I felt that his perspective might bring a valuable 'outsider' element to the study.

I purposefully selected one additional demonstrator to interview, namely the practical administrator (laboratory manager/super demonstrator) whom I have named Thandeka⁸. I hoped to explore her role on the boundary between the demonstrator community and the chemistry department. She was a black South African female. At the start of the research project she was studying towards her master's degree, and shortly after the final data was collected she submitted her doctoral thesis.

⁶ *Bakari* is a name of undetermined African origin and means "hopeful". It was chosen to reflect this demonstrator's ambition (expressed during his interview) to some day be a university lecturer.

⁷ The name *Sandy*, a derivation of the name *Alexander* (of Greek origin), means "warrior", and was chosen to reflect the confident spirit of the individual on which the character is based.

⁸ *Thandeka* means "she is loved" in isiXhosa and the individual her character is based upon was indeed loved (and highly regarded) by students and demonstrators alike.

A final character, Mandisa⁹, will be introduced later (in the narrative contained in chapter 6). She is based on unrecorded, informal conversations with demonstrators during practical sessions, that were written up as journal notes afterwards.

The composition of the demonstrator sample of my study is shown in table 3.2 below. The absence of coloured voices in the demonstrator data will be addressed in the section on *Limitations* that follows later (section 3.11).

Table 3.2: Composition of the demonstrator sample

Demonstrator	Race group & Nationality	Gender	Degree registered for		Research participation
			Before study	During study	
Paki	South African Black	M	PhD	-	Interview
Thandeka	South African Black	F	MSc	PhD	Interview
Nofanele	Foreign Black	F	-	PhD	Interview
Bakari	Foreign Black	M	-	MSc	Interview
Mncedisi*	South African Black	M	-	3 rd year	Focus group and guided reflections
	South African Black	M	-	Honours	
	South African Black	M	-	MSc	
Sandy	White	M	1 st year	Honours	Interview and guided reflections

*Mncedisi, the composite character, was created by combining contributions from 3 individual demonstrators.

3.5.3 Novice lecturer participants

Interviewing demonstrator participants allowed me the opportunity to explore the perceived meanings that participating in demonstrating duties held for senior students. I was also interested to learn what meanings the demonstrating experience held for newly graduated chemistry doctorates entering academia. For this reason I interviewed four novice chemistry lecturers at two different universities in the Western Cape, that I have named University A and University B respectively. The composition of the sample of novice lecturers is shown in table 3.3.

⁹ Mandisa means "sweet".

Table 3.3: Composition of sample of novice lecturers

	Race group	Gender	Demonstrated at	Lectures at
Lecturer 1	Coloured	Female	UWC	University A
Lecturer 2	White	Female	University A	University B
Lecturer 3	Coloured	Male	University A	University A
Lecturer 4	White	Male	University A	University B

One male and one female lecturer were Coloured and the remaining male and female were White. They were purposefully selected for the two qualities they had in common, namely i) they had less than two years lecturing experience at the time I interviewed them, and ii) they had been demonstrators during their years at university. One female subject had been a member of the actual demonstrator community at UWC and moved on to a lecturing position at University A. The other three subjects had all been members of the same demonstrating community at University A during their years as postgraduate students. Two of them (one male and one female) accepted lecturing positions at University B. At the time of data collection, there were no novice chemistry lecturers at UWC to include in the study.

3.5.4 Participants in the WiM2baD survey

Questionnaires were handed out during a demonstrator meeting towards the end of the final semester of 2007. Only 17 of the initial 21 demonstrators signing up at the start of the year were present at the meeting and 12 of the questionnaires were returned. Since the sample size was so small, demographic items were limited to determining (i) how long participants had been demonstrating (*Less than a year*, *Between one and two years*, or *More than two years*); and (ii) their current level of study (*3rd year*, *Honours*, or *Postgraduate*) in order to protect the demonstrators' identities.

3.6 Timeline for data collection

My research data were collected over a period of four years, with the main body of data collected between October 2005 and August 2008. The timeline in figure 3.1 shows the main data collection events and when they occurred. I have included the student and demonstrator surveys (in purple) even though four of them yielded semi-quantitative data that have not been discussed here but will be the focus of chapter 7.

At this point I wish to draw attention to the central feature in the diagram, namely the arrow stretching from the top left corner of the diagram to the bottom right. I chose an arrow as the

basis for the diagram to symbolise the ongoing development and transformation of participation in the demonstrator community, which will continue into the future, in one way or another, regardless of whether or not it is being studied. I have chosen the edge furthest from the viewer as anchoring line for the data collected over the course of the study.

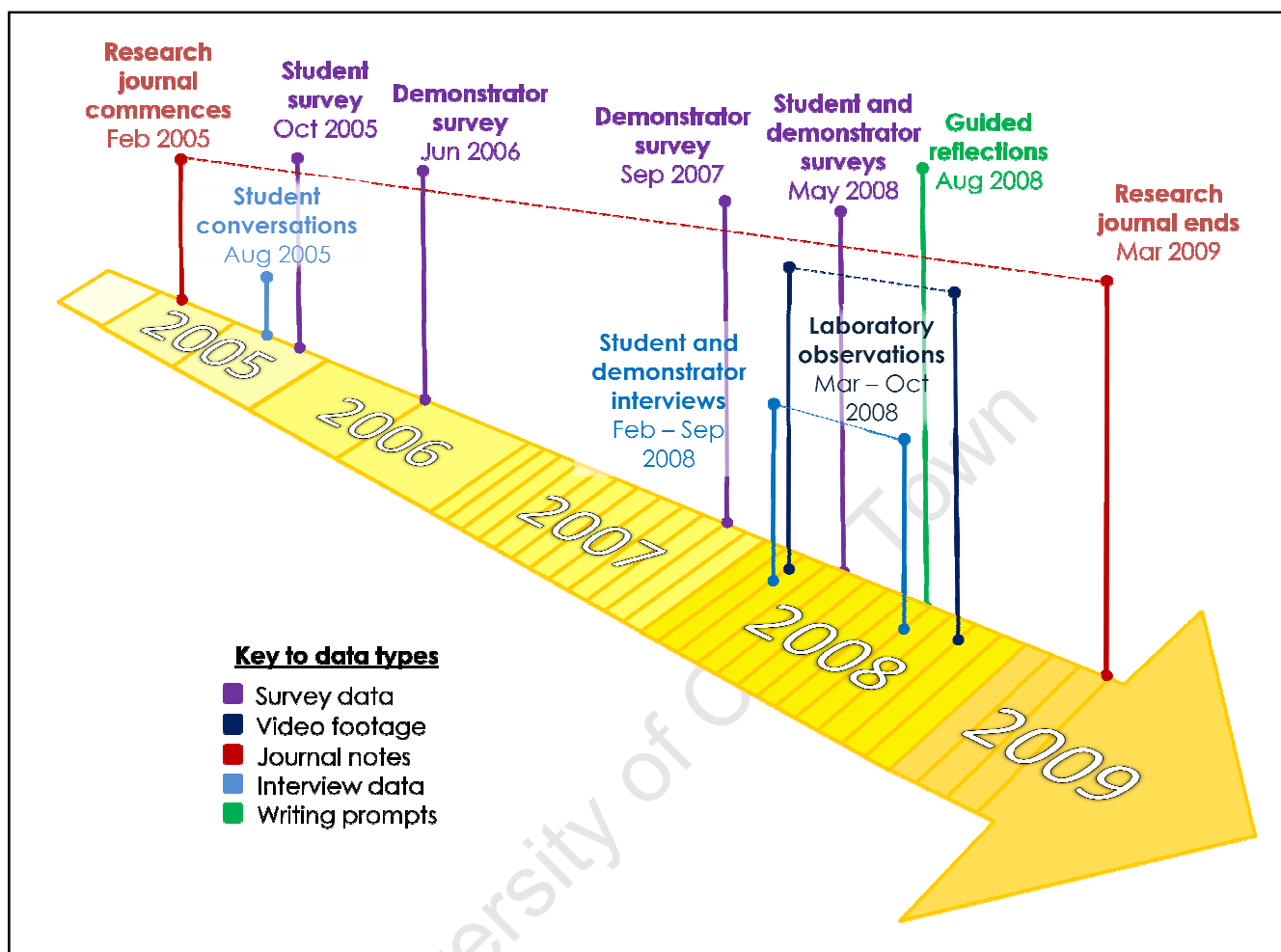


Figure 3.1: Timeline for data collection

In chapter 5, which deals with the intervention, this diagram will be expanded to include the intercessory steps that made up the intervention.

3.7 Data capturing and editing

All interviews and the focus group discussion were recorded on a digital recording device. The sound files were transcribed to electronic texts using a transcription device and accompanying software. Some of the video recordings of laboratory sessions were also transcribed to text. My own journal notes and observations were first handwritten and later transcribed. Writing prompts for the guided reflections were e-mailed to the demonstrators participating in that particular part of the project, and their e-mailed responses saved to electronic documents.

3.8 Data analysis

3.8.1 Framing the analysis

In chapter 2 I proposed an analytic framework for analysis of the research data that combines a number of constructs in a tabular matrix that allows interaction between each of the modes of belonging with each of the dimensions of progress. The matrix, which first appeared as table 2.1, is shown below in table 3.4:

Table 3.4: Analytic framework for analysing the research data

Dimensions of progress	Enterprise (learning energy)	Mutuality (social capital)	Repertoire (self-awareness)
Modes of belonging			
Engagement	Demonstrators identify the gaps in their (and their students') knowing and work (together) to address them.	Events and interactions exist that provide for discussion of issues and development of trust amongst demonstrators, students and the lecturer.	A shared demonstrating experience has accumulated with potential for further development.
Imagination	Visions of the potential of the community inspire participation amongst demonstrators.	Demonstrators know about the meanings that participation in the laboratory makes in their and their students' lives.	There is a language that talks about the community in a reflective mode.
Alignment	Demonstrators have articulated a shared purpose; they subscribe to it, and feel accountable to it. Leadership is distributed widely in the CoP.	Clear definitions of the roles, norms, codes of behaviour, shared principles and negotiated commitments and expectations exist and are upheld in the community.	Methods, standards and routines exist to define good demonstrating practice, and these are upheld and transmitted to new generations.

The matrix contains nine statements which I have used as intellectual “bins” (Miles & Huberman, 1994) for the gathering of constructs present in the data. Each of the statements relates to a desired feature for the ideal CoP within the laboratory context. In the context of case study research, “binding the case” (applying boundaries on the case) and structuring the analysis according to a predetermined set of propositions have been recommended (Baxter & Jack, 2008; Yin, 2003) for providing structure to a narrative report and for placing limits on its scope. It does carry a risk of being overly deductive, however. In the interest of remaining

sensitive to issues emerging from the data that lie outside the limitations imposed by the propositions in the framework (Baxter & Jack, 2008) I started analysing my data *inductively*, then worked towards linking my preliminary parameters with the propositions in the framework, as will be explained in the following section.

3.8.2 Coding the data

To interpret the collected data, I made a preliminary analysis of the salient issues in the four demonstrator interviews using the *Open coding* functionality in AtlasTi (version 5). This process left me with 100 preliminary codes that provided focus and direction for the remainder of the data analysis task. I used the *Link to Code* functionality to code the remainder of the data. During the process of coding the data the list of initial, tentative categorisations was refined and collapsed until I was eventually left with 32 codes that I have listed in table 3.5.

My next step was to generate code families, each representing one of the propositions in the analytic framework (table 3.4 above). Code families were named according to their position on the analytic framework matrix: for instance the code family named *Alignment-Mutuality* relates to the proposition located where the (horizontal) *Alignment* band intersects with the (vertical) *Mutuality* band on the matrix. Thus, the proposition *Clear definitions of the roles, norms, codes of behaviour, shared principles, and negotiated commitments and expectations exist and are upheld in the community* represents this code family.

The final step was to link the 32 codes with the code families generated previously. Table 3.5 shows the 9 code families with the framework propositions they represent and the codes to which they link.

Table 3.5: Code families, propositions and linked codes for analysis of the qualitative data

Code family	Proposition	Codes	
Engagement-Enterprise (EE)	Demonstrators identify the gaps in their (and their students') knowing and work (together) to address them.	confidence confusing the students empowering students focus on the procedural helping students address gaps how demis see knowledge	importance of training learning from each other learning from previous generations learning from students learning from the lecturer
Engagement-Mutuality (EM)	Events and interactions exist that provide for discussion of issues and development of trust amongst demonstrators, students and the lecturer.	coherence in the community importance of training learning from the lecturer	opportunities to interact with other demis relationship: demis and dept relationship: demis and students

Table continues on following page.

Code family	Proposition	Codes	
Engagement-Repertoire (ER)	A shared demonstrating experience has accumulated with potential for further development.	coherence in the community demonstrating practice early community demonstrator experience	learning from previous generations novice vs. experienced demis
Imagination-Enterprise (IE)	Visions of the potential of the community inspire participation amongst demonstrators.	coherence in the community demi as role model demis reflecting, taking a stand	empowering students giving back postgrad community issues
Imagination-Mutuality (IM)	Demonstrators know about the meanings that participation in the laboratory makes in their and their students' lives.	demi as role model empowering students giving back	learning from students meaning / reasons for demonstrating money
Imagination-Repertoire (IR)	There is a language that speaks about the community in a reflective mode.	coherence in the community demis reflecting, taking a stand	how demis see knowledge reflecting on student experience
Alignment-Enterprise (AE)	Demonstrators have articulated a shared purpose; they subscribe to it, and feel accountable to it. Leadership is distributed in the CoP.	clear roles and commitments coherence in the community defining Thandeka's role leadership issues	
Alignment-Mutuality (AM)	Clear definitions of the roles, norms, codes of behaviour, shared principles and negotiated commitments and expectations exist and are upheld in the community.	clear roles and commitments postgrad commitments postgrad community issues	
Alignment-Repertoire (AR)	Methods, standards and routines exist to define good demonstrating practice, and these are upheld and transmitted to new generations.	change takes time defining Thandeka's role demonstrating practice early community focus on the procedural	gaining access to the community learning from previous generations novice vs. experienced demis structure and standards

Some codes linked to more than one proposition, for example: the code which I have named *coherence in the community* could be argued to link with five code families namely:

1. Engagement-Mutuality: *Events and interactions exist that provide for discussion of issues and development of trust amongst demonstrators, students and the lecturer;*
2. Engagement-Repertoire: *A shared demonstrating experience has accumulated with potential for further development;*
3. Imagination-Enterprise: *Visions of the potential of the community inspire participation amongst demonstrators;*
4. Imagination-Repertoire: *There is a language that speaks about the community in a reflective mode;* and

5. Alignment-Enterprise: *Demonstrators have articulated a shared purpose; they subscribe to it, and feel accountable to it. Leadership is widely distributed in the CoP.*

3.9 Ethical issues

I am employed by the university at which the study took place, but I am enrolled at a different university for my doctoral study. This meant that I had to satisfy both universities' ethics requirements in terms of ensuring informed consent, anonymity and confidentiality for the participants of the research. My ethics statement is attached as Appendix 3.14. I also obtained consent from the Research Office at the University of the Western Cape to use the real name of the institution in reporting the research.

I provided information about my research project as an introduction on all the paper-based research instruments (see Appendices 3.7, 7.1 and 7.2) and started every interview and the focus group discussion with a brief verbal introduction to the project during which I also stated my commitment to ensure anonymity and confidentiality. All participants signed consent forms (Appendices 3.15a and 3.15b) prior to their participation.

I wish to address here also the issue of accountability. In line with the tenets of the critical paradigm my research had the universally accepted responsibilities of furthering existing theory and contributing to my own learning, and empowerment of the demonstrator community. Indeed, in the context of a developing country such as South Africa, the many varied responsibilities of research have been argued (Adler & Lerman, 2003) to include among others the researcher and his or her community, and the public. I attempted to remain mindful of these issues throughout the research project. The research undertaken in this project has afforded all participants opportunities to reflect on their own practice and learning, as well as providing me with opportunities to produce research output such as conference papers and a manuscript for publication. Demonstrator-participants have benefited from the workshops and training experiences that have formed the basis for the planned intervention, and future generations of demonstrators will continue to benefit from these and from improvements to the program informed by this research. UWC has benefited from the development of a training program for demonstrators. In addition I have presented and will continue to present my findings at institutional colloquia and will present a copy of my thesis to the Directorate for Postgraduate Studies.

As indicated earlier, one anticipated indirect benefit from the project is the improvement of the quality of learning in the Chemistry laboratory which has been identified as an area of scarce skills and great importance for the future supply of scientists to the South African economy.

3.10 Quality of the research data

Qualitative methods such as those used in this study explore behaviours, experiences, interpretations and meanings in social situations, as expressive of deep-seated values and beliefs (Marshall & Rossman, 2006) that are by definition highly subjective in nature. The researcher has a duty to persuade his/her readers of the quality of the research, and the notions of validity and reliability are often used in discussions of this nature. Both terms have a multitude of different interpretations depending on the research paradigm adopted, and in the qualitative paradigm credibility and trustworthiness are sometimes used as synonymous descriptors of research quality (Lincoln & Guba, 1985). The following paragraphs outline the quality considerations that I built into my own study.

3.10.1 *Validity*

Kvale (1996: 240) defines validity simply in terms of “quality of craftsmanship in research”; describing it in practical terms as knowledge claims that are defensible, made by researchers who are credible and skilled. This author outlines three aspects of validation, namely checking, questioning and theorising.

Validation as checking refers to the process of infusing control checks into every step of the research process, rather than somehow tagging it on to the end of the research process as a kind of final verification. In my own verification of the qualitative findings of my research I used some of the tactics recommended by Miles and Huberman (1994), including: checking for representativeness as well as for extreme or outlying results, using data-triangulation, method-triangulation and informant-triangulation, asking for feedback from respondents and being reflexive about alternative explanations and possible researcher effects. By combining a number of methods, and by offering participants access to their interview transcripts, I aimed to improve the quality of the research data and achieve mutual confirmation of interpretations (Cohen *et al.*, 2000). All of the research was conducted in English. I considered this appropriate as the medium of instruction at the institution of the study is English. Many of the research participants were not English First Language (EFL) speakers, but were sufficiently fluent in the language that we could communicate effectively. Non-EFL persons often express themselves in unique ways that an unaccustomed EFL listener may experienced as idiosyncratic and difficult to understand (Linnegar, 2009). I conducted all the interviews and the focus group discussion myself, and would often ask confirming questions whenever I was not quite sure of the meaning of a participants answer to a particular question. The following short excerpt from my interview with Thandeka is an example. I was asking about the qualities required in the demonstrator who would be Thandeka’s second-in command.

Karen: ...So what are the qualities that you looked for when you chose them?

Thandeka: Somebody who is not ... who can talk.

Karen: Can communicate?

Thandeka: Somebody who can communicate. Somebody who can stand up to everybody, not afraid of ... [long pause].

Karen: (To) assert himself?

Thandeka: Exactly.

(D-In-02-08, 2008)

All demonstrator and lecturer participants were offered the opportunity to review the transcripts of their interviews. All except the focus group demonstrators expressed an interest in reviewing their transcripts, and I sent electronic copies to each one. All participants confirmed receipt of their transcripts, either verbally or by return e-mail, but suggested no changes to the documents. I accepted this to mean that they were satisfied that their responses to the research questions were accurately reflected in the interview data.

Validity as questioning refers to matching the research process to the content and purpose of the investigation; the type of questions posed to research texts determines how they should be read. According to Kvale texts may be read *experientially* (questioning interviewees' deeper understandings of a certain issue), *veridically* (investigating interviewees' knowledge or information about a certain topic or issue), *symptomatically* (questioning interviewees' reasons for responding in a certain way) or *consequentially* (addressing the consequences of interviewees' beliefs about a certain issue). In the interviews and discussions that provided my research data I tried to phrase my questions in language from the demonstrators' (most of whom were not English First Language speakers) own frame of reference rather than using terms relating to the constructs of the theoretical framework. I did not for instance ask "What are the visions of the potential of the demonstrator community that inspire you to participate in the demonstrating programme?" (see *Conceptual framework for the research*, paragraph 2.6.3). Instead I asked about their experiences, views, attitudes, approaches, ambitions and motivations, and in the *reading* of the ensuing research texts found answers to my questions. This required repeated readings of the transcripts, and in some cases alternating the use of all four reading techniques in order to arrive at and find confirmation for the meanings that I was seeking.

Validation as theorisation refers to considering theoretical conceptions about the nature of the phenomena investigated. According to Kvale (1996: 244)

"deciding whether a method investigates what it intends to investigate involves a theoretical conception of what is investigated."

I have provided a detailed articulation of the theoretical framework for this study (chapter 2), and structured my analysis of the research data (reported in chapters 4 and 6) according to the framework. Throughout the analysis I have attempted to heed Robson's (2002) warning of the dangers of not considering alternative understandings of the data. I found that repeated reading of the texts and alternating my reading technique (as described in the previous paragraph) helped me to be more sensitive to data that was not consonant to the theoretical framework.

3.10.2 *Reliability*

The process of meaning-making is by nature highly interpretive and this may pose threats to the reliability of qualitative research findings. "Reliability pertains to the consistency of research findings" (Kvale, 1996: 235) and as is the case with validity, many different interpretations of the term apply to different contexts. Lincoln and Guba (1985), for instance, construe the notion of reliability as dependability, and for them this involves identifying acceptable processes of conducting the enquiry in such a way that the results are consistent with the data. Credibility checks that have been proposed in the literature (Miles & Huberman, 1994) include consensus, auditing, respondent validation and triangulation, and incorporation of as many as possible of these checks is recommended to demonstrate credibility of findings. I asked a colleague (a physics education specialist) to act as inter-rater to assess the degree of correspondence of her categorisations of selected excerpts of research texts with my own. There was a high degree of correspondence between our respective classifications, which I took to reflect the reliability of my findings. I have appended an 'audit trail' comprising samples of instruments, transcripts and other textual data to this thesis to document and justify the particular interpretations that I have attached to my research data.

3.10.3 *Reflexivity*

Reflexivity refers to "an awareness of the ways in which the researcher as an individual with a particular social identity and background has an impact on the research process" (Robson, 2002: 172). My position in the study has received some attention in chapter 1 (*Positionality and the researcher*, section 1.7) but warrants revisiting here. As an academic staff member in the chemistry department where the demonstrator community was being studied, I was by default afforded a position of authority with respect to the demonstrators. When I assumed charge of the first-year laboratory course some 18 months after the commencement of the study, my position acquired dimensions of control and mentorship over the demonstrators, since my duties now included coordinating all aspects of the practical course. I was aware that this position of power (McNiff & Whitehead, 2006) had the potential to create tensions with my primary role of researcher and co-participant in the study.

Internal validity concerns such as reactivity effects on the data (Cohen *et al.*, 2000) should be minimal as demonstrators were accustomed to my constant presence and active involvement in

the laboratories. As mentioned, methodological triangulation was used to ensure further internal validity. Survey data is largely unaffected by power issues owing to their anonymous nature (Robson, 2002). The same applies to the interview with Paki but for another reason altogether: the interview took place when he was no longer associated with the first year laboratories and therefore beyond the power relationship.

To minimise the sense of being scrutinised so often associated with the capture of video footage (during laboratory observations), the services of an independent videographer was used. Students and demonstrators soon became accustomed to his presence in the laboratory. He was instructed to capture the activities of the demonstrators in the laboratory as unobtrusively as possible, and for the most part demonstrators endured this with good grace. However, quite often demonstrators would actively try to avoid the camera's gaze as reflected in the following quote from my own laboratory observations:

The cameraman comes to have a chat with me and (Thandeka) comes over and asks to see some of the footage. She is impressed with the clarity of the images, but wonders aloud how the footage will feature in the write-up. I explain as best I can; she then asks the cameraman whether it is difficult to follow the demis around with the camera. He says no, laughs with her then says that, when he is following the "red coats" they sometimes go the other way to try to avoid being filmed.

(R-JN-01-10-08-We-A, 2008)

Another researcher effect to be conscious of when engaging in research involving participant observation is that of demand characteristics. This will be discussed in the section that follows.

3.10.4 *Demand characteristics and negotiating change*

Demand characteristics are at play when participants form an interpretation of the researcher's purpose and they unconsciously modify their behaviour accordingly (Orne, 1962). This meant that I had to be careful not to communicate directly the expected outcomes of the interventions to the demonstrator community, which was sometimes difficult as every intercessionary step had to be negotiated with and motivated to the community.

In the early community, at the start of the study, a culture of "them and us" prevailed between the demonstrators and the department. The department was viewed as the dominant entity, which not only made it difficult for me to win the demonstrators' trust, but also caused them to view any suggested changes to the programme as unreasonable demands on their time. I eventually negotiated changes to the programme with Thandeka, who assumed the role of go-between in the relationship between the demonstrators and the department. I sensed that Thandeka was very protective of this role as she insisted that I should communicate with the demonstrator community through her. In this way I was gradually able, over several demonstrating cycles, to overcome the demonstrators' passive resistance to change and

introduce the intercessionary steps that I had envisioned and that are described in chapter 5. I will expand on the importance of Thandeka's role in subsequent chapters.

3.11 Limitations

3.11.1 Coloured voices

Though it is likely that some Coloured demonstrators' voices may be present in the survey data of this study, I do not have the voices of any Coloured demonstrators amongst my interview and focus group data. The main reason is that the proportion of Coloured students in the postgraduate cohort taking up demonstrating positions was small in the two years during which my data were collected (2007 and 2008). This is evident from table 3.1: in the final year of data collection (2008) five of 23 demonstrators were Coloured, one of 23 was White and the remainder (17 of 23) were African. In the previous year (2007) only 2 of the 17 demonstrators still employed at the end of the academic year were Coloured.

In hindsight I feel that the inclusion of at least one Coloured demonstrator in the sample chosen for qualitative data collection would have been judicious, especially in light of the fact that the university has a history of having originally been founded as a 'Coloured' institution. However, I suspect that the unintended exclusion of Coloured demonstrators did not have a significant impact on the research findings, as none of the research questions focused on demographic differences in the demonstrator community. The unit of analysis in this study was the demonstrator community as a whole, and the inclusion of a white demonstrator in the sample may have been sufficient representation of the non-Black minority.

3.11.2 Access to findings

Since an underlying motive of the study was to support and engineer change, I had intended all participants to have access to the research findings (Heller, 1986). The likelihood of change tends to be greater under conditions that allow participants involvement in the research process (Fullan, 2001; McNiff & Whitehead, 2006; Morrison, 1998). My intention was to also involve the demonstrators in the analysis process; managing the process as a collaborative effort between myself and the participants. This approach is considered (Mouton, 2001) to enhance construct validity, which refers to how closely the methodology is able to reflect participants' actual experiences and constructions of the situation being researched. In practice the intended co-research relationship with the demonstrators proved difficult to achieve. The demands of their own research (Luft *et al.*, 2004) necessitate that senior students only expend time and energy on activities that are either related to their own studies, or have some form of remuneration attached. I did however use every possible opportunity to discuss and share my interim

research findings with the demonstrator community, informally in conversations and formally during demonstrator training and at departmental seminars.

In this chapter I have attempted to provide an account of how the research projected unfolded, fore-grounded against my choice of research design and data collection methods for the study. In the three chapters that follow I will use my research data to characterise the demonstrating practice in the demonstrator community before (chapter 4) and after (chapter 6) the intervention that was implemented to transform the practice. The latter will be sandwiched in between the two characterisations as chapter 5.

University of Cape Town



Chapter 4

Demonstrator participation in the early community

This chapter is devoted to the characterisation of demonstrating practice in the first-year laboratories around the time this study commenced.

4.1 Introduction

This chapter reports on the demonstrating practices that prevailed in the first-year chemistry laboratories at UWC at the start of this study. I will commence with a justification of the choices I have made with respect to reporting style and data sources used. The reader is then introduced to the three main characters in a story that unfolds as two vignettes. Their actions and experiences, described in narrative style, are intended to allow the reader a glimpse into the first-year laboratories as they were experienced by the community that populated them at, and shortly before, the onset of the study. The discussion that concludes the chapter serves to amplify the main points brought up in the narrative, using constructs from Wenger's communities of practice work (Wenger, 2000) as theoretical tools to frame and characterise demonstrator participation.

4.2 Constructing a narrative

Narrative writing in the context of qualitative research has been described as using prose texts to present research findings in the form of stories told about and by the research participants (Lelliott & Pendlebury, 2009). Zeller (1995) considers narrative-based writing models especially pertinent to case reporting because of their resonance with human experience and inherent comprehensibility. This author describes narration as "the kind of discourse that answers the question, 'What happened?'". The question I am attempting to answer in this chapter as regards demonstrating practice in the early community is: "What was it like?" or more specifically: "What was happening in and around the laboratories at that particular time in the history of the community?"

In constructing the narrative I have given consideration to seven guidelines suggested by Polkinghorne (1995), cited as follows by Lelliott and Pendlebury (2009):

1. Attention should be given to the cultural context in which the story is set.

2. The main characters in the story should be clearly described in terms of how they are embodied. I took this to mean they should be personalised and concretised, so that they seem like real people even if this is not strictly the case.
3. Relationships between the people in the narrative should be clearly explained, especially in terms of how these relationships impact the plot.
4. The narrative should concentrate on the interactions (choices and actions) of its central character(s).
5. The narrator should be able to relate the actions of the main character(s) to their past experiences.
6. The narrative should be time-bounded and contain enough detail to convince the reader that it is a unique description rather than an account that has been synthesised from a series of observations of different people.
7. The story woven from the analysis must be credible and comprehensible.

In the narrative I present, an afternoon laboratory session provides the contextual backdrop for a characterisation of the practice that prevailed before the implementation of any changes to the demonstrating program. The cultural context called for by Polkinghorne's first guideline is closely related to the institutional context of this study and one that should be familiar to South African readers: a historically black university (HBU) predominantly serving African and Coloured communities. As a consequence the majority of demonstrators in the study are members of these population groups. The three central characters in the narrative are embodied as African chemistry students enrolled at the institution. Two are postgraduate students of which one is female; the third is a male student in his third year of study. One or more of the characters could as easily have been from another ethnic group. The survey data used to corroborate the main themes issuing from the narrative included contributions from the entire demonstrator cohort at the time, which included individuals from both ethnic groupings.

Techniques recommended for narrative development (Zeller, 1995) include (i) *scene-by-scene construction*, (ii) *characterisation through ample use of dialogue*, (iii) *point of view* (referring to experiencing an event from the perspective of one of its participants), (iv) *full rendering of details*, (v) *interior monologue* and (vi) *composite characterisation*. What follows is an attempt to show the relevance of these techniques to a narrative description of demonstrating practice, while at the same time giving consideration to the remainder of Polkinghorne's guidelines.

The story of what was happening in the laboratories at the time is told in two anchoring vignettes (or scenes) that offer the reader a snapshot of demonstrator participation at the start of the study. They describe the actions, conversations and reflections of three demonstrators as they go about their demonstrating duties during a typical laboratory session on an afternoon

during the second semester and give relevance to the techniques relating to *character development through dialogue, point of view and inner monologue*. The guideline relating to *interactions of the central characters* from Polkinghorne's list applies here.

Full rendering of details refers to detailing of the 'status life' (rank, interrelationships) of the main character(s) in the narrative, and links with Polkinghorne's requirement for *clearly defined relationships*. The reader will soon be introduced to the three main characters featured in the vignettes. The respective positions (or ranking) of the trio in the demonstrator hierarchy is of special relevance in the narrative since one of the issues that is highlighted by the analytic framework of this study is the transfer of demonstrating experience across generations. This and other issues will be further explored in the discussion that concludes the chapter.

The main characters' past experiences (guideline 5) are of special significance: almost all the demonstrators in the community were once students in the laboratories where they are now demonstrating. They draw on their own experiences as students and their recollections of their interactions with those who were demonstrators at the time when making choices about the appropriate ways of interacting with students in their charge.

My objective with this narrative is to convince the reader that the early demonstrating community has an understanding that learning in the laboratory is a mutual enterprise with students learning from demonstrators and vice versa. Demonstrators have their own ideas about what students need to know and have strategies for helping students to develop this knowing. Although they are learning from the accumulated experience of previous generations of demonstrators, few methods, standards and routines exist to define good demonstrating practice in the laboratory.

All the issues illuminated by the narrative are based on real events and actual data. One pivotal event affects the demonstrator community around the time represented by this case study and this provides a focal point for the narrative. The demonstrators engaged in industrial action following polarisation of the relationship between the demonstrators and the department. This event happened some months before the time described here, and our protagonists reflect on it during the narrative. The first issue to emerge around the event is mutual distrust borne of a lack of communication and understanding. The second is how not only the demonstrators' own postgraduate experience, but also the learning experience of their students, is affected. Lastly, and importantly, the demonstrators' discussion of the event serves to highlight how a negative experience mobilises the community first into reflection and then into action, providing evidence of the community's awareness of its own potential and worth.

4.2.1 *Retrospective nature of the data*

In the interest of presenting a balanced report, I have attempted to capture demonstrating practice as it was experienced by all those associated with the first-year chemistry laboratories. In addition to the voices of selected demonstrators, we will be hearing from the students and academic staff sharing the laboratory experience. The main data sources used to construct this case study are transcripts of interviews with two demonstrators that I have named Paki and Thandeka. I will also draw on my own journal notes and strands from focus group discussions with demonstrators, as well as some data from student surveys.

All the data sources, with the exception of my own journal notes and the student survey data, were collected well into the study rather than at the time that is described here. This came about because initially none of the demonstrators were willing to be part of the study, which also explains the paucity of data from this period. It took a considerable length of time for me, as a new academic staff member in the department, to gain entrance into the community. The distrust with which the demonstrator community regarded the department at the time, details of which will emerge from the narrative, provides some explanation for this.

By the time Paki completed his PhD we had been colleagues for a period of three years; he was one of the valued and experienced tutors in the first-year chemistry course I taught at the time. I took advantage of the fact that he was preparing to leave the department and approached him for an interview. Only once his degree had been awarded, did he feel comfortable to express himself about his experiences as demonstrator and tutor in the department and agreed to be interviewed. He explains his reasons for participating in the research in the following quote:

You know I came to this interview as well because I know maybe now I will not demonstrate again or tutor again. But over the years I always felt that sometimes you need to get information from the people who have been doing the job, and even yourself you also want to have an input to improve the situation. But demonstrators have never been given that opportunity. You see as people we have our wishes more than working for money, we also want to contribute in something, so with this interview maybe I hope I contributed.

(D-In-01-08, 2008)

This interview opened the door to other demonstrators agreeing to participate, and my data collection was finally fully under way, albeit some time into the study.

4.3 Three protagonists

The three central characters in the narrative have been chosen to represent the three main levels of hierarchy in the demonstrator community. Paki and Thandeka are actual persons, and will be the main focus of this narrative while Mncedisi is a composite character woven from several undergraduate demonstrators. Zeller (1995) identifies composite characterisation as one of several techniques from the so-called “new journalism” style of writing made popular by

Tom Wolfe and others from the same genre that is particularly useful in narrative writing. Lelliott (2007) illustrates the use of a composite portrait in his narrative analysis of elementary school learner Tlotlo's experience of a school visit. This author argues that Tlotlo's story is unique and at the same time representative of his classmates' experiences of the visit. In a similar fashion I have opted to weave the experiences of several individual demonstrators (as they present in the data) into Mncedisi's character in the hope of creating a story that is a truly representative description of the prevailing demonstrating practice. As is the custom in social research, all names have been changed to protect participants' identities.

The first protagonist to be introduced is Thandeka. She is the "superdemonstrator" at the top of the hierarchy; a postgraduate student who has been formally appointed to handle all the administrative duties associated with the first year practicals. She has some workplace experience outside of academia and is in her mid-twenties. Thandeka also has some years of accumulated demonstrating experience, in addition she has assumed a formalised position of leadership in the community and carries considerable responsibility, for which she is paid from the departmental budget. All other demonstrators are remunerated from a centralised work-study budget administered by the university's Directorate for Postgraduate Studies.

The midlevel in the hierarchy is represented by the "old hands", experienced demonstrators nearing the end of their postgraduate studies. Paki, who is in his mid to late twenties, belongs to this group. His PhD studies are coming to a close and he has been a chemistry demonstrator and tutor for a number of years. He has experience not only of demonstrating practice at UWC, but has been involved in demonstrating as a postgraduate student at two other South African institutions.

Finally the composite character, Mncedisi, represents the third level in the hierarchy, namely the intake of novice demonstrators that replenishes the community when graduating members leave at the end of each academic cycle to assume positions in the workforce. Mncedisi's character is based on the experiences of several demonstrators from the same rank. He is in his early twenties and is currently completing his third year chemistry modules. We will not hear his voice but will see him moving about in the laboratory as he goes about fulfilling his duties. His actions reflect laboratory observations as chronicled in my own journal notes at the time.

Both Mncedisi and Thandeka will feature again in chapter 6, when we revisit the community towards the end of the study.

4.4 Vignette 1: Thandeka – "She is loved"

The first-year chemistry students are slowly making their way from the lecture hall where the pre-practical information sessions to the laboratories are presented. It is 14:30 and they have just attended a half-hour long pre-practical information session, or *pre-prac talk*, led by Mr.

Smith, the part-time lecturer tasked with presenting the practical sessions. He usually gives them an overview of the practical session and demonstrates any new techniques or the use of new apparatus that they will need for the afternoon's practical work. The procedure was slightly different during the first semester during which a different lecturer from the Chemistry Department performed the pre-prac talk each week.

Once in the laboratory, the students move to their benches and start preparing their notes and apparatus. Thandeka waits until they are all settled then makes a few procedural announcements. In the first semester she used to lead the students through the first few practical sessions in a step-by-step fashion, patiently waiting until everyone had caught up before moving on to the next step, almost like the conductor of an orchestra.

Thandeka is experiencing a busy afternoon, seeing to eighty odd students in the laboratory. In the main, she is dealing with the students' immediate needs, organising items of glassware that are missing from some of the lockers, and answering students' questions about procedural issues, some as trivial as where to find a particular reagent. She spends almost all of her time in the laboratory interacting productively with the students and the other two demonstrators, Paki and Mncedisi, who are also fully occupied. At times it seems as if the three of them are never going to reach all the students who have raised their hands for help.

Thandeka has been a demonstrator for a relatively short while, just 18 months or so, and was recently appointed to the position of practical administrator. It has been a challenge for her to find her feet because her predecessor (also a part-time postgraduate student) had left the job without leaving clear instructions and Thandeka has had to reinvent administrative structures and demonstrating procedures "from scratch". Not surprisingly, none of the other demonstrators wanted the job. Thandeka's experience as a junior manager in industry, where she worked for two years after finishing her chemistry honours degree, stands her in good stead. Her experience of working with people has taught her that it is important to be strict, organized, and to communicate clearly in order to do the job well. Her directness and no-nonsense attitude is often misinterpreted as rudeness by the students. In time she will develop a softer and more empathetic approach to students and she will become, in her own words "the tutor to the students, the sister to some of them, the doctor..."

Thandeka has a clear sense that problem-solving abilities and strong support are other important factors that are contributing to her success in the job. And successful she certainly is, because she is well on her way to completing her master's degree within the required time of two years¹. Perhaps she would have thought twice about taking on the role of practical administrator had she known exactly what it would entail. She was never given a job description

¹ Thandeka remained in the position for 5 years during which she completed not only her master's degree but also a PhD in chemistry. She was appointed as chemistry lecturer at a university in another part of the country shortly before the end of the study.

or list of duties and initially thought that it was going to be an easy job: assigning lockers, general administrative duties associated with the practicals and the like. Very shortly after her appointment she found herself recruiting demonstrators, and matching them up in the laboratories to capitalise on their shared and accumulated demonstrating experience. She has also become much more involved with the students, assisting and advising them on different levels. In time her influence will extend to advising the departmental head on recruitment and remuneration practices, and we will catch up with her again later when we study the community after certain changes have been implemented to develop and improve demonstrating practice in the department.

4.5 *Vignette 2: The old and the new*

Paki is walking to the laboratory with the group of students returning from the pre-prac talk. He attended the talk, but most of his demonstrator colleagues were absent and will probably be joining the group in the laboratory later. He remembers a time when the demonstrators were sometimes expected to give the pre-prac talks. At that time the academic staff in the department took charge of the first-year practicals collectively and rotated duties on a weekly basis according to a roster created by the HoD. Some lecturers would take care of the pre-prac talks themselves, but some preferred to leave the demonstrators in charge. No standard procedure existed, and the demonstrators received no written instructions. They would often herd the students from all four first-year laboratories into one laboratory and one demonstrator would introduce the practical session to the students. The next week it would be the turn of another demonstrator to “do the pre-prac talk”. Sometimes the demonstrators would repeat the pre-prac talk once the lecturer had left the laboratory, because the students often felt more comfortable directing their questions about the practical to the demonstrator, rather than to the lecturer in charge. Their focus would then be on procedural issues, in contrast with the more theoretical focus of the lecturer’s presentation.

Mncedisi, the third demonstrator assigned to the laboratory with Paki and Thandeka, arrives a few minutes late. With only a semester’s demonstrating experience, he is a relative newcomer and in the third year of his Chemistry degree. He was lucky to be appointed; this year there has only been enough money to offer demonstrating positions to the postgraduate students in the department. When Thandeka allocated demonstrators to the laboratories at the start of the academic year she placed Paki and Mncedisi together, reasoning that Mncedisi as newcomer would benefit from working with an experienced demonstrator such as Paki. In the absence of formal demonstrator training, this is the only way in which Mncedisi will learn the ropes.

Once in the laboratories the students busy themselves with their practical work. After the first rush of student appeals for help has abated, Paki and Mncedisi make themselves comfortable.

Mncedisi is sitting on the workbench on the side of the laboratory and Paki leans against it. Mncedisi is peering at his mobile phone, his thumb moving quickly over the keys. Deep in text conversation, he does not notice that several students have raised their hands trying to attract his attention. Paki glances over the laboratory and notices that help is needed. As he prepares to go over to the closest student needing assistance he realises that he does not really know any of the students by name. It is difficult for two or three demonstrators to see to the needs of up to 80 students in one laboratory. It seems that the interactions seldom go deeper than procedural issues, because at times the demand for assistance is simply too high. He has heard that one of the complaints from students in the end of semester course evaluation was that there are not enough demonstrators.

Later, Paki and Mncedisi are chatting; Paki is telling Mncedisi about the time last year, when the department unexpectedly announced that demonstrators would henceforth no longer be paid for their services, since demonstrating was regarded by the department as part of the training of postgraduate chemistry students. Mncedisi was not demonstrating at the time but had heard through the grapevine that the demonstrators had gone on strike as a result of this ruling by the department. Paki recounts his recollection of the event: he explains that there was not actually a strike, even though this was how it was perceived by the department. The demonstrators did not stay away from practicals because they were told that staying away from practicals would affect their registration. Even though they were not quite sure what was meant by this statement, it sounded to them as if it could be a threat, and they decided not to take chances. They attended the practicals but did not assist the students. Technically they had staged a sit-in. Within a week the situation was resolved to the apparent satisfaction of both parties, but the trust relationship between the department and the community of postgraduate demonstrators had suffered serious damage.

Paki concludes his account and heads towards a student who has her hand up. For a while he proceeds to systematically assist those needing help. Since the students complained to their lecturer that the demonstrators do not seem motivated; that they are present in the laboratories without really seeming to want to be there or help the students, Paki has been trying to make more of an effort. Apparently students become especially frustrated when, in answer to their procedural queries, demonstrators send them away with what is perceived by students as one of their standard responses: "Go read your manual". Personally, Paki feels that the students can be very demanding, and will ask the demonstrators for help on even the most trivial of aspects before trying to figure things out for themselves. Some of his demonstrator colleagues can become very irritated when students come to the practical sessions unprepared and ask "stupid" questions. Just the other week he heard one demonstrator say to a student: "You are supposed to know that." Paki noticed that the student did not ask any more questions after that.

The students have their own interpretation when the demonstrators brush them off, or imply that they (the students) should come to the lab knowing everything there is to know. They see these and other unhelpful or condescending responses as evidence of the demonstrators being unprepared for the practical sessions, which leaves them (the students) feeling insecure, unsafe, at risk, and frustrated.

Mncedisi walks back into the laboratory after being away for the best part of 30 minutes. He has been in the adjacent laboratory where the same practical session is being conducted. His friend who demonstrates in the other laboratory called him to come and see her holiday photos. They were paging through her album and chatting about her holiday for quite some time, only stopping to resume their demonstrating work when the students started to complain.

After a few more minutes of helping students, the two demonstrators drift towards the front of the lab. Paki seats himself on an empty bench, and Mncedisi leaves the laboratory, even though the students are far from finishing their practical work. Paki looks at his watch and wonders when the last student will finish the experiment so that he too can get back to his own work. He has been so busy of late that the demonstrating has become somewhat of a nuisance. On the one hand the demonstrators are left to run the practical sessions, which means they must somehow be trusted with the job. Some staff members of the department have commented, however, that the demonstrators “are useless and get paid for doing nothing”. Remarks such as these strengthen demonstrators’ perception that there is a divide between the academics and the postgraduate community. This is coupled to the tension created by supervisors’ expectations for the demonstrators, who are also postgraduate students, to focus on their own research goals. As a result of these factors the demonstrators do not always attend the pre-prac briefings and are sometimes unprepared, even though they are aware that the students find this frustrating.

4.6 Discussion

4.6.1 Modes of belonging

The characterisation of demonstrating practice that follows will focus on the three modes of belonging, *engagement*, *imagination* and *alignment*, proposed by Wenger (2000) for capturing different forms of participation within communities of practice. These constructs have been developed in chapter 2, but in the interest of ease of reference, a brief explanation of each is given:

Engagement refers to interactions that shape our individual experiences of who we are within the community and during which we learn how the community responds to our actions.

When we belong to a community we construct an *image* of ourselves within the community and develop a sense of self and a personal interpretation of our own participation.

Alignment of our activities with other processes, perspectives, interpretations and actions within the community produces synergy for the realisation of higher goals.

4.6.2 Framing the analysis

In chapter 2 three elements with which to describe competence within a community of practice were introduced. They are joint *enterprise*, *mutuality* and shared *repertoire* (Wenger, 2000) and their meanings in the context of the study were discussed in section 2.6.2.1 (*Dimensions of progress in a CoP*). I proposed an analytic framework for analysis of the research data that combines these constructs in a tabular matrix that allows interaction between each of the modes of belonging with each of the dimensions of progress. The matrix first appeared as table 2.1 and for ease of reference I have re-inserted it below as table 4.1.

Table 4.1: Analytic framework for analysing the narrative

Modes of belonging	Enterprise (1) (learning energy)	Mutuality (2) (social capital)	Repertoire (3) (self-awareness)
Engagement (E)	E1: Demonstrators identify the gaps in their (and their students') knowing and work (together) to address them.	E2: Events and interactions exist that provide for discussion of issues and development of trust amongst demonstrators, students and the lecturer.	E3: A shared demonstrating experience has accumulated with potential for further development.
Imagination (I)	I1: Visions of the potential of the community inspire participation amongst demonstrators.	I2: Demonstrators know about the meanings that participation in the laboratory takes in their and their students' lives.	I3: There is a language that talks about the community in a reflective mode.
Alignment (A)	A1: Demonstrators have articulated a shared purpose; they subscribe to it, and feel accountable to it. Leadership is distributed widely in the CoP.	A2: Clear definitions of the roles, norms, codes of behaviour, shared principles and negotiated commitments and expectations exist and are upheld in the community.	A3: Methods, standards and routines exist to define good demonstrating practice, and these are upheld and transmitted to new generations.

The aims of this study centre on what and how the demonstrator learns in the laboratory. For this reason I have chosen to structure the remainder of the discussion according to the three modes of belonging (engagement, imagination and alignment, on the vertical axis) rather than the dimensions of progress (on the horizontal axis). Each mode of belonging will in turn be

discussed according to the three propositions originating from interaction with each of the dimensions of progress. Each of the propositions have been awarded a “bin code” referencing its position in the matrix. For instance, the bin code E1 refers to the proposition found on the intersect of the horizontal *engagement* band (row E) with the vertical *enterprise* band (column 1).

4.6.3 *Engagement*

Proposition E1: Demonstrators identify the gaps in their (and their students’) knowing and work (together) to address them.

Thandeka and the other demonstrators repeat aspects of the pre-prac talk before students begin their practical work. They do this because they understand students’ need for procedural details that the lecturer tends to gloss over or leave out during the pre-prac briefing. In the following quote Paki explains that the lecturer’s focus tends to be on theoretical aspects of the experiment. The demonstrators feel the need to fill in the gaps (or in Paki’s own words “the exact”), referring to procedural issues such as changes to the practical. This practice has a second function: Paki explains at the end of the following quote that it signals to students that they can communicate with the demonstrators; it is as if they are officially inviting students into the conversation at the start of the practical session:

Paki: Some (lecturers) will come and do the pre-prac talk themselves, and then you will re-give the pre-prac to tell the students again...

Karen: On the next day, in the next session?

Paki: In the same session, to get them started. You know normally the person would come and give an overview of the experiment, sometimes some they will also relate it to the theory. And then you will give the exact, if there are any changes about the experiment you will announce them during your pre-prac talk, because the students would be left with you. So we thought it is good that after the lecturer has presented you also talk so that they know that if they have questions they will communicate with you.

(D-In-01-08, 2008)

Paki understands that, in order to become independent, students need to figure things out for themselves rather than be spoon-fed with an answer. This is his rationale when he tells them to “go read the manual”. Experience has taught him that demonstrators can easily be drawn into doing too much for some students at the cost of the students’ independence. His frustration when students keep asking questions that are answered “right there in the manual” is probably all too familiar for those who have been in a supervisory position in an undergraduate laboratory setting. Faced with this situation, demonstrators often interpret students’ inability to make sense of the manual as laziness, when in actual fact access to text, offered in what for students would

be a second or third language, poses well-recognised challenges (Johnstone & Selepeng, 2001; Rollnick, 2000) that demonstrators would not necessarily be aware of.

Thandeka controls the students' activities during the first couple of practical sessions of the year as if she is leading an orchestra. She has some managerial experience gained from a work context outside the university, but she has only been demonstrating for approximately 18 months. A study into the differences between novice and experienced school teachers (Martin & Baldwin, 1993) classified a large sample of school teachers into three categories reflecting their beliefs regarding the degree of teacher power over students. The categories termed *interventionist* and *non-interventionist* represent the two extremes of a continuum and refer to high and low teacher control respectively, with the third category, *interactionalist*, midway between the two extremes (Wolfgang, 1999). In the Martin and Baldwin study novice teachers scored consistently more interventionist, resonating with my own observation that Thandeka, as a relatively inexperienced demonstrator, deems it necessary to control her students' every move during those first weeks. Other demonstrators who are largely disconnected from the students (Mncedisi, when he is ignoring the students in favour of his mobile phone, or Paki, when he refers students to the manual instead of interacting productively with them) may seem non-interventionist or low control.

So, even though the demonstrators have an understanding of what is needed to help the students learn in the laboratory their efforts at facilitation focus mainly on providing (procedural) information and is either interventionist or non-interventionist. These findings suggest that demonstrator training should give attention to the development of a more interactionalist style of facilitation, which should include some focus on the different factors that promote and inhibit students learning in the laboratory.

Proposition E2: Events and interactions exist that provide for discussion of issues and development of trust amongst demonstrators, students and the lecturer.

The trust relationships in the early community are complex and strained. Departmental decisions that affect the early demonstrating community are not discussed with the demonstrators. Rather, a top-down policy holds sway, and out of the blue the announcement is made that demonstrators will no longer be paid for their services but will be expected to demonstrate regardless, as this is now considered a compulsory part of what constitutes their postgraduate training. The demonstrator sit-in (or strike, depending on which viewpoint one subscribes to) results directly from friction on the boundary of the community. Equality between parties is imperative for productive interactions (Habermas, 1984) but the early demonstrator community find themselves disadvantaged by an unsymmetrical power relationship with the department. This strikes at the heart of their postgraduate experience, the very reason they are at the institution in the first place. In the interview Paki uses the term "uneasy" no less than four

times when referring to the relationship between the demonstrators and the department. He explains in the following quote how the ensuing power games affected demonstrators' postgraduate studies. Afterwards the conflict is shelved rather than discussed, and a bitter taste remains:

There is an uneasy relationship, there is no easy communication, so each one gives the instruction to show how powerful the person is, you see. So, there is no clear recognition of each person's role. So, I think that came from that particular strike. To me it did not have any good effect, they didn't take it well, and individually it affected us also in our studies, we didn't get it easy. Although it is not said, but you can see that it comes from that.

(D-In-01-08, 2008)

Wenger (2000: 232) contends that "shared practice by its very nature creates boundaries". Boundaries are important because they create opportunities for communities to interact and for members to be exposed to competences outside of their own community. Boundaries can conversely also create division, leading to the community becoming insular, defensive and "hostage to its history" (p233). The boundary processes end up "merely reflecting relations of power" (p234), reinforcing the boundary between the demonstrator community and the department. Instead of realising the potential of the community for learning from the collective teaching expertise held in the department, the demonstrator community has become closed off and stagnant. Besides being a source of separation, boundaries have potential to be "areas of unusual learning where perspectives meet and new possibilities arise" (Wenger, 2000: 232). The boundary of the demonstrator community is a potential entrance into the community that could be exploited in order to bring about change in the practice of the community. Wenger recommends the promotion of the following elements when attempting to create bridges across communities:

- Brokering; this refers to using key people to act as brokers between communities.
- Boundary objects; this refers to artifacts, discourses and processes that support connections between different processes.
- Boundary interactions; this refers to encounters, practices and peripheries that contribute to creating bridges between communities.

In the following segment from the interview with Paki, he switches from talking about the demonstrators to talking about the postgraduate students in the department. Paki starts talking about the demonstrators, corrects himself, and then continues to talk about the relationship between the postgraduate cohort and the department:

(Demonstrators) still don't have a voice, in fact not necessarily demonstrators, postgrads are not given a chance to voice their dissatisfactions that they are in, like I said there is a big gap

between the ... which makes people to interpret things sometimes in a negative way. That is the problem of the department. It's a problem that creates a very uneasy atmosphere. It's unfortunate.

(D-In-01-08, 2008)

The difference between the two communities is subtle but significant. They are two interrelated and intersecting communities of practice in a larger system of learning represented by the department. In the context of this study the department is best described as a “constellation of interconnected practices” (Wenger, 1998: 127) rather than a community of practice, because at the level of practice different communities, all with their own enterprises, constitute the overall constellation. At the same time as each having its own practice and specific focus, they 1) have related enterprises, 2) serve the same overall mission, 3) face overlapping issues and conditions, 4) have members in common, 5) share tools, artifacts, and discourses, and 6) share the same physical space.

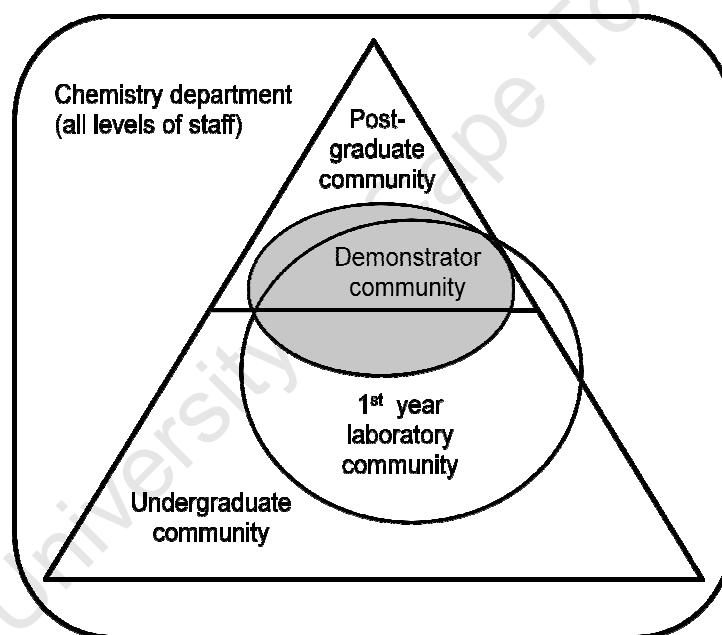


Figure 4.1: Related communities within the chemistry department

Figure 4.1 shows only the different communities relevant to this discussion and how they relate to each other. All chemistry students are represented by the central triangle, with undergraduate students occupying the bottom section and postgraduates the smaller top section. All demonstrators are chemistry students; most (but not all) demonstrators are postgraduates and most (but not all) postgraduates are demonstrators.² Not all demonstrators are allocated to first

² Some postgraduates are tutors but opt not to demonstrate. One reason for this is that practical sessions are longer than tutorials but the pay is essentially the same. Tutorials are more demanding and the more experienced and confident postgraduates usually opt for these positions.

year laboratories; some demonstrate to second and third-year students. The community operating in the first-year laboratories is made up of first-year students, demonstrators, academic staff, technical staff and one or two postgraduates who assist the permanent technical staff on a part-time basis.

Perhaps the switch indicates that Paki identifies more strongly with the postgraduate community than with the community of demonstrators. At the time of the interview he was one of those who had opted out of demonstrating in favour of a tutoring position. There is also the possibility that the switch signifies the spillover of the conflict from the demonstrator community into the postgraduate community, within which the former community is (partly) contained. The spillover has a knock-on effect on relationships with the first-year students which in turn affect their laboratory experience. The following excerpt from my own journal, in which I refer back to a conversation with a first year student, refers to the students' experience of their demonstrators:

(To the students the) demonstrators don't seem motivated; they don't attend pre-prac briefings and are unprepared. This makes the students feel insecure, unsafe and at risk, frustrated and "panicky".

(R-JN-26-08-05, 2005)

The demonstrators are often unhelpful, and some have the attitude of "if you need to ask that question, you shouldn't be here". In the following quote from a focus group discussion a senior student remembers what it was like, highlighting the defensive strategies students resorted to because they felt the need to hide their apparent ignorance from the demonstrators:

Any way, so basically you know, like back then we were like when we were having a difficulty with something then try to ask them and then they tell you, no you are supposed to know that. They were not there to tell you what you are actually supposed to know. Like we had to thoroughly go into the lab knowing like basically everything. Even stuff beyond that, 'cause you didn't know stuff, even when it came to asking a question you had to like ask a question in a certain manner. You didn't really want to show the person that you did not know what was happening. Because they were not really actually approachable and maybe they were there to assist us with a thing or a prac on how to do a prac and all that.

(D-FG-01-08, 2008)

A recent US study (Luft *et al.*, 2004) of a university TA community spanning three scientific disciplines (chemistry, physics and biology) found that TAs had a perception of low student motivation and ability that originated from their current frustrations with their students. It is easy to imagine that a demotivated demonstrator community would be likely to experience an even greater degree of frustration with the students they encounter in the laboratories, and that unproductive interactions such as described above and in the preceding narrative could become commonplace.

In the narrative we also saw how overstretching the demonstrating resource results in impersonal relationships between the demonstrators and the students, and superficial interactions that seldom go deeper than the procedural. In a focus group discussion some senior students were asked about their first-year laboratory experience, which would have occurred around the time described in the narrative. One of the students describes the consequences of having only two demonstrators in the laboratory on a practical afternoon in the following excerpt. He also explains that when a demonstrator (or lecturer) knows his name, it makes him feel more confident, and makes it easier for him to approach that person, and strengthens the relationship.

I still remember that we were about 80 students when we had two demonstrators. And some of us we never had a chance to ask a question because it was hectic in the lab and so basically we had to do our own things by ourselves so it was difficult.

First of all they didn't even know our names, I mean if you don't know your students names, that's something else. You won't have confidence in them and they won't have confidence in you. I mean, if I call you (and) say: "Please come and help me", and you don't know my name, somehow I feel like you want to keep this distance between us. You don't even want to involve yourself. I mean there are questions I would love to ask, but knowing that you are not interested in my life or my studies, it distances me from asking certain questions, because you will think I am stupid, or I will think that I am stupid asking, asking some other questions. So what I suggest is that demonstrators should know their students names and call them by their names. It means a lot. If a lecturer knows my name, you know I really have confidence in myself. It makes it easier for me to approach them.

(D-FG-01-08, 2008)

Another US study (Herrington & Nakhleh, 2003) into TA and student perspectives on what defines effective chemistry laboratory instruction cites affective domain qualities as only slightly less important than knowledge-based qualities and more important than communication qualities, in the eyes of undergraduate students. Student and TA responses from the study highlighted three affective domain qualities of particular importance: (i) concern for the students concern, (ii) wanting and willing to help, and (iii) available and approachable. Students in particular mentioned the importance of "a TA who *cared about them as individuals*, wanted to help them, and was available and approachable". These authors suggest that these issues might all be addressed by demonstrators monitoring and interacting with individual students throughout the laboratory session.

Proposition E3: A shared demonstrating experience has accumulated with potential for further development.

There is evidence of the existence of a shared demonstrating practice in the early community. Paki alludes to this when he refers to experienced demonstrators having an “established style of doing things” that not only the students but also the novice demonstrators learn from:

You know in the role of both of them (demonstrator and tutor) you will need an experienced person with an inexperienced person. Every day the experienced person you need him just because (he) will have an established style of doing things which will also help the student. That's why you need the experienced person because an inexperienced person will also be learning in the process...

(D-In-01-08, 2008)

In the above quote Paki refers to the practice of placing an experienced demonstrator with an inexperienced one, which is well established even in the early community. On the face of it this practice resonates more with cognitive apprenticeship (Collins *et al.*, 1989) than with legitimate, peripheral participation (LPP) (Lave & Wenger, 1991). Both processes can be viewed as guided learning in which the learner learns by doing, but in the former the learning takes place under the mentorship of an expert or master, whereas the latter (LPP) focuses on changing participation and identity transformation in a community of practice. I will return to the issue of transmission of practice to new generations of demonstrators at a later stage.

4.6.4 *Imagination*

The three elements of belonging, engagement, imagination and alignment usually coexist but it is not uncommon for one element to dominate the other two. A community of practice functioning in a work situation characterised by joint activities, such as our demonstrator community, would be based primarily on *engagement*. As an example of a community based mostly on *imagination*, Wenger (2000) uses membership of a nation, arguing that conceptualising one's membership requires an act of imagination, as engagement with all one's fellow citizens would be impossible. In the next section I will explore how demonstrators talk about, reflect on and interpret their participation in the laboratories when I discuss the mode of imagination.

Imagination refers to the process of “constructing an image of ourselves, of our communities, and of the world, in order to orient ourselves, to reflect on our situation, and to explore possibilities” (Wenger, 2000: 227-8).

Three propositions result from the intersection of imagination with the three dimensions of progression, namely:

Proposition I1: Visions of the potential of the community inspire participation amongst demonstrators.

Proposition I2: Demonstrators know about the meanings that participation in the laboratory takes in their and their students' lives.

Proposition I3: There is a language that talks about the community in a reflective mode.

In the previous section we have seen how, following a labour dispute, the demonstrator community's relationship with the management of the department has become characterised by distrust and a lack of communication. Demotivated and feeling undervalued, the demonstrators are often unhelpful towards and disinterested in the students in the laboratory.

Our identities are as much produced through the practices we engage in as through those we do not engage in (Wenger, 1998). As a consequence our identities have elements of both participation and non-participation. Non-participation can be *peripheral*, as in the case of novices who do not yet fully participate in a practice; peripherality is often temporary and may eventually enable full participation. Non-participation can also be *marginal*; this is when non-participation act as hindrance or restriction to full participation. Hence, peripherality is enabling whereas marginality can be considered problematic. Non-participation has become an *active* albeit problematic aspect of the practice of the demonstrator community. Yet, as they engage in this shared practice, their commitment to each other and to their common plight grows. Non-participation transforms into a substantial experience of participation (Wenger, 1998). Together, the demonstrators reflect and discuss on their issues (proposition I3) and realising their potential as a community, unite to oppose what they perceive as unfair treatment on the part of the department (proposition I1), in spite of their concerns about the consequences of their actions for their own studies. The following quote from Paki bears this out:

We talked about (it) as demonstrators, even before we could do what we did. Some of us we were not very much easy about doing it because we foresaw that there could be problems afterwards.

(D-In-01-08, 2008)

So, events in the department have motivated a culture of non-participation that has become an established practice in the early community.

What do demonstrators know about the meanings that participation in the laboratory takes in their and their students' lives (Proposition I2)? As was explained earlier on in this chapter, the reluctance of demonstrators to participate in the study in the early stages means that data from

that period is thin and patchy. The baseline study that was performed around that time was designed to explore student and demonstrator experiences, and did not yield data about the deeper meanings of those experiences. It is possible however to catch a glimpse of the past in the memories of present members of the community. One of the demonstrators from the focus group discussion recalls that his younger self, a student at the time, believed the demonstrators were there to “find things” for the students. His colleague adds that demonstrators had a monitoring function:

Student 1: They were basically doing (the laboratory assistant's) job. I mean if you couldn't find any chemical those are the people you would ask. Like: “Hey, I can't find a certain product” or whatever, and then he will go and collect it for you.

Student 2: They were just there to monitor us to check if we were doing everything right. We don't burn the lab and all that.

(D-FG-01-08, 2008)

I have included the following excerpt from the interview with Paki to try and construct a more detailed picture of what it meant to be a demonstrator at the start of the study. I am not sure how much of what he is saying applies to what he believed then, and how much of it is built on insights that he has accumulated in the meantime. When sifting through memories, it is often difficult to separate old beliefs from new ones, because the old beliefs often cease to exist when they are transformed into the new. Perhaps his ideas are for him both universal and transcending of time; they certainly are long and commonly held (Sfard, 1998). In the excerpt he talks about the importance of demonstrator training, which was not a feature of the practice at the start of the study but had been introduced by the time the interview took place. During this particular part of the interview he had begun to drift off the topic but, mindful of the value of non-directive interview techniques to get at the deeper attitudes and perceptions of the interviewee (Cohen *et al.*, 2000), I let him talk. Demonstrator training is the context of the excerpt, but what is interesting here is his repeated use of the term “knowledge transfer”. There is a sense that to Paki this is the essence of what demonstrating is all about:

If you want the demonstrators to contribute or to transfer knowledge you have to have a way to extract that knowledge from the demonstrators. As an academic staff, if you really want that knowledge to be transferred you have to have a plan to make sure the knowledge is transferred, not force it because if you force the knowledge it cannot come out. You have to have a plan in which it will be able to be useful to the students.

If you train the person ..., tell him how to do it, and not just put him there, and say OK you say you are a postgraduate, you are willing to do this job, then do it. In that way you cannot be sure that the knowledge will be transferred. Maybe the person doesn't know how to deliver the message or to transfer the knowledge to the students. If you train the person he will be able to do the job, and you will be sure the knowledge is transferred.

(D-In-01-08, 2008)

Sfard (1998) uses the notion of an *acquisition* metaphor as repository for constructivist models of learning that regard knowledge as a “commodity” that can be acquired through learning (as opposed to the *participation* metaphor, represented by sociocultural models that view learning as participation and knowing as “doing”). Paki’s reference to the transfer of knowledge places him firmly in the “students’ minds are vessels to be filled” school of thought, and he sees himself as the font from which this knowledge will be forthcoming. In his mind all the demonstrator needs is to know how to deliver the message and “you will be sure the knowledge is transferred”. This has some resonance with Luft and coworkers’ findings (2004) that the TAs of their study had a predominantly instructive teaching style characterised by providing information to students and directing their laboratory experiences. These authors relate their TAs instructional practices to their intuitive beliefs (see *Engagement*, proposition E2) about student learning and abilities, and their own experience as students. In this regard they recommend that TA training should draw on the literature base in education that explores the process of learning to teach science.

4.6.5 Alignment

Proposition A1: Demonstrators have articulated a shared purpose; they subscribe to it, and feel accountable to it. Leadership is distributed widely in the CoP.

Firstly, I have argued that the staged demonstrator sit-in reflects a shared purpose that demonstrators subscribed to, felt accountable to and acted upon in dramatic fashion. When I discussed my research informally with American postgraduate students who were also demonstrators (or TAs) at their respective institutions, they reported that demonstrator strikes are not an uncommon occurrence at US universities. However, they were quick to point out that at many institutions demonstrators are formally appointed support staff, and that their strikes are (without any exceptions that they were aware of) usually part of institution-wide labour action. None of the demonstrators I spoke to were aware of any instances of non-unionised demonstrating communities staging strikes or sit-ins at their institutions, confirming my contention that the early community at UWC had to experience considerable disgruntlement to take such a strong and contentious stand against what they perceived as unfair treatment by the department. This provides an instance of the community coordinating its actions and directing its energy to a common purpose (opposing unfair treatment) that is misaligned with the broader enterprise of the department.

Secondly, Thandeka occupies a position of leadership in the demonstrator community, bestowed upon her by the department. Later on I will argue that Thandeka actually finds herself on the boundary of the community, neither in nor out, but *brokering* across the boundary with the “outside” (Wenger, 1998). No other leadership positions have been defined in the early community, and no distinction is made between novices and experienced demonstrators as far

as duties are concerned. The consequences when the experience of the “old-hands” is not recognised will be discussed in the final segment of this discussion.

Proposition A2: Clear definitions of the roles, norms, codes of behaviour, shared principles and negotiated commitments and expectations exist and are upheld in the community.

The roles, norms, codes of behaviour, shared principles and negotiated commitments and expectations are poorly defined within the community. These issues have strong points of reference in proposition A3 and in order to avoid needless repetition they will not be discussed separately.

Proposition A3: Methods, standards and routines exist to define good demonstrating practice, and these are upheld and transmitted to new generations.

When Thandeka first assumed the responsibility of being the “practical administrator” there was very little in terms of an accumulated demonstrating experience for her to draw on. Her predecessor had become disenchanted, presumably because it was a “tough” job, and had left only a rudimentary marks administration system for Thandeka to continue with. Thandeka uses the word “tough” to describe the experience of taking over the job no less than seven times during the interview, from which the following quotation has been extracted:

Karen: I want to know a little bit about your demonstrating history. When did you become a demonstrator and how did you end up being a ‘super demonstrator’?

Thandeka: I was a demonstrator first. I remember 2003: SH was working as a lab manager, but that time it wasn’t called lab manager. It was called practical administrator. And then she just got tired of everything, so I decided, why don’t I try it, it might be tough but let me try it. And then, it was tough the beginning of the year with no help, because she didn’t show me the whole thing so I had to start everything from scratch. She quit right in the middle of the year so I had to use her method and then the following year I just decided to do my own thing. It was tough.

(D-In-02-08, 2008)

The only relevant experience she has to draw on is 18 months of being a demonstrator herself. She compensates for the lack of existing routines and structures by deriving a workable practice from 2 years worth of work experience outside of the laboratory context. She displays in the following interview segment her belief that managing people’s activities in one community of practice is much the same as in another. She displays confidence in her own ability to transfer her experience across practices when she says “already I was doing that, so I thought I can do the other one”:

Karen: You obviously had some experience. You came from industry, I understand?

Thandeka: Yep.

Karen: So you spent how long in industry?

Thandeka: Two years.

Karen: And did you get some management experience then?

Thandeka: Ja, I was managing all the people in the Transnet. I had a manager but I was doing his work to make sure that everybody is on time. It's the same thing as practicals, you know, setting up schedules, making sure everybody's on work, making sure that if you don't come I find somebody who is going to replace that person. But it was tough because I was at home and I was a manager for this old man who knows my father, they are my father's friend. So you have to approach them with politeness every time. But it was fine. I think that's why I took it. I took it as a challenge because already I was doing that, so I thought I can do the other one. But it was tough.

Karen: Was this also in a science lab or not science related?

Thandeka: No, it wasn't science related work.

(D-In-02-08, 2008)

Thandeka adds to the repertoire of the demonstrating community by importing, reinterpreting and adapting aspects of practice from another, very different, community (of computer programmers). Aspects of the repertoire of a practice, such as styles and discourses, can be imported and exported across boundaries (Wenger, 1998), even though they represent resources for the negotiation of meaning in practice, rather than being practices in themselves.

Paki alludes to the transmission of demonstrating practice from one generation to the next despite the absence of formal instructions or standard demonstrating procedures. At the end of the following interview segment he mentions that this was an informal (non-formalised) process that happened naturally when experienced and novice demonstrators were paired up:

Paki: You know we don't know how we were mixed, but usually it was common that there would be a PhD and a master's (student). It was strictly PhD and masters then, no Honours participation. The Honours participation started, I think, late in 2005, but in the beginning there were no Honours, it was strictly PhDs and master's students.

Karen: So, how did the demonstrators know what to do; who told you what to do? Did you get any printed materials about demonstrating? I am not talking about prac manuals now, I am talking about did anybody give you instructions... like a job description?

Paki: No, it never happened in my presence here ... I think the new ones always learnt from the old ones. It was no(t) formal.

(D-In-01-08, 2008)

One problematic consequence of the practice of pairing novice demonstrators with experienced ones is that the former group not only learns about good demonstrating practice from the latter, but they are also influenced by those who are setting a bad example. In the following interview segment Paki suggests that this may be an outcome when the experience of more senior demonstrators is not recognised. There is a sense that the mentoring role of the more experienced individual should be formalised in some way (“give that responsibility to that person”). At the end of the segment he uses a striking example of a more experienced demonstrator justifying his disengagement (“so let me just sit, it’s OK”) because no differentiation is made between old hands and novices (“we are the same as this person”) and the novice demonstrator (“even this one”) emulating the disengaging behaviour (“OK he’s relaxing, I’m relaxing as well”):

Paki: If you don’t give responsibility to the old ones, if they feel equal to the new ones, then they will be no learning in that. There will be no learning in that, someone will just sit there, but if you give that responsibility to that person and indicate to the young one that tomorrow it’s going to be you in that (position). That forces that person to learn.

Karen: So, what I am understanding is that you are saying by not recognising the older demonstrators you devalue their participation.

Paki: That’s true.

Karen: So you don’t give recognition to the years that they have put into the job and to their own development really.

Paki: Yes, that is the case. Because a person will say OK we are the same as this person, I need the money so let me just sit, it’s OK. And even this one will say, OK he’s relaxing, I’m relaxing as well.

(D-In-01-08, 2008)

The above discussion of Paki’s views on the transmission of practice across generations sheds some light on how non-participation could have become an established part of the practice of the demonstrating community.

The TAs in the Luft study (2004) regularly shared the tricks of the trade with, and “overwhelmingly found their greatest support in each other”. They valued learning from each other, with some even preferring to learn from other TAs rather than their laboratory coordinator. This is important counsel to bear in mind when designing a demonstrator training programme.

4.7 Conclusions

4.7.1 *Summary of findings*

In answer to the question: “What was happening in and around the laboratories at that particular time in the history of the community?” I offer the following with respect to the framework used in this study:

Engagement: The demonstrators seem only to recognise the gap in students’ procedural understanding of their laboratory work, as this is what they focus on in their interactions with students. As a community they struggle to find a balance between over- and undercontrol in their dealings with the students in the laboratory. They do not participate fully in the laboratories; there is a sense that they are just keeping their heads down and “getting on with it”. This sense of disengagement is very evident to the students in the laboratory and it negatively affects their experience of the laboratory course.

Imagination: The shared accumulated practice in the community includes a substantial element of problematic non-participation. This has developed as a collectively negotiated response to events and decisions imposed upon the community from the outside, and points to reflective discussion, and collective decision-making indicative of cohesion and solidarity in the community, and an understanding of its collective power and potential. Demonstrators hold mainly transmission notions of student learning and see themselves as agents of knowledge transfer, and student learning as the acquisition of knowledge.

Alignment: The practices of the demonstrator community are mostly aligned to those of the department to the extent that most demonstrators come to work and assist students in the laboratory even though they have little enthusiasm for the job. Despite the fact that there is no official hierarchy in the community, there is a system of transfer of what is considered standard practice across generations. Some systems and routines have been imported from another practice by the super demonstrator who ostensibly occupies the only leadership position, but is in actual fact a broker between the community and the department.

4.7.2 *Usefulness of the analytic framework*

At this point I want to comment on my experience of the usefulness of the analytic framework for analysing the narrative. After I had identified the salient themes in the data I had to make decisions about where each theme fitted best on the framework matrix. *Addressing the gaps* (bin E1), *trust relationships* (bin E2), and *community leadership* (bin A1) are all examples of themes that were easy to “bin” because it was immediately clear where they belonged.

Other themes were less easily contained and could be accommodated in more than one of the bins simultaneously. I came to think of them as “slippery” because they were so difficult to get a good grip on. An example of such a slippery theme is demonstrators uniting for the sake of a

common purpose, which I have interpreted to be evidence of both *visions of the potential of the community* (bin I1) and a *shared purpose* (bin A1). In the discussion I have even construed the same theme as evidence for *reflectivity* (bin I3), reasoning that some reflective discussion amongst demonstrators had to precede the decision to unite.

I started to think about the lines separating the bins (or propositions) of the framework as *porous*, selectively allowing flow of themes between the bins. An example is *shared accumulated experience* (bin E3) which I found difficult to separate from the *transmission of practice to new generations* (bin A3). By virtue of how demonstrators are paired up (experienced and novice together), shared practice *becomes* transmitted practice. The line between A2 (clear definitions) and A3 (methods and standards) is similarly porous, as I have mentioned in the discussion.

Taking a step back in order to get a “wide-angle” view of the framework, I noticed that the slippery themes mostly straddled bins that belonged to the same band (either horizontal or vertical) of the matrix. Returning to the example mentioned earlier, *demonstrators uniting for the sake of a common purpose*; this theme straddles bins I1 and I3 and hence speaks to aspects of *imagination*. Recall that this mode of belonging refers to a personal interpretation of demonstrators’ own participation. The same theme also straddles bins I1 and A1. Bins E1, I1 and A1 collectively speak to aspects of *enterprise* (the first dimension of progress), the negotiation of which is a source of community coherence.

4.7.3 *Implications for designing an intervention*

Throughout the discussion I have mentioned recommendations offered in the literature for addressing the specific limitations identified in the early demonstrating community. These recommendations were woven into an intercessionary process that is the subject of my next chapter. I have attempted to summarise here the recommendations that I considered most appropriate for inclusion in the demonstrator training and other processes that were implemented after the start of the study in an effort to improve demonstrator participation in the laboratories.

Firstly, it has been recommended that demonstrator training programs should address the following aspects:

1. the development of a more interactionalist style of facilitation;
2. a focus on the different factors that promote and inhibit students’ learning in the laboratory;
3. drawing on the literature base in education that explores the process of learning to teach science; and
4. encouraging peer learning and support.

Wenger's recommendations (2000) for creating bridges across communities are useful for consideration when designing intercessionary processes and actions complementary to formal demonstrator training, and include:

1. expanding the role of the super demonstrator beyond that of broker between the demonstrators and the department;
2. creating systems, processes, routines and documents to formalise roles, norms, codes of behaviour, commitments and expectations that will support demonstrators in their duties; and
3. creating opportunities for dialogue (meetings, briefings and debriefings, events and functions) in order to repair and strengthen the bridge between the demonstrator community and the department.

In the chapter that follows I will show how these recommendations were accommodated in the intervention that was implemented over an extended period of time, with the intention of transforming participation in the community.

University of Cape Town



Chapter 5

Transforming demonstrating practice

This chapter deals with the nuts and bolts of the intercessionary process that was set into motion approximately one year into the study with the intention of transforming demonstrating practice in the first-year chemistry laboratories.

5.1 Introduction

At first conceptualisation, the aim of this study was to improve the quality of the first-year laboratory experience in a tertiary chemistry department. This aim is plainly reflected in the first working title I chose for the project namely: *Improving the quality of the first-year Chemistry laboratory experience*. In chapter 1 I explained my motivation for selecting the demonstrating community serving the first-year laboratories as the key point of intervention for improvement, using the argument that demonstrators are the primary facilitators of learning in the chosen context.

In the preceding chapter I attempted to capture the essence of laboratory demonstrator participation at the onset of the study. I used a framework (Wenger, 2000) to characterise learning-as-participation in terms of the degrees of *enterprise* (learning energy), *mutuality* (social capital) and *repertoire* (self-awareness) present in the demonstrating community. I used excerpts from transcripts of demonstrator interviews and focus group discussions, some baseline survey data and my own journal notes in a narrative report that highlighted the quality of the relationship between the demonstrator community and the chemistry department as problematic. Demonstrators' main concerns at the start of the study pointed towards a lack of trust and clear communication where the community interfaced with departmental structures. This manifested in low motivation and confidence on the part of the demonstrating community, which ultimately affected their own and their students' tertiary experience.

This chapter deals with the planned intervention that was implemented approximately one year into the study. The intention of the intervention was to transform the demonstrating practice in the first-year chemistry laboratories. This in turn was anticipated to positively transform the manner in which the laboratory sessions were experienced by those participating in them. I will start by describing how my own conceptualisation (influenced by years of positivist scientific training) of a static "intervention" was transformed into a more naturalistic conception of an

organic “intercessory process”. I will then go on to discuss the elements that constituted the intercessory plan, followed by a description of its implementation.

5.2 “Intervention” or “intercessory phase”?

I have described (3.2 *Guiding assumption and initial plans for the study*, p44) how the intervention phase concluding the first action cycle of this study was first envisioned as the implementation of a static “package” consisting (i) formal demonstrator training and (ii) guided reflective practice for demonstrators. Following this intervention, the second data collection cycle would proceed and the anticipation was that the data from the second cycle would reflect a positive impact (correlated to the intervention) on the quality of learning in the laboratory. It seemed initially that this would be easily done.

What occurred in reality was that the “intervention” first envisioned evolved into an intercessory process that consisted of a number of separate but interrelated steps overlapping with and to some extent also mutually informing the data collection for the “second cycle” of the study. I have put “second cycle” in inverted commas because, instead of being implemented in a single event, the intercessory process grew and transformed organically over an extended period of time. Some of the theoretical considerations behind the process have been elaborated upon in section 3.3.2 (*An adapted action research design*).

Integrating intercession with data generation in this way is not uncommon in flexible design studies (Yin, 2003). The next paragraph deals with the way in which the intercessory process was developed.

5.3 Developing the intercessory process

An underlying motive of the study was to support and engineer change in the way demonstrators participated in the first-year laboratories. Thus, not only did I intend to provide the demonstrators access to the research findings (Heller, 1986), I also intended to involve them in the process of transforming their own participation. The likelihood of change tends to be greater under conditions that allow participants involvement in the process (Fullan, 2001; McNiff & Whitehead, 2006; Morrison, 1998).

I will attempt to chronicle the process of intercession as it unfolded over a period extending from the first demonstrator training session in March 2006 to the last recorded training session falling within the period described by the study, namely that of 2009. To help the reader anchor events in temporal order, a visual timeline for the intercessory process will be provided later (figure

5.2). First, I wish to expound on the intercessionary elements selected with some motivation for their inclusion.

I kept demonstrators advised on the progress and findings of the research project informally by finding opportunities to share, discuss and ask their opinions, and formally by always including a presentation of my latest findings in the proceedings of the annual demonstrator training workshop, starting from the first workshop in 2006. Changes to procedures were always brokered through the superdemonstrator whom I have named Thandeka. I have tried to capture the negotiated nature of the intercessionary process by including strands of data to motivate the intercessionary steps that were included in the process, where I have deemed them appropriate.

5.3.1 *Demonstrator training*

The demonstrator community of this study did not receive training before 2006. In this important aspect they differed from demonstrating communities from at least two other South African institutions with apparently healthy demonstrating cultures (B. Davidowitz, personal communication, 2006; G. Green, personal communication, 2008). Paki was an experienced demonstrator at the start of the study, who had demonstrated at both of these other institutions, where he also received demonstrator training. In an earlier quote (p87) he gave recognition to the importance of training for empowering demonstrators to “transfer the knowledge”.

Demonstrator training models received attention in the literature review (section 2.4.4). My own experience of managing first-year chemistry practicals left me with a clear vision for the demonstrator training that I wished to implement. I opted for a half-day training workshop adapted from a demonstrator training program used successfully at an institution where I had been employed before. The program consisted of the following elements, most of which are also present in short-format demonstrator training programs used at local institutions and abroad (B. Davidowitz, personal communication, 2006; M. Mocerino, personal communication, 2008). An example of the programme of one of the training workshops has been attached as appendix 3.10:

- Discussion of the role of the chemistry demonstrator with particular focus on the facilitation of learning in the laboratory
- Discussion of procedural aspects of the practical sessions
- Dealing with hazards, accidents and challenges to the demonstrator’s authority
- Feedback from the demonstrator research project
- Question and answer session

One element of the training program was unique, namely feedback to demonstrators about preliminary results from this study. Giving participants access to the research findings is important when an underlying motive of the study is to support and engineer change (Heller, 1986).

During the workshop, demonstrators were issued with a demonstrator manual which was essentially a compact reference guide in which all of the above issues were reviewed. The content page of the manual has been attached as appendix 3.9.

The demonstrator training workshops were repeated on an annual basis in the week preceding the start of the first-semester practical course, and they have since become a regular feature of the demonstrating programme. Attendance is compulsory only for first-time demonstrators, but the experienced demonstrators are usually also invited and encouraged to attend. The workshops are usually concluded with refreshments, which may explain why they are always well attended.

During the course of the study, four training workshops were presented. At the first workshop there was very little demonstrator participation, but at subsequent workshops first Thandeka, and later other leaders in the community took to presenting some of the segments of the training workshops. In the final training workshop Thandeka's successor, Nofanele (meaning "suitable"), mobilised all the demonstrators to participate in the presentation. An excerpt from my own journal captures the tone of the event:

(Nofanele) said why don't we get the demis to do the training themselves this year. So we put them into small groups (5 – 6 in a group) and gave each group a topic from the demonstrator manual to present. Group 1 got the section on "What your students can expect from you" and they did a very funny role-play with M playing a very strict and unapproachable demonstrator. Some of the other groups simply summarised their sections in points, with each demi naming and sometimes discussing one point. One other group identified a spokesperson who did the whole section on behalf of the group. A lively and entertaining workshop resulted with all participants fully engaged.

(R-JN-13-02-09, 2009)

5.3.2 *Guided reflective practice*

In the context of teacher training, the "professional growth approach" advocated by Guskey (1986) and Clarke and Hollingsworth (2002) has shown greater promise as a means of transforming the practice of teachers than earlier models aimed at improving teachers' skills and knowledge. The approach requires teachers to engage in reflective participation in practice, and this encourages higher-order thinking about the practice (Shulman, 2002) that serves ultimately to move the practice forward.

In selecting elements to include in the intervention, formal demonstrator training and guided reflective practice were obvious choices in light of the “best practice” recommendations discussed above. However, it proved difficult to persuade demonstrators to maintain reflective journals, with most of them citing the demands of their postgraduate work as the main constraining factor. The problem was circumvented to some degree by using writing prompts to guide demonstrator reflections. The writing prompts were used in two ways during the study. In the first instance, a number of prompts were compiled into a survey carried out on the entire demonstrator cohort in the third year of the study. Secondly, during the fourth year, towards the end of the study, writing prompts were distributed to a small sample of individual demonstrators on a weekly basis to which they were required to respond by email. Both methods yielded valuable data.

I became aware over the course of the study that the purpose of the guided reflections shifted somewhat from its original intent, namely as intercessionary element to improve demonstrating practice, to a method for generating research data. At first this created within me some tension, as I was left uncertain whether to report on it as an element of intervention, or an element of data collection. Considering the participatory tenor of the study, however, the question effectively becomes a non-issue. In the context of mathematics education, Miller (1992) cites cognitive and affective benefits for both responders (students) and readers of student responses (teachers/researchers) to writing prompts, suggesting that this shift in purpose may not have averted the original intent of the intercession, and for this reason I chose to include it here.

5.3.3 *Weekly demonstrator briefings*

Weekly information sessions were introduced shortly after the first demonstrator training session. At these briefings academic staff would meet with demonstrators to discuss forthcoming practical sessions without the students present. This intercession was motivated by a pervasive and frequently mentioned concern in the early demonstrating community regarding ineffective communication between the academic staff involved with the practicals and the demonstrating community, attested to by the following quotes from the first demonstrator survey performed at the start of the study:

D2: It might be a good idea for the lecturer or technical staff to demonstrate the practical beforehand and inform demis of changes to the practical. For the most part of this semester I found myself running around the lab problem solving because the lecturer and technician did not communicate.

D10: Arrange a meeting with the tutors once in a while to discuss problems encountered.

D15: (Start) communicating with the demonstrators all the time and before practicals.

(D-Su-01-06, 2006)

The briefing sessions, though strongly campaigned for by some demonstrators, proved to be difficult to sustain in practice. They were poorly attended from the start, and were later abandoned. They were, however, supported from the beginning by comprehensive printed briefs that were distributed to demonstrators prior to the laboratory sessions. These briefing notes were retained as a central feature of the intercessionary process even after the briefing meetings fell away.

5.3.4 *Supporting printed materials (briefing notes)*

Examples of briefing notes (appendix 3.11) and a marking memo (appendix 3.12) have been attached. Aspects included in the demonstrator briefing notes were the following:

- An overview of the week's practical task(s);
- Discussion of supporting theoretical concepts;
- Important procedural aspects, such as new techniques to be demonstrated, changes to procedures, dealing with waste, specific safety considerations and the like;
- Aspects of the experiment(s) that students may find difficult to understand or execute; typical student errors;
- Demonstrators tasked with assessing students' practical work were supplied with marking schemes.

Paki explains that clear instructions engender confidence in the demonstrator; in his view confident demonstrators improve the quality of the demonstrating program:

If everything is clear from the material that is given to the demonstrator or the instructions are clear, it makes the whole program very good and it also gives the confidence to the demonstrator. If the demonstrator is confident then what he has is understandable, is very organised and then that makes him a very good demonstrator or tutor.

(D-In-01-08, 2008)

5.3.5 *Procedural changes*

Finally, a number of general procedural changes were made to the way practical sessions were run. The first of these was to issue demonstrators with red laboratory coats to distinguish them from the students who were all wearing the standard white laboratory coats. Sandy, a demonstrator who was a first-year student at the start of the study, remembers how difficult it was to know who the demonstrators were when everyone in the laboratory wore white:

...if you needed help you had to find them (the demonstrators) which was difficult because they were all wearing white.

(S-In-02-08, 2008)

Dressing the demonstrators in red (the first issue of red coats even had the word “demonstrator” embroidered over the breast pocket) also seemed to give the demonstrators a sense of status.



Figure 5.1: A demonstrator (in red) and student interacting during the practical session.

Perhaps the most important procedural change implemented during the study was to place each demonstrator in charge of the same group of between 10 and 15 students for the duration of the academic year. Previously demonstrators would “roam” through the laboratory, assisting students in a haphazard fashion, and often not reaching all of those who had queries. The intention with this change was to increase demonstrator accountability by forcing demonstrators to interact more often with the same students, thereby hopefully developing a relationship with them. The following quote from a focus group with demonstrators speaks to the value of such relationships between demonstrator and student(s). The demonstrator quoted here uses the example of a lecturer knowing a student’s name (implying that the lecturer knows the student personally), and goes on to explain that such a relationship gives the student the confidence to approach the lecturer with questions:

So what I suggest is that demonstrators should know their students’ names and call them by their names. It means a lot. If a lecturer knows my name, you know I really have confidence in myself; it makes it easier for me to approach them.

(D-FG-01-08, 2008)

The survey data (reported on in detail in chapter 7) confirms the importance of this issue in the minds of students. In both student surveys – *Baseline* (Survey 1) and *Beyond* (Survey 2) – the category that I have named *Facilitator role* (of the demonstrator) that includes responses relating to interaction, assistance, guidance and “checking up”, was mentioned with the second highest frequency by students (see table 7.8 Category code S-TeLe-2).

5.4 Timeline for implementation

In the preceding section all the elements that formed part of the intercessory process have been described and some motivation for their inclusion given. This section will deal with the implementation of the individual elements in chronological order.

The point has been made that data collection overlapped with the intercessory process, and that the research data informed the intercession in some respects. In the diagram I wanted to capture the entwined nature of the relationship between process and data, and for this reason I have overlaid the timeline for data collection (first presented as fig 3.1, p58) with a map of the intercessory process. The expanded diagram (figure 5.2) will serve to anchor the prose to a timeline. I will now proceed to explain the diagram in some detail.

As mentioned in section 3.6 (*Timeline for data collection*, p57), the central arrow in the diagram symbolises the ongoing development and transformation of participation in the demonstrator community. The two long edges of the arrow can be interpreted as parallel axes, one edge or axis (closest to the viewer) representing the intercessory process and the other axis or edge (furthest from the viewer) representing the data collected over the course of the study. The intercession axis in the foreground represents the primary focus of this chapter, while the data axis in the background provides a backdrop for the discussion.

The annual demonstrator training workshops are flagged as teardrop-shaped bubbles on the timeline. They represented the main feature of the intercessory process and as such have been given a strong visual presence on the diagram. The first demonstrator training workshop took place in March 2006, only a few days ahead of the first practical session of the academic year. Weekly demonstrator briefing meetings were introduced in the second semester of that year (July 2006) when I became the academic in charge of the first-year practical course. During the demonstrator meetings, detailed printed briefing notes were supplied to the demonstrators. Due to poor attendance by demonstrators the demonstrator meetings were discontinued at the end of the second semester (October 2006).

The second demonstrator training workshop was held shortly before the start of the practical course in March 2007. At the demonstrator training workshop red laboratory coats were introduced for demonstrators, and remained a feature of the demonstrating practice for the remainder of the study. Demonstrator briefing notes were issued to provide demonstrators with salient information about each forthcoming practical in advance. This too remained a feature of the demonstrating practice for the remainder of the study.

At the third demonstrator workshop in March 2008 changes were made to the way demonstrators assisted students in the laboratory. Where demonstrators had in the past been allocated to a particular laboratory, but beyond that had no responsibility for a specific group of students, demonstrators were now required to take charge of all the students allocated to one of

the four benches in the laboratory. The demonstrator was responsible for checking their preparatory work, recording their attendance, and assisting them first, before attending to students at other benches needing assistance.

The fourth demonstrator workshop took place at around the time when data collection for the study terminated, in March 2009.

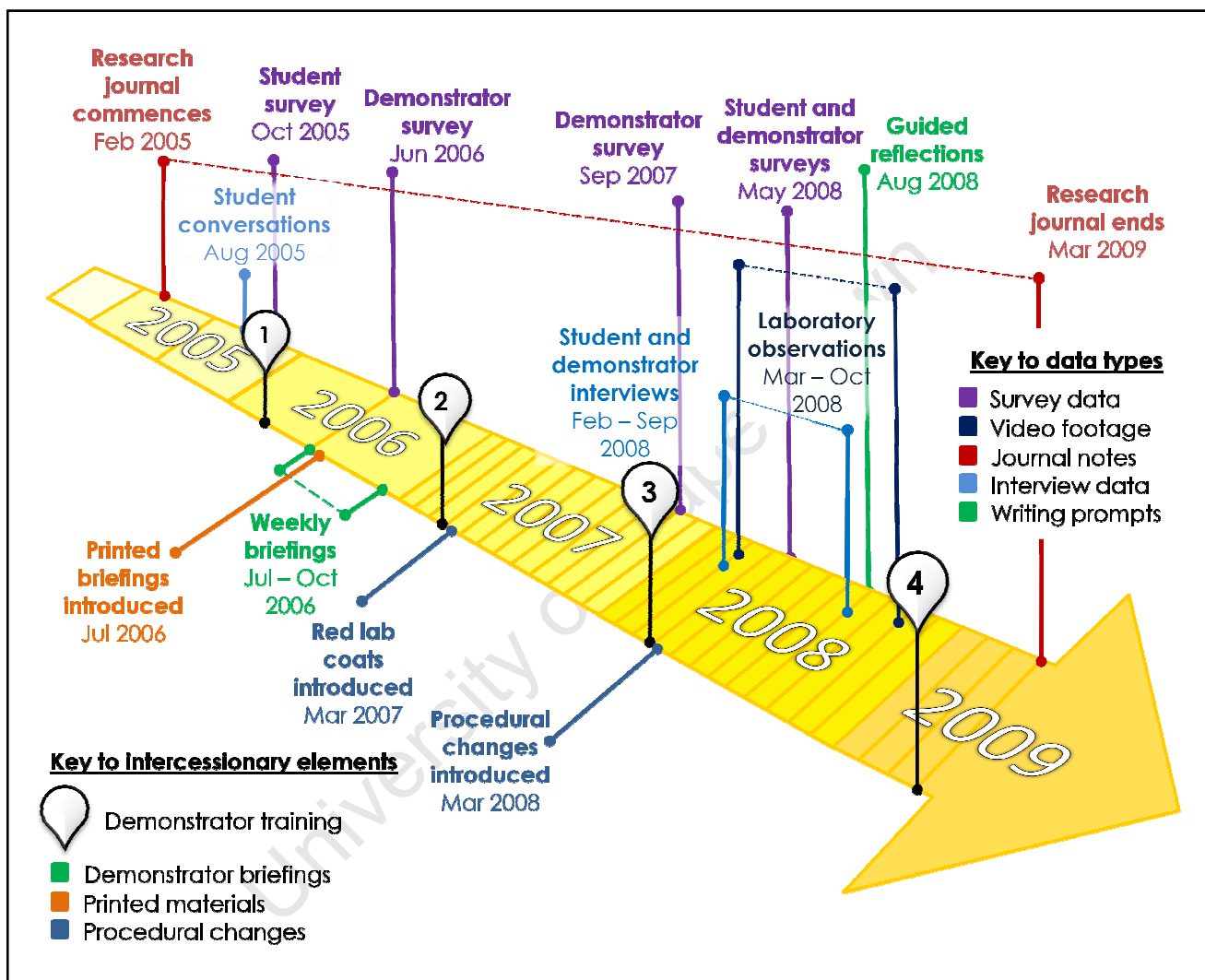


Figure 5.2: Timeline for the intercessory process

I explained earlier how, in the case of demonstrator reflections-turned-writing prompts, it was sometimes difficult to tease apart their intercessory intent from their data-generating function. The reader will notice that the writing prompts (indicated as “guided reflections” on the diagram) were given a place on the (vertical) data axis of the timeline. After giving the matter much consideration, my contention is that, in the context of this study, their primary utility was as a device for generating data.

In this chapter I have discussed the intercessionary process that was implemented approximately one year into the study. The intention of the process was to create impetus to move the practice of the demonstrator community in the first-year chemistry laboratories forward. I discussed the elements that constituted the intercession, namely demonstrator training and weekly briefings combined with the provision of briefing notes, and the implementation of some procedural changes aimed at increasing interaction between demonstrators and students and improving the smooth running of the laboratories. I discussed guided reflective practice as an additional element of the intercessionary process, but also argued that it had value as data generation method. Finally, I anchored all the individual elements to a timeline.

The following chapter looks at the ways in which demonstrating practice in the first-year laboratories were transforming after the implementation of the intercessionary process.

University of Cape Town



Chapter 6

Demonstrator participation in the transforming community

This chapter is devoted to the characterisation of demonstrating practice in the first-year laboratories after the implementation of the intercessionary process described in chapter 5.

6.1 Introduction

The final research question guiding this study clearly embodies its concern with transformation following an intervention: *How does intervention in the form of a formalised training program combined with demonstrators' guided reflections on their practice change their participation?*

Transformation or change implies that there will be an “after” that is discernibly different from what came “before”. I have chosen to use three separate chapters to tell the story of what demonstrating practice was like at the start of the study (“before the intervention”), what was done to change the practice (“the intervention”) and what the practice was like “beyond the intervention”. Hence, chapter 4 dealt with a characterisation of demonstrating practice around the time this study commenced, and chapter 5 described the implementation of demonstrator training and other intercessionary steps aimed at transforming demonstrator participation in the laboratories. In the present chapter I hope to show how demonstrator participation changed following the intervention.

Chapters 4 and 6 can almost be considered twin chapters as they describe “before” and “after” practices respectively, with the “intervention” chapter sandwiched in between them. In order to contrast the “before” and “after” most effectively, I have chosen to structure the present chapter in the same way as its twin, chapter 4.

First, I will introduce the narrative and discuss which data sources were used. This will be followed by an introduction to the main characters populating the two vignettes that tell the story of “what is happening in the laboratories now that the intercessionary process is underway?” Lastly, a discussion of the foremost themes raised in the narrative concludes the chapter. Once again the theoretical framing of the discussion will be guided by the nine propositions contained in the analytic framework that were introduced in chapter 2 and summarised in chapter 4 around three broad modes of belonging to a community of practice, namely *engagement*, *imagination* and *alignment*.

6.2 Another narrative

I motivated my decision to use narrative writing for the description of the early community (chapter 4) in some detail. In the same chapter I outlined Polkinghorne's guidelines (Lelliott & Pendlebury, 2009) for narrative construction and showed how they were given consideration in the description. These motivations and considerations apply in the same measure to the description of the transforming community that follows.

Once again the narrative centres around the (reconstructed) activities of a group of demonstrators in the first-year laboratories of the chemistry department and the issues raised are based on real events, conversations, and other data. Like most demonstrator communities that are populated by senior undergraduate and postgraduate students, the community of the study has a high turnover of members. Membership may last from a few months to a few years (seldom more than 5), as postgraduates feed into the cohort from the undergraduate program and others complete their postgraduate studies and leave to join the work force. At the time of this, the second narrative, the community has retained some of the individuals who were present in the early community, but they are far outnumbered by "new blood". A pivotal character from the first narrative in the person of Thandeka, the super demonstrator, is still present and serves to link the two narratives. In the first vignette we follow her around the laboratory to witness how her role has been transformed in the years following our first visit to the laboratory. The second vignette captures the interactions of some of the other members of the demonstrating community, to be introduced shortly, during the same practical afternoon. With these two vignettes I hope to create a coherent description of practice, while at the same time highlighting the fundamental changes that have occurred in the practice of the community in the ensuing years.

6.2.1 *Data sources*

In my discussion of the intercessory process (chapter 5) I pointed out that it consisted not of a single event but rather a number of intercessory steps, and that data collection continued throughout the remainder of the study. I attempted to capture the interwoven nature of the intercessory and data collection processes by placing them at right angles on the timeline offered in Figure 5.2 (for ease of reference I have re-inserted it as figure 6.1 below).

At this point I wish to draw attention to the data collection (vertical) axis of the diagram: it shows how data collection extended over almost the entire study and peaked in the penultimate year (February to October 2008) during which time the bulk of the research data were collected. The diagram also conveys that there was no point that could clearly be labeled "after the intervention" since the intercessory process was introduced in stages.

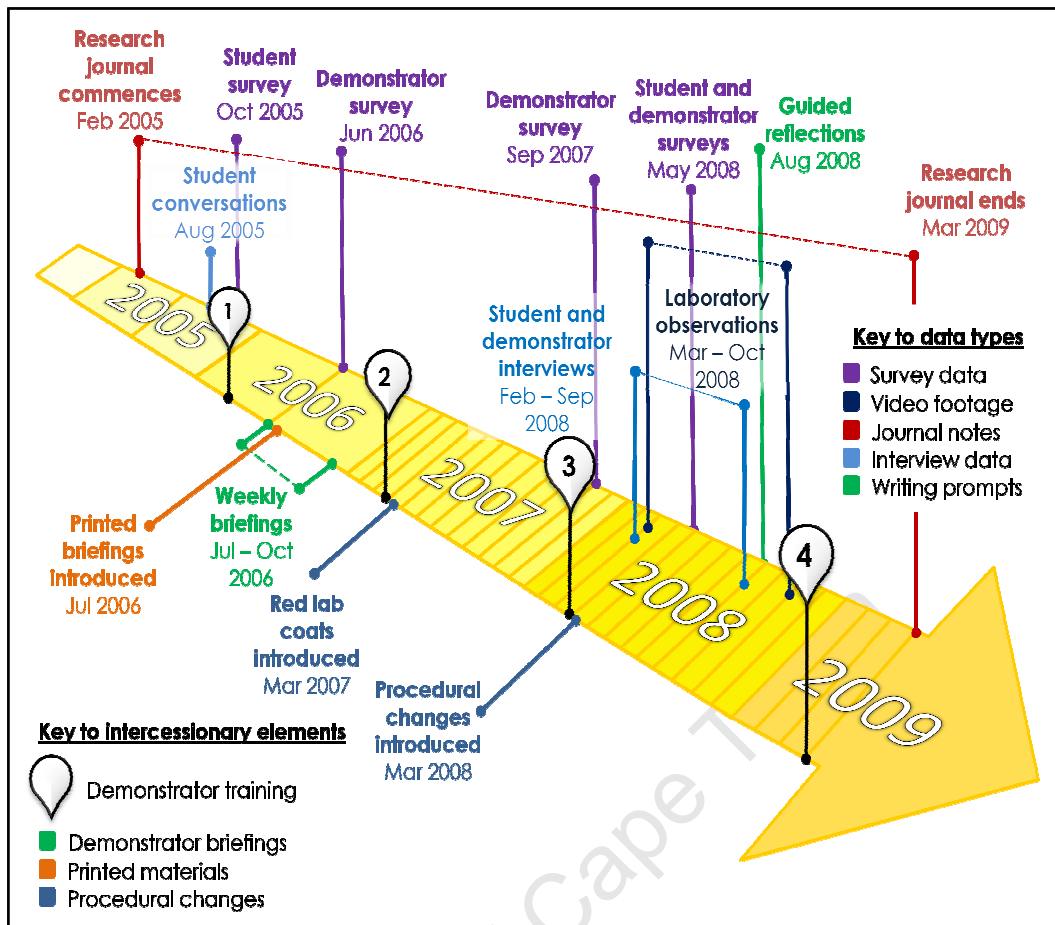


Figure 6.1: Timeline of the intercessory process

Since the majority of the intercessory steps were introduced before the middle of 2007, I have decided to use only data collected after this point in time to represent the “after the intervention” situation. These data include two demonstrator surveys, a student survey, interviews with selected students and demonstrators, laboratory observations, demonstrators’ guided reflections and my own journal notes.

Throughout the two vignettes I have used strands of actual dialogue to create fictional conversations between the main characters of the narrative. In most cases the dialogue has been constructed from demonstrators’ actual words, extracted from the research data and used as it is, though not necessarily ascribed to the actual demonstrator who uttered them. In three cases I made small adjustments to the dialogue, but was careful not to allow these to affect the essence conveyed by the data. The following excerpts contain adjustments:

1. Vignette 1: Nofanele and Mncedisi discuss flow diagrams.
2. Vignette 2: Mandisa discusses her reasons for participating in the demonstrating program with Mncedisi.

3. Vignette 2: Mncedisi and Nofanele discuss finding a balance between too much versus too little help to students during the practical sessions.

I will now attempt to explain briefly the kind of adjustments that I am referring to, using the following (constructed) exchange between Nofanele and Mncedisi that I had intended to include in vignette 2, but decided against using because I had made the point elsewhere:

Mncedisi: Maybe (the students) are shy to show their ignorance.

Nofanele: I don't know. They don't want to be reprimanded. Some (demonstrators) shout: "You really don't know this? How did you get into university? How come you are doing your first year; how did you pass matric?" People say such things.

In the above exchange the suggestion "Maybe (the students) are shy to show their ignorance" ascribed to Mncedisi was actually given by me, uttered during the interview with Nofanele (D-In-03-08). Her retort is the actual response she gave during the interview. Excerpts 1 and 2 from the above list contain this type of adjustment.

Another example of a constructed exchange is the following. Here is an excerpt from the transcript containing the words as they were uttered by Nofanele during her interview:

Karen, I don't want to say the wrong thing. I might have been taught this way, but there is a way in which one trained them. So I would come to you, like: "Oh, I am not too sure. The burette (reading): are we supposed to go to two or are they still at the one stage, like one decimal place?". "No, no, it should have been mentioned in that tutorial".

(D-In-03-08, 2008)

Below I have reshaped her words into a dialogue between Nofanele and Mncedisi. The word *tutorial* was replaced with *pre-prac talk* (the demonstrators' term for the pre-practical briefing) because it was clear from the context that she was actually referring to the latter.

Nofanele: The burette reading: are we supposed to go to two (decimal places) or are they still at the one stage, like one decimal place?

Mncedisi: No, no, it should have been mentioned in that pre-prac talk.

Nofanele: I don't want to say the wrong thing.

The essence of Nofanele's words namely that she is concerned about confusing the students by giving them information that is "wrong", has not been lost. Excerpt 3 from the above list contains this type of adjustment.

Lastly, I will be referring to the "transforming" rather than the "transformed" demonstrator community, in order to give recognition to the fact that transformation of the community is

ongoing; this is also symbolised by the representation of the timeline in Figure 6.1 as an arrow pointing beyond the present towards the future.

6.2.2 *The protagonists: some old, some new*

Five characters feature in the narrative. Thandeka, Paki and Mncedisi were introduced in chapter 4 but Paki has since left the department to take up a position in industry. In the narrative Thandeka still heads the demonstrator cohort. She is now in her late twenties. Mncedisi is now an experienced demonstrator in the final year of his master's study, and is in his mid twenties. As before, Mncedisi is a composite character compiled from the collective experiences of a number of (now senior) demonstrators. The two old hands are joined in the laboratory by Sandy, an English-speaking, White male Honours student (early twenties) who is demonstrating for the first time, and Nofanele, a foreign Black female PhD student (mid to late twenties) also in her first year of demonstrating but with some demonstrating experience at the institution where she completed her undergraduate and masters studies back home. Sandy is somewhat of a rarity; he is the only White postgraduate student in the department¹. His perspectives are interesting not so much because he is from this particular demographic group, but rather because he is more confidently outspoken than the demonstrators from the other cultural groups represented in the community (South African Blacks, Coloured and foreign Black students). Mandisa represents a black, female, third year chemistry student who has recently joined the community of demonstrators. The coloured demonstrators are the only demographic group that is not represented by a specific character. The only reason for this is that none of the coloured demonstrators volunteered to be part of the study. The absence of Coloured demonstrators from the demonstrator sample was discussed in chapter 3 (section 3.11.1: *Coloured voices*).

Finally, one additional character is mentioned in the narrative. She is not actually present in the laboratory, as she is away at a conference. She is the lecturer in charge of the practical course, who is also the researcher in this study, namely me. In the vignettes I have chosen to refer to myself as Karen, rather than Ms Wallace because the demonstrators address me by my first name in real life. Also, I feel that using the more formal title and surname format would be at odds with the participatory spirit of the research design, and might be suggestive of power issues that I have worked hard to downplay throughout the research project. In the discussion that follows the two vignettes I will revert to referring to myself in the first person.

¹ UWC is a historically black university (HBU), hence the number of white students is relatively small. The first-year chemistry group typically contains approximately 5% white students (see table 3.1). Most of these are not chemistry majors but are enrolled for study programs (dentistry, pharmacy, medical bioscience, etc.) demanding a maximum of two semesters of chemistry as prerequisite. Sandy was the only white student graduating in chemistry when he completed his final year.

6.3 *Vignette 1: Thandeka on the boundary*

It is five minutes before the start of a practical session on an afternoon during the second semester. Thandeka bustles into the first-year laboratory carrying an armful of colourful files and a navy blue laboratory coat draped over her free arm. Her coat is different from the red coats worn by the rank and file demonstrators; and signals that her role is different from theirs. Nofanele, Thandeka's assistant, arrives shortly after, also wearing a navy blue coat. Similar to Thandeka's coat, it has her name embroidered over the breast pocket. The two young women talk briefly about the afternoon's practical. They are not expecting any unpleasant surprises today as the problems were all straightened out during yesterday's session, the first of the week. Nofanele asks Thandeka about a colour change observed during yesterday's practical session and how it relates to a shift in equilibrium for a particular reaction. Thandeka uses a balanced equation and bases her explanation on Le Chatelier's principle, adding that she knows this because she is "lecturing the work at the moment". Thandeka has been offered a part-time contract to assist with the teaching of a one-semester service course in the department.

A few minutes later the first-year chemistry students are slowly making their way into the practical venue where the pre-practical information session is about to begin. Their progress is hampered somewhat by students up ahead in the queue fumbling around in their bags for their pre-practical assignments and flow diagrams. All students have to submit these two documents upon entering the laboratories. This procedure is very familiar to the students who have been expected to follow the same *modus operandi* since the beginning of the year, but for some reason it is only once they are in the narrow passage leading to the laboratory entrance that they seem to remember to get the paperwork ready. Thandeka and Nofanele are greeting the students at the laboratory entrance, accepting their assignments and hurrying them along. Noticing the latest bottleneck caused by yet another student groping around inside her bag, they look at each other and smile good-naturedly, shaking their heads. Some of the other demonstrators, in their red coats, are an informal part of the welcoming committee, smiling and greeting students as they enter the laboratories.

Mncedisi and Nofanele are now sorting the students' pre-practical assignments according to their locker numbers in order to simplify the matching up of pre- and post-practical assignments after the session. Mncedisi is telling Nofanele that the practice of requiring students to submit flow diagrams before the start of the session is relatively new. For the past two years students have been required to draw and submit a flow diagram of the procedure(s) relevant to the afternoon's practical work. This was an attempt to get the students to actively engage with the practical manual before the laboratory session.

Nofanele: Now we expect them to draw a flow diagram and it works quite well.

Mncedisi: Over the years what I have noticed is that, if you don't tell them (to submit a flow diagram), you will end up doing the experiment for each and every student because they will ask each and every thing, you see. But, if you tell them to follow that, they will be independent in the long run. They will do the experiment; they will get to understand what they are supposed to do and what they are doing.

Around 14:05 the students from both adjoining laboratories (A and B) are gathered around the podium in the front of laboratory A. The demonstrators are all clustered at the back, chatting together while waiting for the pre-practical briefing to start. Karen, the lecturer responsible for the first-year course, is away at a conference and has left Thandeka in charge of this and next week's practical sessions. Thandeka silences the group: "OK guys, listen up!", then conducts the session according to the instructions left by the lecturer while the students listen and take notes. Some of the demonstrators are also paying attention but a few of them are talking quietly at the back. This annoys Thandeka but she does not reprimand them in front of the students; instead she makes a mental note to talk to them about it afterwards.

Thandeka concludes her briefing to the students thirty minutes into the practical session. The students from laboratory A move to their respective benches. The students assigned to laboratory B traverse the short passage to their own laboratory and their demonstrators meet up with them there. The students are now free to prepare their work stations for the afternoon's practical work. A few are queuing to replace broken bits of equipment at the dispensary and others are checking the marks indicated on their newly returned assignments against a printed list that Thandeka posted up before the start of the session. This is one of the many ways in which she has streamlined operations to "reduce the stress" for everyone concerned, herself included.

This is not the first time Thandeka has been given the responsibility of presenting the pre-practical briefing. As she files away the briefing notes she reflects on how far she has come. In the beginning she found it very daunting to address the large group of first-years. Now she is quite comfortable taking them through the session provided she is briefed beforehand. She has learnt much from watching how Karen presents the briefings and interacts with students. The two women have built up a good relationship and regularly consult each other on matters surrounding the practicals. Thandeka will often ask Karen's advice on how to handle difficult situations with students. Karen, in turn, quite frequently consults Thandeka for advice about handling the demonstrators.

Since first being appointed to assist with the practicals, Thandeka has fine-tuned her administrative systems so that the first-years are now more evenly distributed across the three afternoon practical sessions. This means that the staff associated with the first-year practical course was easily able to accommodate the loss of first one and later a second laboratory venue due to departmental directives to this effect. Distributing the students in this way has

helped her to manage the practicals more smoothly, as all the students in the two laboratories in operation each afternoon can now be marshalled into one laboratory for the pre-practical information session, obviating the need for pre-practical venues and circumventing problems with students having to walk back to the lab afterwards. This also means the pressure on laboratory resources such as balances and pH meters has evened out, as have the pressures associated with managing the activities of the students and demonstrators. In the past, for a variety of reasons, places in the Wednesday afternoon sessions were in high demand, and as a result of this the laboratories were over full and in Thandeka's own words "a lot of work".

She attributes her reputation as an exceptional laboratory manager to the fact that she is organised, a straight talker and someone who likes to "fix things". When she was appointed to her present job she was tasked with maintaining the administrative records of the practical course, but over the ensuing years she has assumed responsibility for many other aspects of the course. None of this has ever been formalised in a job description, but she does not complain. She likes being in charge, and she is comfortable acting as mediator between the demonstrators and the department. One aspect of the job that was not part of her original duties is that of recruiting and selecting demonstrators and tutors. Much of this job is now left up to her entirely, although the paperwork relating to contracts and payments is handled by one of the technical officers in the department. The head of department (who controls the budget from which demonstrators are paid) relies on her to recruit sufficient postgraduates to meet the department's staff needs in terms of assistance in the practical courses and supplementary instructional activities such as tutorials, while at the same time staying within the relatively small work-study budget. Demonstrators are paid according to their level of qualification, and this is a major motivating factor in employing senior undergraduates rather than senior postgraduates in demonstrating positions. This essentially means more demonstrators can be appointed on the limited budget. Thandeka has learnt, however, that it is prudent to balance expenditure against experience by enlisting enough new blood to ensure renewal of the community, while at the same time retaining enough senior postgraduates to ensure that the accumulated practice is retained and transmitted to the new generation of demonstrators.

This arrangement will come to an end shortly as Thandeka will be submitting her PhD thesis soon and is currently looking for a permanent, full-time job. When Karen asked Thandeka to help in identifying a replacement, she recommended Nofanele without hesitation because she is confident, assertive ("somebody who can talk"), reliable and responsible. Thandeka arranged for Nofanele to be appointed as her assistant so that she would have an opportunity to learn the ropes before Thandeka's departure from the department.

The afternoon's practical activity is coming to a close. A student comes to the front bench to submit her practical assignment and sign out. Thandeka glances at her report and makes an appreciative comment about the student's neat handwriting. She looks at the document more

closely for a moment, then points out that the student has left a crucial energy term out of a thermochemical equation. She then gives the student the opportunity to correct her work before she resubmits and leaves. When all the students have left, she gathers her papers and leaves the laboratory.

6.4 *Vignette 2: The redcoats*

The students in laboratory A are setting up to start their practical work. The demonstrators, clearly recognisable in their red laboratory coats, are moving around their respective benches, chatting informally to the students and checking to see if they are setting up their experiments correctly. Some of them still wear the name badges issued with their red coats at the beginning of the year, but most have lost theirs. This does not matter much, because the students know their names by now. Each laboratory has four parallel benches around which the students are stationed. With four demonstrators per lab, each demonstrator is responsible for one bench of students. The demonstrator community was not really amenable to this change in procedure at first. They wanted to remain with the old practice of roaming the laboratory until students put up their hand for assistance, and saw the new practice of having their own group of students to assist as representing a greater responsibility. They did not want that and it took Thandeka the best part of three years to broker this change, first suggested by the lecturer in charge. Since the arrangement was finally adopted, the demonstrators and students have learned to know each other much better, and there has been much more engagement and interaction between the two groups.

Thandeka has managed to convince two of the third-year demonstrators to work today even though this is not their shift. The third-years seem to be especially popular with the students. At the back of the laboratory one of them, Mandisa, is laughing with a small group of students, one of whom has his arm draped over her shoulder. Thandeka reflects that she has never seen the students as comfortable as this with any of the more senior demonstrators. She has had to co-opt the third-years, because with the end of the semester looming, the honours students are very busy completing their own research projects. They have to present their work to the department next week, and this means their demonstrating commitments are secondary to the demand of their coursework commitments for the moment. Thandeka expected this, as it happens every year. She compensates by calling on the assistance of undergraduate demonstrators who have an afternoon free to demonstrate, and even sometimes make impromptu appointments of new undergraduate demonstrators willing to work at short notice. Frustrating as it is for Thandeka when demonstrators do not report for duty, there is very little she can do about it since she does not control their payment. The more senior demonstrators are more reliable but then their research commitments are less intense and more evenly spaced throughout the year.



Fig 6.2 a and b: The demonstrators (in red coats) interacting with students in the first-year chemistry laboratories.

In the large weighing room linking the two laboratories, Mncedisi and Mandisa are pre-weighing reagent samples into weighing boats using 2-place balances. They do this by tipping the powdered reagent directly into the weighing boat on the balance pan. Mncedisi is so adept at this that he has several weighing boats on the pan simultaneously. The idea is that each student will collect a pre-weighed sample upon entering the weighing room, and redetermine and record its mass using an analytical (4-place) balance. This practice serves several purposes: it limits contamination of the reagent in the stock containers, limits waste and spillage of large quantities of the powdered reagent on and around the analytical balances, and it saves time. It also serves to simplify the technique of weighing out solid samples for the students, thus scaffolding the building of a skill that novice chemistry students find difficult at first.

An hour into the session, the students are all working busily. Nofanele looks up from helping a student and notices a few of her group moving towards the weighing room. She calls after them:

Nofanele: Guys, remember to weigh the empty crucible first.

Mncedisi, looking confused, comes to check what she meant when she said that. He wants to be sure that his own students do not make an unnecessary mistake during the same step. Nofanele explains that, when she looked at the manual earlier, she noticed that the instructions missed an important step.

Nofanele: And then I look at the manual: like no, no, no, I would have corrected that one personally. Then I realised they are all going to (miss it). It wasn't mentioned (in the manual, and) they were all likely to do the same thing.

Nofanele seems to be especially good at pre-empting students' behaviour. Concerned that they will forget to collect their notes for the practical exam in two weeks time, she circulates around the laboratory to hand the notes to them personally, despite Thandeka's announcement to students to collect the notes from the front desk. Nofanele sometimes struggles to find a balance between doing too much for the students and helping too little. She worries that withholding information from the students is wrong. Mncedisi's instructional style is more hands-off, and he considers Nofanele's style to be spoon-feeding:

Mncedisi: Why do you tell them? Let them mess up; let them learn from that.

Nofanele: I don't know, I have to say something! [laughs]

Mncedisi: Don't tell them. Don't spoon-feed them.

Nofanele: What's the point of having me there if I can't help them out?

Mncedisi: I think that sometimes when we help them too much they don't read their practical (manual) as such.

Back with his own group, Mncedisi is helping a student with a calculation. He glances at the printed demonstrator briefing sheets received from Thandeka earlier to remind himself of the finer details of the calculation. His confidence as a demonstrator has grown in leaps and bounds over the past few years. He attributes some of that to the briefing materials that the demonstrators have been receiving at the start of each practical cycle. These have been very clear, and organised into sections dealing with the theoretical background to the practical, safety hazards, waste disposal instructions, calculations and the like. The sections dealing with the typical aspects which students struggle with have been especially useful.

Next door, in laboratory B, Sandy's students are unhappy with him because he is spending most of the afternoon with another demonstrator's students instead of with his own group. There is a girl he likes in the other demonstrator's group and the two of them have their heads bent over some papers. Sandy is explaining something to her. He is a strong student and really enjoys explaining the theoretical principles behind the practicals. Unfortunately he tends to over-explain sometimes, going far beyond the level of understanding required from the first-year students. He is one of the few demonstrators who are comfortable to engage his students in conceptual conversations about the practical work, although his style seems to be more talking than listening. One by one Sandy's own students finish their practical work, submit their assignments and leave the laboratory. About 30 minutes before 17:00 Sandy finally lifts his head, looks around the laboratory and notices that his own students have all left. The girl he has been addressing prepares to leave also and he leaves the laboratory with her despite the fact that, apart from the superdemonstrator who is attending to some administrative issues at the front desk, there are no other demonstrators present in the laboratory at this time. About 25 students are still in the laboratory, finishing off their work. Sandy does not return to the laboratory for the remainder of the afternoon's session because he still has some work to complete on an assignment for his chemistry honours course.

Towards the end of the afternoon's session the students in laboratory A are completing their worksheets. Some have already submitted and left, and the remaining ones do not seem to need help at the moment. Mandisa and Mncedisi have drifted towards the side of the laboratory from where they are surveying the students and sharing a chat. Mandisa feels comfortable with Mncedisi. He is different from the other postgraduates and does not make her feel that, as a third-year student, she is not really as important as the other demonstrators. The two demonstrators are talking about money. Mandisa mentions that, after the 80% deduction that HR pays over into her student account for fees, she effectively takes home R9 (the equivalent of roughly USD 1.25) per laboratory session.

Mncedisi: Why are you doing it then?

Mandisa: I am doing it for my CV. Also, you know these people they are nice. The first-years they are sweet ... yeah, you want to give back. When you walk in res, everybody knows everybody, doesn't matter whether you are Coloured or Black.

She does add, however, that her student fee account is gradually being reduced in the process. The two demonstrators go on to talk about other matters. Mandisa recalls that Thandeka was her demonstrator when she did the first-year practical course.

Mandisa: She was way mean back then, but now she is much calmer.

Mncedisi nods and laughs; he has also noticed a change in the way Thandeka deals with the students. She is much more approachable and her manner with the students is much kinder and more patient than when he first started working with her as a novice demonstrator.

Two students from Mncedisi's group have come to join the conversation. They are asking him about his research project and he attempts to link his explanation to some of the concepts they are currently dealing with in their theory course. The conversation drifts to Mandisa's plans after graduation. Mncedisi asks if she is planning to register for the Honours course, and she says she is thinking about it but it will depend on whether she passes all her third-year modules in the final examination.

The two demonstrators drift back to help the last students finish their worksheets and pack up. It is just after 17:00 when, without removing their red coats, they collect their bags and head for the door.

6.5 Discussion

In this chapter I hope to highlight the ways in which demonstrator participation in the community has changed. Occasionally I will touch on aspects of their practice that have stayed the same. Some changes to the practice are a direct result of the intercessionary process effected on the demonstrator community over the course of this study. Others are indirect spin-offs that could reasonably be attributed to the intercession. However, there is an important aspect of community that should not be overlooked for its potential to redirect practice, even in the absence of any form of intervention. Practice is produced by its members as a negotiated process of meaning-making (Wenger, 1998) but membership of many communities, including the demonstrator community, is *transitory*. Senior demonstrators graduate and leave the community, making room for novice demonstrators to replenish the ranks. Thus new generations of members are added annually. A complete reproduction cycle is longer because demonstrators may remain in the department for as long as six to seven years before they graduate with a PhD or, alternatively, they may choose to exit at some intermediate point of the trajectory with a lesser qualification. The point is that community members are constantly

changing, and even though the shared purpose of the community remains the same, the way in which community members engage in mutual enterprises aimed at realising the goals of the community evolves constantly. The demonstrator community as it is being characterised here has reached a point at which there has been an almost complete generational change; very few of the early demonstrator cohort remain. The uneasy atmosphere of mutual distrust that characterised the early community has all but disappeared along with the old guard. In the following quote from his interview Paki foresees this shift. In the quote the word “*that*” (underlined) refers to the events and circumstances surrounding the demonstrator sit-in:

I think it will take a generation. If these people who experienced that were a part of the past – leaves – I think maybe the new things it would get better because maybe that atmosphere will change.

(D-In-01-08, 2008)

The analysis of the narrative will progress in a similar fashion to the discussion of the early demonstrator community offered in chapter 4. Recall that three modes of belonging (*engagement, imagination and alignment*) from the conceptual framework served to frame the description of the early practice, and that three sets of three propositions each were used for a more comprehensive characterisation of the modes of belonging. Once again I will “bin” the salient ideas foregrounded in the narrative according to the same nine propositions.

6.5.1 *Engagement*

Proposition E1: Demonstrators identify the gaps in their (and their students’) knowing and work (together) to address them.

In the transforming community each demonstrator is in charge of the same group of between 10 and 15 students, which means that demonstrators are interacting more often with the same students. The data abound with evidence of demonstrators’ pro-active engagement with students. In the following excerpt from an interview one of the demonstrators (the one I named Bakari) explains how he knows when a student is struggling and needs assistance, and how he would engage such a student in discussion.

Bakari: Obviously, when a student is struggling they will not look at ease ... the student may have the manual here [points to the right] and the apparatus here [points to the left] then the student is trying to interpret this one and transfer the same thing into the practical skill, but then you can see there is no coordination between what is being read here and what is being taken to action. In most cases you can see that. That is why, when you sense it, it is good to ask: “Could there be any problem” or “Are you stuck somewhere?” In most cases (one) would know.

Karen: And then they would say: “Yes, I’m stuck, I need help”?

Bakari: Yeah, and others may be shy to ask you for some assistance, until the time they realise that you have noticed it, that is when they are forced maybe to raise up their hand, or now open up.

Karen: So there are definitely signs that one can interpret. Some students will ask you directly?

Bakari: Some will ask yes.

Karen: And others won't ask directly and then you have to interpret the signs?

Bakari: Yeah, until you approach the problem yourself.

(D-In-04-08, 2008)

Bakari classifies student problems as either “*a problem of not interpreting the thing*” (conceptual) or “*a problem of not knowing how to handle the apparatus*” (procedural).

Karen: Now, when you have to go about finding what it is that is that a student is struggling with, how do you find out what it is?

Bakari: Now, when you suspect or when a student raises a concern over something that he or she is not understanding, you go right away to the station, and find out what the problem could be, as in: is it a problem of not interpreting the thing or is it a problem of not knowing how to handle the apparatus? Once you identify whether it is interpretation or the handling of the apparatus, then you ask them to show you how they have attempted it. So that you can identify the actual mistake. So as they do it you will be able to know this is where the student is making a mistake and you ask them: “Now at this point, you are supposed to have done this.” So when that student corrects that and he is able to connect the next step, I think the student will feel OK.

(D-In-04-08, 2008)

As mentioned in 2.4.5.2, Bond-Robinson (2005) offers an identification scheme for pedagogical content knowledge (PCK) in the chemistry laboratory, which she represents as PChK (pedagogical *chemical* knowledge) to emphasise *chemistry* as the relevant discipline. Her scheme contains four forms of PChK and rates their difficulty in acquisition in the following order: PChK-0 < PChK-1 < PChK-2 < PChK-3. Bakari appears to display both PChK-1 (the ability to give general procedural guidance) and PChK-2 (an understanding of chemical concepts and topics in order to transform them to make sense to students). Bond-Robinson found that the TAs from her study seldom progressed beyond PChK-1 in their interactions with students.

Bakari was a teacher of mathematics and science in a neighbouring African country for two years before starting his masters studies in the chemistry department. This may explain why he was able to display higher levels of PChK. His approach of letting the student show him how far they have progressed on their own before they encountered difficulty, and then helping them to identify and correct their “mistakes”, was probably carried over from this experience. Wenger

(1998) contends that “learning in practice is not necessarily parochial”; what participants learn in a particular setting may become part of their identities that can be carried into other parts of their lives. What Bakari learnt in the school setting certainly seemed to be part of his identity, and throughout my interview with him he drew parallels between the two contexts; the first-year laboratory on the one hand and the Kenyan high school setting on the other. I have chosen the following quote to represent how he saw himself. During the interview, I asked whether there had been a change in his participation in the laboratories since he started demonstrating. His simple answer confirmed his identity:

Umm, I have not seen much change because I see myself the very teacher.

(D-In-04-08, 2008)

What about the demonstrators who do not have teaching or workplace experience to draw on? How are they addressing the gaps in their own and their students' learning? During a focus group discussion with novice demonstrators who had been serving in the first-year laboratories for less than a year, the conversation turned to the tension demonstrators experience between giving students too little versus giving them too much assistance. The first demonstrator in the quote (who has just started demonstrating) fears that helping them too much will make them too reliant on the demonstrator. He uses the specific example of the student not reading his/her manual, which is a common source of frustration for demonstrators and lecturers alike (refer back to chapter 4). The second demonstrator (who has been demonstrating for almost a year) then offers some advice. He suggests first referring the student back to the manual, stressing that this should be done in a friendly manner. He is referring to an unhelpful demonstrator (perhaps from his own days as a student?) when he talks about “a person” in the last line of the quote.

Demonstrator 1: Sorry, may I ask a question? When ... our job is to help the students during the practicals but I think that sometimes, when we help them too much, they don't read their practical as such. Sometimes a question that they ask us maybe they are in the prac manual but they are very easy questions. And if they read up they would know. So sometimes we overcompensate (for) their non-reading and it affects their reading of the manuals.

Demonstrator 2: Just to actually add the way I normally do this: I normally ... like it's all about the approach; the manner you say it. I mean if a person is actually struggling with something or maybe it's something that is easy to you. You don't have to assume that it is easy to that person. But what you try to do is to tell that person: “No, you know what: you have your manual” and then you show that person that it's actually in the manual so that next time they should try to be more ... to read a prac before she comes to the lab. Explain in a certain manner that's actually friendly and all that,

because you get a person (that will say): “you know what, you are supposed to know that”.

(D-FG-01-08, 2008)

The third demonstrator in the group also has approximately one year’s demonstrating experience. He suggests that, when a student still struggles after having been guided back to the manual, it is time for the demonstrator to step in and help more directly. In response, demonstrator 2 speculates that often student questions stem from a lack of confidence, and all they need is the demonstrators’ confirmation of their own interpretations. He suggests a technique for “turning (the situation) around”; making the student feel as if they are answering their own question(s). His contention is that this is empowering to the student.

Demonstrator 3: And to add to that: When they ask these questions you don’t have to give them direct answers. So for example they ask you since you know the answer you turn back the pages and tell the student read this paragraph and tell me if you can find out the answer. And if he asks you a second time that’s when you can try help them.

Demonstrator 2: Because I mean again you can find that the person actually knows the answer, but is not quite sure of what they know. So what you do is make it... turn it around... make it like you are answering the questions while she is actually... more like you empower the person...

(D-FG-01-08, 2008)

A survey (D-Su-02-07) of the 2007 demonstrator cohort contained an item set aimed at exploring who demonstrators felt they learnt the most from, and in what way. The set was introduced with the prompt: *I learned the most by...*, and demonstrators were then given the following options:

- Watching / talking / listening to my student(s)
- Watching / talking / listening to another demonstrator(s)
- Watching / talking / listening to the lecturer

The twelve demonstrators taking part in the survey could choose as many of the options above as they felt applied to themselves. Interactions with *students* attracted the most responses (25 in total); judging from the number of responses demonstrators considered *watching* students (8/25), *talking* to them (9/25) and *listening* to them (8/25) roughly equally useful for learning about demonstrating. Interactions with other demonstrators and with the lecturer attracted the same number of responses (18 in total) from the demonstrators surveyed, with each of the categories *watching*, *talking to* and *listening to* attracting roughly the same number (6/18) of hits. The research data abound with confirmation of demonstrators learning from their interactions with all the abovementioned role players in the laboratory. I will return to

demonstrator learning shortly (proposition I3) when I discuss the different trajectories that demonstrators are exposed to through their participation in the first-year laboratories.

I want to end this section with a quote from Paki, ever the wise one, highlighting that it is the questions that have not occurred to us, the ones to which we do not always know the answers, from which we learn the most.

Out of the questions that students ask; someone who is blank and asks you a question, sometimes he will ask you a question that you never thought about, from that you learn.

(D-In-01-08, 2008)

Proposition E2: Events and interactions exist that provide for discussion of issues and development of trust amongst demonstrators, students and the lecturer.

At the start of 2007, the penultimate year of data collection for the study, there was another brief demonstrator strike. This event was once again precipitated by a departmental decision that affected demonstrator and tutor wages. As mentioned before, demonstrator and tutor wages are paid from a central work-study budget. It happened from time to time that this budget (meagre to begin with) would be diminished from one year to the next; the budget amount was not fixed and seemed to bear no relationship to the number of demonstrators and tutors needed in the department. The department would respond to cuts in the work-study budget by decreasing the number of hours senior postgraduate students were allowed to demonstrate or tutor, and using the money thus saved to employ more senior undergraduates and junior postgraduates, who earn considerably less. This in an attempt to meet the department's needs in terms of demonstrator/tutor to student ratio.

At R110 a session, a PhD student earns more than double the wage of a third year student (R45 per session). At the time of this report, third-years, honours, masters and doctoral students earned R45, R59, R86 and R110 per session respectively, before deductions. In the case of a strike, the rule of no work no pay applies, but this rule is meant to be enforced by the technical officer, who does not control the demonstrators' duties and has little insight into what they do or whether in fact they report for work at all. Different payment control methods have been tried with varying degrees of success; at some point during the study for instance, the department was paying demonstrators even when they did not come to work, because it was reasoned that if the department did not use the entire work-study allocation made available for the payment of demonstrators and tutors, it would affect the following year's work-study allocation. Another model the department had tried in the past was to pay salaries to the demonstrators through the departmental budget and the human resources office, but the demonstrators soon learnt that the money would then be paid regardless of whether they

worked or not, and some then started staying away. Payment of the demonstrators remains a complicated issue to control.

After the second strike, Thandeka played a pivotal role in swiftly brokering an agreement between the department and the postgraduates, but the incident was not without fallout. As before, accusations were made and people were annoyed. Paki draws a parallel between the first (“in 2004”) and second (“last year”) strikes in the following quote:

And the department obviously interpreted it as individuals wanting to sabotage (the programme). So that has been a problem. And again when we met the people in the department last year it came up that we wanted to sabotage their programme. Even in 2004 the same statement was made. Some threats were also passed.

(D-In-01-08, 2008)

Predictably, the senior postgraduates were most affected by the wage issue. In addition to being targeted for a reduction in hours by virtue of being the higher income group, they were also the ones with the most to lose: many already have dependents and are therefore more reliant on receiving a certain amount every month to cover their financial commitments. Also, they have more years invested in their studies and hence stand to lose more from a soured relationship with the department. By comparison, the younger demonstrators are always less affected by power dynamics in the department. However, once an agreement had been reached, the peace was restored and life in the laboratories went on much as before. To me it seemed that recovery of the demonstrators' relationship with the department was much swifter than in the case of the first strike. Perhaps it was because by the time the second strike occurred, generational turnover had filtered the more disillusioned individuals of the senior postgraduate cohort from the system. I do not have evidence for this intuitive assertion, because demonstrators were reluctant to talk to me about the strike.

The intercessionary steps introduced over the course of the research project (discussed in chapter 5) increased the number of opportunities for demonstrators to interact with the lecturer in charge of the practical course and with each other (the annual demonstrator training session and weekly demonstrator briefings fall into this category) and with students (procedural changes like putting the demonstrators in charge of small groups of students fall into this category). A special annual end-of-year event was also introduced for demonstrators to interact informally with the lecturer and each other. During this celebratory event, to which demonstrators received a written invitation, and at which refreshments were served and each demonstrator presented with a small gift, demonstrators were encouraged to air their opinions about what worked and what did not work for them during the year.

Did these events and interactions have the desired effect of developing trust amongst demonstrators, students and myself? I enjoyed good relationships with Thandeka and later

Nofanele, and my regular meetings with them were characterised by openness and clear, productive conversation. After the demonstrator briefings were discontinued, Thandeka and later Nofanele were responsible for distributing and clarifying my written briefing sheets and marking schemes to the demonstrator community. Towards the end of the study most of the demonstrators themselves were quite comfortable in my presence, and would regularly come to chat to me of their own accord during practicals. I also noticed that demonstrator attendance at the pre-practical briefing sessions was much higher than at the start of the study, which I interpret as evidence that the demonstrators of the transforming community are more committed to the demonstrating task. As mentioned earlier (proposition E1), giving the demonstrators accountability for a small group of students has helped to foster closer relationships between the demonstrators and students. A consequence is a more positive laboratory experience for the students, as is acknowledged in the following quote from the focus group discussion:

When your students actually know you ... uhm ... the people that you demonstrate to, they actually look forward to the pracs for the session ... so that's the nice things about the way the structure is now.

(D-FG-01-08, 2008)

The younger demonstrators seem to identify more strongly with the students, and vice versa, which makes a good case for involving undergraduate students in demonstrating duties, since they are much closer to the student's own experience than older, more experienced demonstrators. The group of (relatively young) demonstrators of the focus group discussion spoke at length about their respective attitudes towards the students. The following excerpt captures a strand of conversation from the discussion:

Karen: How do you like to be with your students?

Demonstrator 1: OK, the (way) that I actually like to be with the students is to be more like friendly like try to be approachable. And OK, there is always that thing like that the student has got to know that we are supposed to like seriously want. 'Cause you try to make the point to make it more like fun, try to have that fun element within the thing. So that the person can enjoy what he is doing. 'Cause its pointless to have a prac, I mean, without having fun. 'Cause ... what I normally do is to like in-between the pracs I will normally talk to the students individually just to get their view on the pracs. How the pracs are going? How the chemistry life it's actually like, the tests and all that you know. And in most cases you will, I mean like, funny enough, there is the still (a whole lot of people who don't believe) that I am doing honors and when they look at me (they think) he's still very young, he is doing probably the second year or something. So it's something that sort of motivates them.

Karen: So you are like a role model to them?

Demonstrator 1: That's the thing. So I always try to be sort of more like one of them. Yeah, 'cause it's something that's – I mean – I can sometimes stand my ground and tell them you know what, you can't do thisbut honestly the relationship with the student has got to be, you must try to come down to their level, so that you can understand what they are going through. And be more like them – make it more – be approachable.

(D-FG-01-08, 2008)

In the above excerpt the first demonstrator (in his honours year) attaches importance to “coming down to their level” in order to “understand what they are going through”, being “approachable”, bringing in a “fun element”, and showing an interest in students’ “chemistry life” (referring to their experience of their chemistry course, the tests and practicals) outside of the practical sessions. He seems to suggest that students find it motivating to interact with a demonstrator as young as himself. In the following excerpt, the second demonstrator (in his third year of study) sees himself as “one of the students”, but with a little more experience.

Karen: What do you think [*addressing demonstrator 2*]? You are closer to the experience, because you are a new demonstrator, right?

Demonstrator 2: Yes I am. Because we are all students – that's the attitude I like to have: we are all students – I think I act exactly like one of them. It's just that I have been through the practicals, so I know a little more than them ... So I like to be very friendly and I understand we are all students. I like to be very relaxed. I am not very firm. I'm not a very firm person but I'm learning to become as well.

(D-FG-01-08, 2008)

From the quote above, he seems to have some difficulty balancing the discipline aspect of the job with his friendly, relaxed “buddy-to-the-students” identity in the laboratory. Novice teachers commonly attach prime importance to cooperative and friendly relationships with their students (Geddis, 1993).

The red coats issued to demonstrators at the start of each year served another purpose besides making the demonstrators more visible in the laboratory. They gave the demonstrators recognition for their leadership role in the laboratory, and it was clear from the fact that they were often seen sporting them outside the department, that they wore their red coats with pride.

Proposition E3: A shared demonstrating experience has accumulated with potential for further development.

Practice in the transforming community is different from the practice in the early community in many respects. Some of the changes to the demonstrating practice have been introduced “from the top down”, such as the intercessionary steps that were discussed in the previous chapter. Some have evolved “from the bottom up”, such as the way in which the demonstrators have

taken ownership of the training sessions (see *Demonstrator training*, chapter 5). Thandeka and Nofanele's practice of getting the students to check their practical marks against the printed list was also not introduced "top down" but originated with themselves.

Some changes have been easy to introduce and demonstrators have immediately recognised (and experienced) their value. An example of this is the requirement that students submit flow diagrams at the start of the practical session. A flow diagram is essentially a schema showing how the student intends to progress through the procedural steps of the experiment. Flow diagrams as learning strategy have the potential to improve student preparation for their practical work (Davidowitz & Rollnick, 2001) since their construction requires a deeper level of engagement with the experimental instructions than simply reading through the procedure. The argument is that, in order to construct a flow diagram, the student has to engage with the experimental instructions on a level that would permit transformation of the experimental procedure into a pictorial schema. An example of a student's flow diagram has been attached as Appendix 6.1).

Other changes to the demonstrating practice have taken longer to take root: the idea of each of the demonstrators taking charge of a small group of students took several years to find acceptance. I had suggested this change at the start of the study, but was told at the time that demonstrators would not accept it. Given the uneasy relationship between the department and the demonstrators at the time, I chose not to force the change, but I kept suggesting it year after year. In the penultimate year of the study the demonstrator community was finally ready to implement my suggestion. Perhaps the gradual "generational change" that I spoke of in the introduction to this chapter had resulted in an attitude shift and greater acquiescence in the demonstrator community. In the following excerpt from the interview with Thandeka, she explains that the demonstrators of the early community preferred the practice of roaming (*just being in the lab*) to each demonstrator being in charge of their own group of students because they had the perception that the latter represented an increased responsibility (which can also be interpreted to mean "more work") for each of them. She contends that her own tenacity (*sticking to it*) won in the end, but that demonstrators soon recognised the value of the new practice (*they see that it works*) because it meant their interactions with students during the practical sessions were much less rushed (*you don't have to run up and down*).

Karen: But you know what, in the beginning there was not much support for that idea. In the beginning when (the lecturer) suggested it, the demis didn't really want to do that.

Thandeka: They didn't, yeah.

Karen: So now, how is it that (you) managed to introduce it and they bought into it?

Thandeka: I think we stuck to it. Some people don't like change. Because what we were suggesting to them it was more responsibility for them. They like the idea of just being in the lab. So when

you say: "You are going to have your own students", (they are) like: "OK, now its more responsibility for me, and I don't want that."

Karen: It is uncomfortable?

Thandeka: Exactly. So people don't like it, but we were lucky enough of sticking to it, and saying this is what we want, work on it. So people tend to not like it at the beginning and then they see that it works, because if it is like that you don't have to run up and down and do something.

(D-In-02-08, 2008)

Along with the demonstrators being responsible for assisting their own small group of students came the responsibility of keeping a record of their attendance and achievements on practical tasks. In the following excerpt from the same interview, Thandeka talks about a common situation in the laboratories, namely that of a student being absent from the practical and then claiming afterwards to have been present. Since attendance at practicals is a compulsory requirement of the course it is important to keep an accurate attendance record. However, keeping account of every single student in a group of 60 or more presents a problem when at most one person per laboratory is invested in this task. The early practice saw Thandeka having to deal with numerous students claiming to have been present at previous practical sessions, but with no signature on the centrally kept attendance record to show for it. In most of these cases there would be a submitted and graded assignment, and therefore a mark awarded to the student, but given the fallibility of the record-keeping system it was easy for students to get an accomplice to submit worksheets on their behalf and then later to claim that they had forgotten to sign the register. These students would often be given the benefit of the doubt because it was not easy to prove their absence, and as a result absenteeism was very common. Thandeka illustrates the value of the new practice (*now, with the demis in control*) compared to the old (*when the demis are all over the place*) in the excerpt below. What is valuable about the new practice is that it improves control in the laboratory, but in a way that is not coercive or giving the impression that the students are being policed.

Thandeka: And also when it comes to students not pitching up. When the student doesn't pitch up, because the demis are all over the place the student says he was around, (but) the script is not there. And I'm like OK fine, where do I have proof that the student was not around? And he will come with a friend ... the friend will go like "Ja, he was here", even though he wasn't. But now, with the demi (in control of the register), I ask the demi: "You know your students more than I do, was he really here?" And the demi goes like: "No, he wasn't" or "Yes, he was. I know my student was here." "Why didn't you put a mark?" or "Why is the mark missing here?" You see, things like that, because they know them very well.

Karen: Yeah. That's interesting; it improves the discipline in the laboratory in a friendly way?

Thandeka: In a very friendly way.

(D-In-02-08, 2008)

Social theories of learning focus on learning as participation, but I was also interested to consider what demonstrators learnt *from* their participation. The data contained varied conceptions of demonstrators' own learning that are important to include here. In the following quote Nofanele expresses *surprise* at having learnt things in a situation that was ostensibly meant to be a learning opportunity for students:

At the end of the practical what has the student learnt? And you will be surprised that the demonstrator, you have learnt something too from that practical.

(D-In-03-08, 2008)

The demonstrator in the next quote learnt some chemistry that he had forgotten from his first year, but he has also learnt something about teaching, namely that when students teach each other by verbalising their own understanding of a concept, that aids their own learning.

I don't always recall the stuff that I did in our first year pracs and so I am always learning (from) what (the students) are doing. And when we actually go through the pracs together I actually get some of the answers. Then I can apply those answers to the other people, and I like them to explain the answers to their friends as well. It makes it much easier, the process, because they get to learn a bit more as well. 'Cause when you explain you are learning as well.

(D-FG-01-08, 2008)

They have also learnt about students, student learning, and some of the requirements for learning to occur. In the next quote one of the demonstrators in the focus group suggests that experiments should be more fun and interactive in order to maximise the learning opportunity. This demonstrator also refers to the reciprocal nature of learning; demonstrator and student learning from each other:

They must really actually try to make it more fun, more interactive. So that the person just don't go into the lab and tell himself: "I am going to just do my prac and leave". I mean there is whole lot of stuff that ... one can learn out of a prac, not just chemically related but there is actually a whole lot of stuff. Even if it's chemically related I mean there is a whole lot of stuff that we don't really do in class that we can learn from the first years and that they can learn from us.

(D-FG-01-08, 2008)

Thandeka, in her interview, suggested that she had learnt about professional behaviour, and what it means to be an academic:

You learn to see how people work. You know I was looking at (Karen) every day, I would see how (she) talked, how (she) give the lectures, and I was like, OK, that's how you do it, and everything I was following what (she was) doing.

(D-In-02-08, 2008)

The demonstrator in the following quote has learnt that the demonstrators can rely on each other for support:

So it's something that you ... learn like that you are not alone. You are not on your own, as in that you have people that, whatever happens, they always there to support you. You can always go and seek help.

(D-FG-01-08, 2008)

Finally, a number of demonstrators referred to the enduring nature of learning, in the following trio of quotes from Paki's interview and the WiM2baD survey:

You know, what I learnt is that any practical course, any technical course, if you get involved in it, whether teaching or learning or being a student (in fact that's what I always say to students) whether you pass it or you don't pass it, but you will remain with the knowledge.

(D-In-01-08, 2008)

To assist and learn students with the necessary skills during the practicals for future use. That is something which can never be taken away from them for the rest of their lives.

(D-Su-02-07-D1, 2007)

The next section of this thesis will argue that they have also learnt about their own identities and priorities when I draw together my findings in relation to the extent to which demonstrators see themselves as participants in groupings and processes that reach beyond their direct engagement in the practice of the demonstrating community.

Wenger (2000: 232), in discussing learning in a community of practice, contends that "communities of practice deepen their mutual commitment when they take responsibility for a learning agenda, which pushes their practice further". I have described how the community of demonstrators is taking the first tentative steps towards defining their own learning agenda, with Thandeka playing a pioneering role in defining a transformed practice for the community.

6.5.2 *Imagination*

Proposition I1: Visions of the potential of the community inspire participation amongst demonstrators.

When asked about their reasons for participating in the demonstrating programme, most demonstrators will first cite money as their main motivator. However, the data contain three explicit references (from three different individuals) to "giving back" as one of the reasons demonstrators gave for participating in the demonstrating programme. One reference was from a demonstrator interview (with Nofanele); another from an informal conversation with Mandisa during a laboratory session and a third was from a demonstrator survey (D-Su-02-07). Nofanele uses "giving back" in the sense of "paying it forward" in the following interview segment. Beyond

her mention of “other people” (her own first-year demonstrator) believing in her, she is not specific about what she intends to pay forward:

I have to give back. That’s the way I just regard it. I have to do the same for my students because other people believed in me. So if they did that for me, why not do the same for them?

(D-In-03-08, 2008)

The unknown demonstrator in the survey uses “giving back” in a similar sense, but refers specifically to knowledge:

The other thing was to learn to interact with other young students so that I can give back the knowledge that I have learnt.

(D-Su-02-07-D8, 2007)

Mandisa’s use of the phrase “giving back” is also non-specific, captured in the following excerpt from my own journal notes:

Demonstrating is an opportunity to connect with people, and this is something (Mandisa) enjoys. She wants to give back, she says. I ask her why that is important to her, and she offers the following explanation: “When you walk in res, everybody knows everybody, doesn’t matter whether you are Coloured or Black”.

(R-JN-09-10-08, 2008)

What is interesting about the above interaction is that Mandisa seems to be suggesting that there is a sense of connectedness that engenders support in the student community on campus. Connectedness is central to the African concept of *ubuntu*. It is best summarised in the Zulu expression *umuntu ngumuntu ngabantu*, or translated: “a person is a person through other persons” (Ramose, 1999). The philosophical tenets of *ubuntu* express the unity and harmony of personhood in addition to holding the notion that *identity is developed through interaction with other persons*. *Ubuntu* as a world-view has strong parallels with the perspectives of social learning theories. The latter hold that learning occurs through active participation during which individual identity transformation is achieved in relation to the practices of social communities. I want to include here two additional definitions of *ubuntu*, both cited by Forster (2006) in his exploration of the concept in the context of artificial intelligence. The first definition is by du Toit (2004: 33), who writes about *ubuntu* from the perspective of the interface between science and religion:

In Africa, a person is identified by his or her interrelationships and not primarily by individualistic properties. The community identifies the person and not the person the community. The identity of the person is his or her place in the community. In Africa it is a matter of ‘I participate, therefore I am’... *Ubuntu* is the principle of ‘I am

only because we are, and since we are, therefore I am'. Ubuntu is African humanism.

The notions of interrelationship, community, identity, and participation are central to community of practice theory, where they are used in specific relation to social communities. In the definition above the same notions are applied to community in its widest sense, namely human society. The parallels are strikingly clear.

The second definition (Broodryk, 2002: 13-14) introduces the notion of "family". Broodryk defines *ubuntu* as follows:

A comprehensive ancient African world view based on the values of intense humanness, caring, sharing, respect, compassion and associated values, ensuring a happy and qualitative human community life in a spirit of family.

A demonstrator from a focus group discussion actually mentions "family", in relation to a growing network of connections in the demonstrator/postgraduate community, in the following quote:

So the only person here that I am really close to is Thandeka. And Thandeka introduced me to Nofanele, and these guys (referring to the two other demonstrators in the focus group) I knew from last year. So but recently we starting to develop this family thing; we starting to know each other better.

(D-FG-01-08, 2008)

Demonstrators (even relative novices like Mandisa) understand that, beyond the extrinsic rewards of money and a reference on their CV that benefit them on an individual level, their participation in the laboratories contributes to something bigger on a collective level. Their awareness of the potential impact of their participation inspires them to remain involved in the practice even when the individual rewards hardly seem worth the effort. Whether or not this represents a *collective vision* is not clear, but probably unlikely. It is also not possible to say how widespread the notion of wider contribution is in the community of demonstrators, because the issue was never explicitly raised during data collection. As with most of the data, individual insights are given prominence here. This is the case also with the following quote with which I want to conclude the discussion of this segment. In the quote Paki displays an awareness of the *interdependence* (an implied tenet of *ubuntu*) of all those involved in the laboratories. In the preceding conversation he had been referring to the relationship between the department and the demonstrator community. Here he refers to the demonstrator sit-in ("that strike") as a lesson to all that "each one needs the other".

And I thought that strike, if one studies it very well, it is a lesson it gave that each one needs the other. Each one needs the other.

(D-In-01-08, 2008)

Proposition I2: Demonstrators know about the meanings that participation in the laboratory makes in their and their students' lives.

I have just argued that demonstrators' desire to "give back" is evidence of a vision of contribution to the wider community in the spirit of *ubuntu*. One could also make the case that "giving back" is part of what it means to be a demonstrator. *Meaning* both permeates and shapes our *vision*, as much as our vision (or imaginative insight) shapes the meanings we attach to our experiences.

In this section I want to focus on *meaning* in the sense of *meaningfulness*, rather than limiting my discussion to the everyday definition of the word. Wenger (1998: 52) offers a definition of *meaning as an experience of everyday life* that reaches considerably wider, and is best summed up in the author's own words:

- “ 1) Meaning is located in a process that I will call the *negotiation of meaning*
- 2) The negotiation of meaning involves the interaction of two constituent processes, which I will call *participation* and *reification*
- 3) Participation and reification form a duality that is fundamental to the human experience of meaning and thus to the nature of practice”

Hence, Wenger locates meaning in the continuous, often incremental, back-and-forth process of *meaning-making* that infuses all of human engagement. “Negotiated meaning is at once both historical and dynamic, contextual and unique ... Meaning exists neither in us, nor in the world, but in the dynamic relation of living in the world.” (p54).

Participation, in the sense that it is meant here, refers to more than the common understanding of the term, namely the process of taking part (or sharing with others) in some experience. It encompasses all that is implied by “the social experience of living in the world in terms of membership in social communities and active involvement in social enterprises” (p55).

Reification refers to the process of creating (often abstract) representations of experiences or ideas that, within social communities, turn those experiences or ideas into “things”. There are many good examples of reification in chemistry. Think of the highly symbolic formulae that chemists use to represent compounds. Water, as most people would know, is represented by the formula H_2O , which is nothing more than a string of three symbols ordered in a certain way. To a chemist's mind (and the minds of many who are not chemists but paid attention in science class) those three symbols repeated in the correct sequence and format *becomes* the substance water. The tendency of some South African chemistry students to refer to water as “aych-two-oh” bears testimony to the inseparability of the substance and its reification (the formula) in these students' minds. Even the word “water” is a reification of the actual substance that we perceive as having a reality of its own. Another example (and there are many more)

from chemistry is the notion of *titration*, which is a reification made up of many layers of reifications. To a chemist the words “to titrate” brings to mind not only the process of performing quantitative volumetric analysis, but also the equipment, materials and special techniques that might typically be required, how these might be prepared and employed to perform the analysis, what the experimental data might look like, which algorithms might be useful to translate data into results, what the sources of error might be, and so on and so forth. To a non-chemist on the other hand, the same abstraction may mean nothing at all.

On one level the process of reification simplifies communication by condensing meaning into negotiated “chunks”. On another level reification focuses our attention and enables new kinds of understanding. Reification can take many different forms: a caution symbol on a bottle of hydrochloric acid, a grade mark (in red ballpoint pen) on a student’s practical report, the raised eyebrow of a demonstrator glancing at a student’s titration figures, or the many parallel graduations on the side of a burette. All of these indicate larger contexts of meaning in laboratory practice.

Participation and reification are complementary processes that permeate our practices. Wenger (1998: 63) stresses that they represent a duality rather than a dichotomy. He captures the duality of participation and reification in a diagram that has in its centre a motif that is strongly evocative of the fishtails in the familiar Chinese *Yin-Yang* symbol (Reninger, n. d.).



“The curves and circles of the *Yin-Yang* symbol imply a kaleidoscope-like movement. This implied movement represents the ways in which Yin and Yang are mutually-arising, interdependent, and continuously transforming, one into the other. One could not exist without the other, for each contains the essence of the other.”

Whether it was the intention of the author to suggest a parallel with the notion of *Yin* and *Yang* is uncertain, but to my own mind it is very fitting. I have adapted Wenger’s original diagram to capture how the participation-reification duality might play out in the community of demonstrators (figure 6.3 below). The fishtails in my adaptation represent participation and reification flowing into each other. In the *Yin-Yang* symbol the interior dots (or eyes) suggest that *Yin* and *Yang* both contain the seed of each other. In the same way reification and participation contain the essence of each other.

Participation compensates for the inherent limits of reification. The demonstrators interact with students when there is something in the manual (a reification) that the students do not understand. They demonstrate to students how to operate the pH meters, even though there are written instructions in the manual. The lecturer or Thandeka discusses the information on the briefing sheets with the students and demonstrators at the start of the practical session. The demonstrators inform the students not to use 40 cm³ of the 5% sulfuric acid solution as instructed in the manual, but rather 20 cm³ of the 10% solution that has actually been supplied.

Thandeka explains the memorandum and codes used for evaluation of the students' work to the demonstrators, thus when the reification is inadequate, outdated or not flexible enough, participation steps in to fill in the gaps.

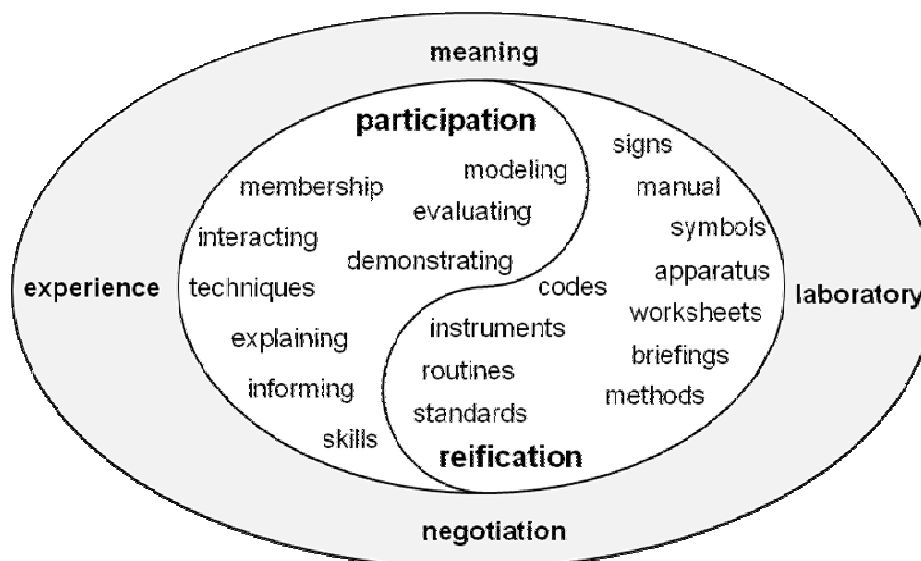


Figure 6.3: The participation-reification duality in the demonstrator community.

By the same token, reification compensates when participation is inadequate. Thandeka draws a burette section (reification) on the board when she explains to students how to read the burette volume to two decimal places during the pre-practical briefing session. A decal (reification) at the laboratory exit reminds students to wash their hands before they leave the laboratory. A demonstrator helps a student with a question on chemical equilibrium that requires application of Le Chatelier's principle² (participation). The demonstrator writes the equation (reification) for the equilibrium reaction on a piece of paper and indicates on the equation the direction of the expected equilibrium shift during their discussion. Thus, reification solidifies participation, clearing up ambiguities, tightening informality, and adjusting misalignments.

Proposition I3: There is a language that talks about the community in a reflective mode.

Proposition I3 is rooted in the mode *imagination*. My concern at this point is with the ways in which members of the demonstrator community develop a sense of self and a personal interpretation of their own participation. Proposition I3 can be complemented by the statement: *There are self-representations that would allow the community to see itself in new ways* (Wenger, 2000). The implication is that, beyond constructing an image of their present selves in relation to the community, members are also imagining where their participation may take them in the future. The term *trajectory* (Lave & Wenger, 1991; Wenger, 2000) describes a learning

² Le Chatelier's principle is a key concept covered both in the theoretical and practical components of most first-year chemistry courses.

path that encompasses where one comes from and where one is headed, and is useful for this discussion.

Thandeka singles out the lecturer in charge of the practicals as the one person from whom she learnt the most. In the following quote she reflects on watching the lecturer's interactions with students ("*how the lecturer talks*") and presentation of pre-practical lectures, and then following the lecturer's example when she was given the opportunity to stand in for the lecturer.

You know I was looking at (the lecturer) every day, I would see how (the lecturer) talk(s), how (the lecturer) give the lectures, and I was like, OK, that's how you do it, and everything I was following what (the lecturer) were doing ...

(D-In-02-08, 2008)

Thandeka is learning by observing and working with the lecturer and, much like an apprentice, gradually takes on greater responsibility as her confidence and competence grows. Her role as practical manager or superdemonstrator is exposing her to a possible future in academia³. Her identity is expanding over time (Lave & Wenger, 1991) and she is starting to imagine a trajectory for herself.

Wenger (2000) discusses three different kinds of trajectories that community members might embody, and that newcomers to a community might use as material for constructing their own trajectories. The first of these, *inbound trajectories*, "invite newcomers into full membership in a community". Newcomer demonstrators are on inbound trajectories into full membership of the demonstrator community. This type of trajectory also plays out when newly appointed lecturing staff are formally inducted and mentored in the practices of an academic department. Thandeka's trajectory has taken her through the demonstrating experience and beyond that on to a new trajectory headed for an academic career.

Four novice chemistry lecturers at two different tertiary institutions were interviewed separately during the study, and all four reported having demonstrated and or tutored during their postgraduate years (three of the four actually started demonstrating while they were still undergraduate students). None of them had an academic career in mind at the outset, and all but one started seeing it as a possibility sometime during their postgraduate studies. The following interview segment sums up one young lecturer's experience:

Karen: When you started out as a student, did you have an academic career in mind?

Lecturer 1: No, I didn't really have ... I wasn't really sure ... I liked science and that was about as much as I knew and I started on a science path and I didn't really know where I was going to end up. I didn't specifically think I was going to be an academic but I didn't specifically not think I was going to be an academic. I don't remember.

³ In chapter 4 I told the story of how her dream of an academic career was realised sometime towards the end of the study.

Karen: So, when did you first start considering it as an option?

Lecturer 1: I guess when I started doing my postgraduate studies, when I started a Masters. I love research and then I also very much enjoyed the tutoring. I guess it was from when I started postgraduate ... even ... probably even before that, when I was doing Honours. I was initially planning to do oceanography, when I started first-year that was my plan. I majored in oceanography and chemistry, and then I got a vac position with prof X and then I decided that chemistry was actually what I was going to do. I think that was the end of second year. So even from then I kind of had the research thing in my head and I knew I was generally going in that direction.

(L-In-03-08, 2008)

Two of the remaining three lecturers interviewed reported similar experiences and the fourth reported that only once she had completed her doctoral studies, and had recovered from the stress (she uses the word *emotions*) of the experience, she saw lecturing as a career option.

Karen: When you started your studies, did you have an academic career in mind at all?

Lecturer 2: No. Not at all. I actually didn't quite, I just went where I felt comfortable, so I had no real plans in mind. I would never have thought that I would become an academic really because I could not imagine that I would be able to stand in front of a big crowd and speak. I did not plan this at all.

Karen: When did you begin to see it as an option?

Lecturer 2: The moment I finished my PhD.

Karen: Oh, so only then?

Lecturer 2: Yeah, only then because, what happened: You know you go through a lot of emotions when you start writing your PhD, the last thing you want is to be at university. You just want to get as far away as possible. So, I actually saw this ad online and I just said: "No ways, I don't want to be at university anymore", but that was just a lot of emotion. And, the minute I submitted (my thesis) and I was gradually releasing ... the weight started becoming a little bit lighter ... then I thought: "Oh, maybe I should apply, it's not such a bad idea". So that's when I applied and I surprisingly got the job.

(L-In-04-08, 2008)

Thus, peripheral participation in teaching (demonstrating and tutoring programs) *and* research activities (postgraduate research programmes) open up trajectories into academic careers. In the discussion that follows I want to present evidence that participation in demonstrating may actually open trajectories *into* postgraduate study. I ask the reader to bear with me through a rather lengthy introduction to the argument, which I nevertheless believe has relevance as a point of departure. At one point during the interview with Nofanele I was exploring the strong sense of cohesion that I had become aware of amongst members of the postgraduate community. Nofanele was a relative newcomer to the community at the time of the interview,

but had some experience of demonstrating practice at her first institution in Botswana, and I was interested in her experience of the community under study. In the following excerpt she talks about “relating more” to demonstrators who are masters and doctoral students (she refers to them as *postgrads*) than to those who are still third-years or Honours students. The implication is that, to the (true) *postgrads* both groups (Honours and third-years) are excluded from full membership of the postgraduate community even though BSc Honours is officially considered a postgraduate course. Her half-expressed reference to “class” serves to strengthen the sense of exclusion. When it comes to doing the demonstrating work, however, all the demonstrators essentially “do the same thing” irrespective of her earlier distinction. She then constructs a conversation with an imaginary third-year student-demonstrator. In her invented conversation, she asks whether the student is planning to enrol for postgraduate studies (*do your postgrad*). She later rephrases this question into an *invitation*: “Are you coming to join us?”

Karen: In a previous interview I got the sense that the postgraduates are connected somehow, there seems to be a community of postgraduates, more than a community of demonstrators? Or maybe a larger community of postgraduates within which the community of demonstrators operate?

Nofanele: Yes definitely. I think that's true ... I relate more with the post grads than (with) the honours and third years. So post grads ... yes, we talk. I would find it easier to have a conversation with a fellow post grad. With the third years I think that they are scared to come and talk to me ... you do recognize the others as demonstrators but whether it is a class thing now going on? But there is that thing of post grads. Yeah, we can talk. (I might say to an) undergrad: “Oh, so you are doing your third year? Oh, do you plan on doing your post grad?” The conversation is a bit strained. But when it comes to work we all do the same thing. We all get to work.

Karen: That is interesting. Could it mean that they are actually on the fringe of the community?

Nofanele: Yes.

Karen: And with the potential of (coming) into the community?

Nofanele: Yes, yes, (in the sense of) “Are you coming to join us?”

(D-In-03-08, 2008)

Later in the interview Nofanele returns to the same topic:

I never thought I would do any research myself but I was hired in my third year as a research assistant, so that's the way I found myself doing (research). My university never used to consider undergraduates for (demonstrating) posts. But still, exposing them to that at such an early stage, I think it's really good. Because now they want to get to that level where, I don't know, they get to interact with us more now. They get to know us, we talk about our studies with them and I think we are getting more (postgraduate students). If you look at the number of people who've come as postgraduates here, I bet most of them they have been

demis, they have worked as demis. As compared to somebody who has never worked as a demonstrator, chances of them showing any interested in postgraduate work is a bit limited I think.

(D-In-03-08, 2008)

I found this extremely interesting. In the excerpt above Nofanele suggests two different ways for undergraduate students to gain exposure to the world of research. The first is through involvement of undergraduates in research internships; this kind of trajectory is well recognised in the literature (Seymour, Hunter, Laursen, & Deantoni, 2003) and is how Nofanele came to imagine for herself a future in research. Secondly, when undergraduate demonstrators have contact with postgraduates through their joint involvement in demonstrating duties, their interactions open up trajectories for the former group into the latter. One could argue that trajectories into the demonstrating community intersect with trajectories into the postgraduate community since interactions of the kind that Nofanele refers to in the excerpts above have potential to invite newcomer demonstrators who are not yet postgraduate students to consider joining the postgraduate community.

Peripheral trajectories, the second type of trajectory Wenger (2000: 241) speaks of, are those that allow people to “interact with the community without making a commitment to becoming a full member”. When postgraduate students are involved in peripheral teaching activities such as tutoring and demonstrating, they are given a small taste of what it means to do academic work. The survey (D-Su-02-07) of the 2007 demonstrator cohort contained an item aimed at exploring the reasons why postgraduates applied for demonstrating positions. They were required to complete the sentence: *I decided to become a demonstrator because...* Four out of the 12 demonstrators participating in the survey gave reasons specifically to do with education (learn about teaching, improve my teaching, learn to interact with students, learn about how students operate/think). I do not have data about how many of the demonstrators surveyed actually had academic/teaching careers in mind, but I know from informal conversations that at least one demonstrator in the group did, and this demonstrator was not one of the four mentioned.

The final category of trajectory that Wenger (2000: 241) speaks of namely *outbound trajectories* point to “forms of participation outside the current communities”. This author uses the example of schools offering outbound trajectories when they prepare learners for careers outside of the school community. Chemistry students’ tertiary experiences prepare them for a variety of possible futures that may include careers in chemistry but may also reach wider than that⁴. The demonstrators do have a strong sense that demonstrating is preparation for their future careers. Out of the 12 demonstrators taking part in the DSu-10-07 survey, four demonstrators gave

⁴ Naturally, their exit levels from university determine their access to certain careers, at least in the short term.

reasons to do with the benefits demonstrating would bring in terms of their future careers (acquiring a reference for future job applications – 3 mentions; gaining work experience (non-specific) – 3 mentions).

We have seen in the previous section (proposition I2) that the demonstrators see their participation in the first-year laboratories as more than just a job. Once again, Paki has the last word. During the interview he reflected at length about the teaching aspect of demonstrating. He points out in the following quote that the demonstrating experience contributes to a person's growth (*it grows you*), even when one has no interest in an academic career.

In every class every year you always have something to learn from what (the lecturer) give(s) us in the practical itself and also the way the students approach it. It grows you even if you have no interest of teaching...

(D-In-01-08, 2008)

In the preceding discussion I have considered the ways in which members of the demonstrator community develop a sense of self and a personal interpretation of their own participation, which is the work of *imagination*.

6.5.3 Alignment

Proposition A1: Demonstrators have articulated a shared purpose; they subscribe to it, and feel accountable to it. Leadership is distributed widely in the CoP.

When discussing inbound trajectories in the previous section (proposition I3) I mentioned how, in my interview with Nofanele, I had become aware of a subtle divide in the demonstrator cohort that is based solely on academic level. The master's and doctoral students consider themselves (true) postgraduates and the honours students are not yet seen as part of this exclusive group. I wanted to hear what the honours students thought, and posed the question: *Do the honours students feel a part of (the) postgraduate community, or not?* during the focus group discussion with novice demonstrators. The only honours student in the group attributes his classmates' feeling of not quite being a part of the postgraduate community to the fact that the Honours group are still doing all the things traditionally associated with undergraduate studies (classes and tests, for instance) and none of the things that chemistry postgraduates traditionally do (working independently on research projects). His colleague (a master's student) then adds that in previous years the postgraduate committee in the department provided a means of uniting all the postgraduates (including the honours students) and giving them a voice in the department⁵.

Demonstrator 1: Right now, we don't really, for us still we still feel like we are undergrad students like although like lecturers always try to maybe treat us in a special way. But I mean the

⁵ At the time of writing the postgraduates had not managed to reconstitute the postgraduate committee.

way things are still running I mean it looks like we still attend normal classes. So its one of these things we have got classes, and lectures, we got tests. So we haven't really felt like whereby you actually have to manage your own time and get to meet with other postgrad students and all that. The only group that we still know is that Honours group which is just our class.

Demonstrator 2: To add onto that – I think it is like this because last year we had the post grad committee and we don't have it this year for some strange reason. So what we used to do (was to) have meetings at least once a month. We organized the honours students, masters and PhD, basically all the post grads. And we raised complaints like if we are having a problem with your supervisor, and what we do we just write the minutes and submit it to the head of department. Basically it was a support group so unfortunately this year we don't have that committee anymore and I was trying to ask last years committee what's going on now. And I am still waiting for them to reply. As soon as I know I will try to organise this committee. 'Cause it really helps you a lot.

(D-FG-01-08, 2008)

What other evidence is there of a shared purpose in the demonstrator community? I included in the second vignette my observation of demonstrators popping into the laboratories on their days off to visit their colleagues and then staying a while to help out when student demand for assistance was high. Most of these were undergraduates or from the Honours group. On the other hand, it would also happen that demonstrators' individual purpose would be at odds with the community's purpose, as when they had an important test to prepare for or a project to submit. Some demonstrators would then simply stay away from their demonstrating duties without notice, sometimes leaving Thandeka without a single demonstrator in the laboratory. This was strictly against the rules, as demonstrators were expected to not only notify the department, but also find a suitable replacement whenever they were absent from work. On an occasion, feeling frustrated about the large number of demonstrators absent from that afternoon's practical, I asked Thandeka which demonstrators were meant to work on that day. My intention was to call them in and demand an explanation for their absence, followed perhaps by a mild reprimand. Thandeka answered in an evasive way, and I was left with the distinct impression that she was protecting the defaulting demonstrators. Thinking I had imagined it, I tried on a few more occasions to elicit the names of absent demonstrators, and every time the same thing would happen. Even Nofanele, after taking over the reigns from Thandeka, behaved in exactly the same way. The only explanation I could think of for this baffling behaviour was that the two women were protecting the defaulting demonstrators, but why? They both knew me very well as somewhat of a "softie" who would never behave in an unfair or heavy-handed way with any student or demonstrator. It then occurred to me that perhaps they were protecting themselves, or rather, their position as broker on the boundary of the community. Perhaps if they were seen to "break ranks" and betray their demonstrator colleagues to a representative of the department they would lose their credence in the demonstrator community? It may have

been perfectly acceptable for them to reprimand a defaulting demonstrator themselves, but it never happened that they “sold out” any of their colleagues to me or any other academic in the department. Wenger (1998: 109) speaks of the uncomfortable “ambivalence” inherent in the role of broker: walking a fine line between being pulled into the community and being rejected as an outsider.

In the following excerpt I ask Nofanele about a sense of community amongst the demonstrators. She talks about “supporting each other”, being “in it together”, being “willing to help” each other and each other’s students, and “sharing duties”.

Karen: Would you say that there is a sense of community amongst the demonstrators?

Nofanele: Uhm, yes. We do support each other. Like you’d get somebody who is maybe junior to you. If they come up that they don’t know something that I might know, then I am willing to help. If one of us doesn’t turn up I would have to take over his students. So there is that community but the fact that we didn’t go to maybe to (the same class), maybe we didn’t do the same courses, we are not as close as they would be if they are from the same class for instance. Yes, so that not as close as we should be but still there is. We are in it together.

Karen: So there is a sense that you are in it together?

Nofanele: Yes, there is. We are in it together. We have sections to work in the lab but still, if somebody is not there we just won’t leave them. If one of the students comes to me, I won’t say: “No, you are not my student”. So yeah, there is that thing, like, it’s a big group but we try to share the duties amongst us. So there is that sense of community.

(D-In-03-08, 2008)

On the issue of the distribution of leadership in the community, Thandeka attempted to stratify the demonstrator community somewhat by introducing the practice of identifying another demonstrator to be “second-in-charge” to herself. This “lieutenant” did not have a special title but did wear a navy blue laboratory coat like Thandeka, and led the activities in one of the two laboratories in use during the practical sessions. Like Thandeka, this demonstrator would be paid from the departmental budget rather than from the work-study budget and their remuneration would be considerably more than that of the rank and file. Thandeka would lead in the other laboratory, and she and her lieutenant would coordinate their actions so that the same thing happened more or less at the same time in the two laboratories, and the same messages and information were relayed to both groups of students. This practice also served to groom Nofanele, who was second-in-charge to Thandeka in the year preceding Thandeka’s departure, to eventually take over Thandeka’s role. Nofanele perpetuated the practice during her own term as leader of the community. Thandeka also introduced the practice of selecting a number of experienced demonstrators to act exclusively as markers (graders) of the students’ practical worksheets. These individuals would not be required to attend practicals, and all of their “demonstrating time” would be reserved for marking. They were paid at the same rate as

other demonstrators with the same level of qualification, but could perform their marking in their own time, provided that it was completed before a certain weekly deadline. The freedom to choose when they did their demonstrating work was considered a privilege and consequently marking jobs were sought after and strictly reserved for the “old hands”.

Thus, in the transformed community, there is some stratification. At the bottom level are the rank and file demonstrators who all do the same work but are paid differently, according to their level of qualification. This group is informally separated into “true” postgraduates (masters and doctoral students), honours students and undergraduate students. The next level represents the “markers”, who do not interact with the rank and file, or with the students; their interactions are exclusively with Thandeka. Above them is Thandeka’s “lieutenant” who does the same work as Thandeka herself in the laboratory, but does not have the same behind-the-scenes responsibilities. At the top level is Thandeka, who manages the whole community, brokers with the department and acts as marks administrator.

Proposition A2: Clear definitions of the roles, norms, codes of behaviour, shared principles and negotiated commitments and expectations exist and are upheld in the community.

With the introduction of the demonstrator manual at the first training session, a clear set of expectations was communicated to the demonstrator community. Thandeka’s role, which was not clearly demarcated at the outset, was also shaped and given boundaries once the study got underway. What roles do the demonstrators see themselves playing in the first-year laboratories? Throughout the study demonstrators used many different terms to describe themselves in relation to the students (mentor, instructor, teacher, advisor, and role model to name but a few). The following quote from one demonstrator’s guided reflections represents a fresh perspective. This demonstrator uses the metaphor of a *bridge* spanning the *gap* between the lecturer and students. The *gap* may be created by the lecturer being unapproachable on the one hand, or by students being reluctant to approach the lecturer because of the language barrier between them, on the other (the parenthetical phrases in the quote are the demonstrator’s own).

I consider myself a bridge between students and lecturers. Most of the students are finding it hard to approach lecturers (I was also one of them when I was doing my undergrad), I have to admit some of the lecturers are not “student friendly” (not easily approachable). Therefore it is our duty as demonstrators to narrow that gap by communicating with students when they are having problems or misunderstandings. I think being a demonstrator is very helpful to most of the students especially black students. Sometimes they (Black Students) are finding it hard to approach lecturers mainly because they are not confident with the language (English). So to us as demonstrators, we have an ability to speak their language and it really make things much easier for them.

(D-RW-03-08-TM, 2008)

Another demonstrator uses the same metaphor in the demonstrator survey (D-Su-02-07) in response to the prompt: *During practicals it is the job of the demonstrator to...*

Be more like a bridge between the student and the lecture (lecturer) i. e. the theory and the practice.

(D-Su-02-07-D12, 2007)

In the quotes above the notion of “broker” comes to the fore once again. However, the demonstrators act as brokers on the boundary between the first-year student community and the department, while Thandeka (and later Nofanele) operates on the boundary between the demonstrating community and the department.

If the demonstrators were to construct a code of conduct for the community, one rule in particular would have a prominent place close to the top of the list, namely: “Never confuse the students” or, in the words a demonstrator might use: “Do not tell students the wrong thing”. This phrase occurred so often in the data that I started thinking of it as one of the demonstrators’ “commandments”. I have included three examples here; note the reference to *fear* in the final quote:

Demonstrator (in response to the prompt: *The most important lesson I learnt about demonstrating, was...*) ... know when to ask for help when I need one to avoid giving student wrong information.

(D-Su-02-07-Q8-D12, 2007)

Nofanele: So it’s one of those things, don’t disturb the students, don’t teach the students the wrong thing.

(D-In-03-08, 2008)

Paki: Normally what I always fear to do is to confuse the student...

(D-In-01-08, 2008)

In chapter 4 (proposition I3) I referred to research (Luft *et al.*, 2004) that showed postgraduate teaching assistants’ instructional styles to be directive and instructive. Students do not like to be told “the wrong thing” and the demonstrators know this from their own experience as students and from their experience with students. Luft and co-workers link the instructional styles of teaching assistants to the style of presentation of the practical *curriculum*, by which they essentially mean the laboratory manual. In the case of the first-year practical manual issued to the students and demonstrators of my own study, the style of instruction is also what would be termed *instructional* or according to other classifications *expository* or *traditional* (Domin, 1999) or so-called *verification labs* (D. Herrington, personal communication, 2008). Domin (1999a & 1999b) recognises the value of the use of this style of instruction when physical resources such as space, money, time and manpower are in short supply (all these constraints apply to the

first-year chemistry course in this study) but is strongly critical of its failure to encourage meaningful learning. He cites the work of Stewart (1988) to make the important point that traditional laboratory instruction tends to be results-driven and consequently, from the students' point of view, a race against time. Students simply do not have the time to make mistakes and cannot see how doing something wrong and having to repeat it can be of any benefit to them (Malina & Nakhleh, 2003). This procedural emphasis and results-driven attitude is also present in the demonstrators, as captured in the following quote from Nofanele:

You should all be into it for one thing. You want to work for the common goal. You have this practical you have to finish it. That's the way I look at it, so the ideal thing is: let's respect each other and let's work towards this one goal, finishing whatever it is.

(D-In-03-08, 2008)

This is probably the result of demonstrators' own undergraduate experiences having been primarily results-driven and focused on the transmission of procedural knowledge (Abraham, Cracolice, Graves, Aldhamash, Kihega, Palma-Gil, & Varghese, 1997; Hilosky, Sutman, & Schmuckler, 1993). Also, as mentioned before, demonstrators' own study agendas take priority. When deadlines loom and they are eager to get back to their own work, their sense of urgency may be transferred to the students, as suggested in the following quote from Nofanele:

(Demonstrators) are committed but their supervisors take priority, their personal work takes priority. So if there is conference there is something going on, people they won't be as committed ... Because if I have a paper to submit now, we are supposed to finish (the practical) at 5, not five past five.

(D-In-03-08, 2008)

A way around this apparent focus on results is to restructure the way in which practical work is assessed, so that less focus is placed on actual results and a greater mark allocation is reserved for evaluations of conceptual understanding (B. Davidowitz, personal communication, 2009). However, the assessment of results generally require considerably less insight (and time) than the assessment of conceptual understanding, and since demonstrators are assessing large volumes of practical worksheets under considerable time pressure, the ideal is not easily achieved.

Proposition A3: Methods, standards and routines exist to define good demonstrating practice, and these are upheld and transmitted to new generations.

The demonstrator manual and demonstrator briefing documents provide structure and delineate the space within which demonstrators operate in the laboratory. Paki sees this as a major factor in moving the practice of the community forward. In the following excerpt he refers to briefing

materials that were “organised and clear”. He expresses the belief that well-structured materials such as these ultimately help the students by aiding the development of the demonstrators.

Good demonstration depends on what you have and how is it given to you as a demonstrator. My belief is that for the benefit of the student, like (lecturer X) has been doing, I think I have made mention of that, (their) work was very organised, very clear. You need something like that which will benefit the student even if the demonstrator is not good. Such kind of material also trains the demonstrator. In the long run the demonstrator will also be good. If I demonstrate for you this year, you having such kind of organised material, when I come back next year I'll come back as a better demonstrator. So what makes a good demonstrator is the material the demonstrator has, the way it is structured, the organisation of it, that makes a demonstrator very good.

(D-In-01-08, 2008)

The practice of matching novice with experienced demonstrators is now well-established in the transforming community, but Thandeka has refined this practice even further. In the following excerpt she explains her methods:

Karen: OK, so now you've chosen your demonstrators, and you've got your list, how do you decide which ones to place where?

Thandeka: Ah, usually I make sure that they are not friends. I know who are friends, so I tend to separate them. And also it depends on what day they choose, they want to work. Except the postgraduates, they are flexible enough I can put them (any day). I put them so ... that I can see that they are compatible, like, can they work together? Not too many girls in one lab, not too many boys in the other lab, and if this one is a little bit quiet I put the other one who is very talkative on the other side. Because the thing is when they come in you can see who does a lot of talking and then, OK this one talks and this one doesn't.

Karen: And you said you don't put friends together, is that to prevent them from socialising too much?

Thandeka: Yes. They end up sitting just together at the same time not helping the students and truly speaking, since I've done that it works.

(D-In-02-08, 2008)

Thandeka's strategy is to match confident demonstrators (“*one who is very talkative*”) with demonstrators that are not as confident (“*is a little bit quiet*”), and to ensure that there is an even gender distribution. This practice helps to ensure that demonstrators stay focused on their interactions with students rather than interacting socially with each other. Thandeka seems to be of the opinion that her approach “works” (final sentence).

6.6 Conclusions

In this chapter I attempted to answer the question: “What is happening in and around the demonstrator community now that the intercessionary process is underway?” or “In what ways is the demonstrating practice transforming, following the introduction of changes to the programme?” The reader would have noticed that, in exploring the practice of the transforming community, I have not always looked at exactly the same aspects of practice that were considered when characterising the practice of the early community. I have used the same repositories or “bins” for analysis of the “before the intervention” and “after the intervention” data, but in some cases the “before” and “after” data simply brought up completely different issues. This may be because the before and after data could not be matched. I explained earlier how the reluctance of demonstrators to participate in the research at the early stages of the project meant that certain questions were not asked of the early community. Later, in the concluding chapter of this thesis, I will attempt to contrast the two situations as best I can, but for now I will suffice with a brief summary of the “after” data in terms of the modes of belonging chosen to frame the analysis at the outset of the study:

Engagement: A generational change has occurred in the demonstrator community and this, coupled with increased opportunities for interaction and improved communication with the department has had a positive effect on the trust relationship between the two parties. The small-group demonstrating model that has been adopted by the transforming community represents a prominent feature of the demonstrators’ engagement with the students, and this has seen a qualitative improvement in the number and quality of interactions between demonstrators and students. Younger demonstrators still tend to struggle with the tension between over- and under-control of the students in their charge. They are, however, a valued subgroup in the community for their ability to relate well to first-year students because they are closer to the experience of the students. All demonstrators are very aware of the value of their demonstrating experiences for their own learning, and most consider their interactions with students (as compared to their interactions with academic staff and other demonstrators) especially edifying.

Imagination: Demonstrators have an understanding of their participation in the laboratories that reaches beyond individual rewards such as money and work experience. The notion of *ubuntu* is deeply entrenched in their participation and inspires them to contribute to the demonstrating programme even when the remuneration hardly seems worth the effort. Demonstrators are aware also of the possible futures that their participation in the laboratories is opening up for them, whether they have aspirations to become lecturers, or want to go into industry. There is evidence that early participation in the demonstrating community may open the minds of undergraduate demonstrators to enrolling for postgraduate studies in the department, through their contact and interactions with demonstrators who already have membership of the

postgraduate community in the department. Not surprisingly, participation in the practices of the community involves many of the reifications (symbols, abstractions and representations) that form part of the repertoire of chemistry as a discipline. Demonstrators routinely use these reifications to help students make sense of their own learning in the laboratory.

Alignment. An unwritten code of conduct appears to exist amongst the demonstrators in the study. One of the most often articulated rules in the code is “do not confuse the students”. The unwritten code also recognises an informal stratification amongst the rank and file demonstrators, based solely on academic level, that operates alongside a small number of formal levels of leadership in the community. The master’s and doctoral students in the community see themselves in a different category from the rest even though they all do the same work. Some demonstrators are sufficiently committed to the community that they will volunteer to help out when their demonstrator colleagues are under pressure, but most will put their commitments to their own academic goals before their allegiance to the community. The leaders in the community are protective of community members even when they default, and will not betray defaulters even when the leaders themselves are disadvantaged by the behaviour of community members.

Attempts to structure and formalise demonstrating practice through the introduction of printed materials have seen a measure of success in improving demonstrator confidence.

In conclusion, many changes have occurred in the practice of the demonstrator community. In constructing the narrative above I have highlighted some of these changes but I have also attempted to shed some light on aspects of practice that are not necessarily different from “before” but are perhaps better understood in light of research data emerging from the transforming community. Finally, the transforming practice of the demonstrator community still identifies problems to be solved.

The next chapter describes an investigation based on mixed-method survey data generated before, and towards the end of the study. This will be the final data chapter of the thesis and will both support and contextualise the qualitative findings of chapters 4 and 6.



Chapter 7

A broader context for the study: Survey data about Baseline and Beyond

This chapter describes an investigation based on survey data generated before and towards the end of the study. The findings reported here provide a broader context for the qualitative findings discussed in the preceding chapters.

7.1 Introduction

I was appointed as chemistry lecturer at UWC during the first year of this study. I had just enrolled for my doctoral degree at another institution, and was developing my research proposal as I was becoming accustomed to the new job. At this point I knew that I wanted to locate my study in the undergraduate chemistry laboratories at UWC, but was not sure of my exact focus. A conversation with one of my new colleagues, in which I learnt of a demonstrator strike that had occurred during the previous academic year, intrigued me so much that I decided I needed to know more about the dynamics that had caused the demonstrators to take such a strong stand against the department.

Around the same time the results from the bi-annual course evaluation (see Appendix 7.1) contained a significant number of complaints about the practical course and the practical demonstrators. I wanted to explore these complaints in greater depth, as I suspected they might offer a point of departure for the demonstrator study that I wanted to undertake. I was interested in acquiring a broad sense of students' experiences and therefore I intended to use an open ended questionnaire format that would require students to write freely and reflectively about their experiences.

Thus, the data collection for this research project commenced at the end of 2005 with a survey to gauge first-year chemistry students' expectations and experiences of their interactions with the laboratory demonstrators. Initially I referred to this survey and the demonstrator survey that followed it as the "baseline study" since my intention with the twin surveys was to collect baseline data at the start of the study.

At the time of the student survey the demonstrators were still very reluctant to participate in the research. I was keen to include them in the study, but all my initial attempts at initiating conversation failed. The demonstrators were polite and respectful, but kept their distance. I then had the opportunity to present the results of the student survey at a departmental seminar. As a newly appointed academic I hoped to use this opportunity to raise awareness for my research

project in the department, but I also wanted the demonstrators (who were present in the audience since they were all members of the postgraduate cohort at the time) to hear how they were being perceived by the students in the laboratories. It so happened that the seminar also presented me with a long-awaited opening into the demonstrator community. During question time after the presentation, one of the demonstrators in the audience (the one that I have named Paki) commented that demonstrators should also be surveyed, since considering only the students' experiences of the laboratories offered a skewed view of the situation. Thus, following Paki's timely recommendation, the student survey was followed some six months later with a survey of the first-year demonstrator cohort. The demonstrator survey focused on demonstrators' expectations and experiences of their interactions with the first-year students in the laboratory and with the structures of authority within the chemistry department who were responsible for creating the laboratory learning experiences for the students.

A further purpose of the first demonstrator survey was to serve as a screening instrument for the selection of suitable participants to interview and to include in focus group discussions later.

7.1.1 Baseline and beyond

I have made the point that the twin surveys (student and demonstrator) were not initially intended to answer the research questions of this study, but rather to generate baseline data. These data painted such an interesting picture of the relational dynamics at play in the laboratories at the start of the study that I felt a picture of the situation "beyond the baseline" – an "after" picture so to speak – would provide an interesting and valuable comparison. For this reason the twin surveys were repeated towards the end of the study. The initial student and demonstrator survey set will henceforth be referred to as the "baseline" survey, or Survey 1, and the repeat survey set will be referred to as the "beyond" survey, or Survey 2.

I was interested to see if there would be significant changes over the course of the study in the ways that student and demonstrator participants perceived each other and the departmental environment. At the same time the entire collection of survey data would provide a broader context for the qualitative data of the project. Qualitative methods can sometimes be so focussed on the micro-aspects of social phenomena that large-scale aspects are overlooked (Robson, 2002). By integrating a quantitative element (such as the fixed response sections of this study) and/or a global perspective (by surveying a relatively large sample, for instance) a fuller understanding of the research can be achieved.

7.1.2 A quasi-numerical investigation?

I was unsure how to classify this investigation. The surveys generated both quantitative and qualitative data and in addition the sample sizes were large enough (especially in the case of the student surveys) to allow for the generation of frequency counts that lent a numerical

dimension to the qualitative data. This numerical dimension helped with the interpretation of the qualitative data and also with the comparison of the “baseline” (Survey 1) results with the “beyond” (Survey 2) results. In the context of health education Steckler, McLeroy, Goodman, Bird, and McCormick (1992) recognise this particular way of integrating quantitative and qualitative data as one of four possible models for the integration of methods to support, cross-validate and strengthen findings. There was also a longitudinal quality to the investigation: it can be argued that the same student and demonstrator populations were studied over time, though it is true that the individuals (and therefore the samples) surveyed “before” and “after” were not the same. Since the surveys provided snapshots of the two populations (students and demonstrators) at the start and towards the end of the research, this investigation has commonalities with both cross-sectional and trend studies (Robson, 2002).

The remainder of this chapter deals with the details of this comparative quasi-numerical investigation. I chose the term “quasi-numerical” to reflect the non-numeric origin of the free-response survey data that will feature prominently in this chapter. I will cover aspects of questionnaire design and provide details of the survey instruments used. The analysis methods used for making sense of the rather large amount of data generated will be discussed, followed by a comparison of the Survey 1 and Survey 2 results. The penultimate section of the chapter contains a reflection on the investigation, and the chapter concludes with a summary of the findings.

7.2 Collection of the survey data

The survey data was collected on the 2005 and 2008 first-year chemistry student cohorts and the 2006 and 2008 demonstrator cohorts. All surveys were anonymous, and participation was voluntary for the students and demonstrators. Table 7.1 summarises descriptive information about the comparative investigation as a whole, such as the numbers of individuals participating in each of the surveys, and information relating to the data collection practices employed (the latter is contained in the column headed *Comments*).

Table 7.1: Descriptive information related to student and demonstrator surveys.

Survey and date	Number of participants in cohort	Number of questionnaires returned	Comments	
SURVEY 1	Student survey October 2005	285	155	The questionnaires were handed out during the penultimate lecture period* of the final semester of 2005.
	Demonstrator survey June 2006	16	16	Eleven of the individuals in this sample were demonstrators to the students who participated in the 2005 student survey. The remaining five were novice demonstrators.
SURVEY 2	Student survey May 2008	315	190	The questionnaires were handed out during the final weekly practical cycle at the end of the first semester of 2008.
	Demonstrator survey April 2008	21	17	This survey coincided with the student survey of 2008. Questionnaires were handed out during a demonstrator meeting towards the end of the first semester of 2008.

*The sample consisted of students attending the last week of lectures. These students tend to be the more conscientious individuals in the group. It is worth noting that this may have affected my findings, although to what extent would be difficult to predict, as two opposing effects would have been at work: On one hand more conscientious students might be expected to have higher expectations of their demonstrators (as indeed they tend to have of themselves) than students who are less conscientious. On the other hand these students would probably have been better prepared for practicals, which could mean that they would have been less dependent on assistance from the demonstrator and could therefore have had lower expectations.

7.3 Survey designs

Table 7.2 summarises the design features of the two survey instruments. In addition to sections for generating demographic and logistic data, each of the questionnaires used in the surveys contained a fixed response section and a free response section. The fixed response sections of each instrument were intended to explore participants' perceptions of their own learning in the laboratories, and the free response sections were aimed at exploring participant's expectations and experiences of each other. The demonstrator survey contained a second free response section in addition to the one intended to gauge demonstrators' experiences of their interactions with the first-year students. The second section was intended to explore their experiences of their interactions with the chemistry department, *in relation to their roles as demonstrators*.

Table 7.2: Design features of the student and demonstrator survey instruments used in the quasi-numerical study.

Survey	Sections	Comments
Student survey	Demographic	This section probed students' enrolment details (whether they were in the CHE114/124 or CHE116/126 course) and logistical details about their placement in the laboratories. The latter was included in case I wanted to extract data about a specific laboratory or demonstrator later.
	Fixed response	This section probed students' perceptions about their learning in the laboratory course (5 items) and their enjoyment of the chemistry practicals (1 item).
	Free response	The free response section invited responses about students' experiences of their demonstrators during the laboratory sessions.
Demonstrator survey	Demographic	This section probed the length of demonstrators' involvement in the demonstrating program and logistical details about their placement in the laboratories (for possible cross-referencing with the student data later on). The "beyond" survey required respondents to also indicate whether they had been part of the "baseline" survey.
	Fixed response	This section probed demonstrators' perceptions of their own learning while involved in the demonstrating program (5 items) and their enjoyment of their participation in the program (1 item).
	Free response (2 sections)	The first free response section invited responses about demonstrators' experiences of their students during the laboratory sessions. The second free response section invited responses about demonstrators' experiences of the chemistry department as it related to their involvement in the demonstrating program.

In the paragraphs that follow I will provide more specific design detail about the survey instruments.

7.3.1 Fixed response sections

7.3.1.1 Student survey

In the student survey participants' perceptions of their own achievements of the learning outcomes of the practical course were elicited using five simple statements. An additional statement intended to gauge students' enjoyment of the practicals was included in the set. These 6 statements were constructed around generally accepted outcomes for laboratory work as embodied in the following list (Domin, 1999a):

- conceptual understanding;

- retention of content knowledge;
- scientific reasoning skills;
- higher-order cognition;
- laboratory manipulative skills;
- a better attitude towards science; and
- a better understanding of the nature of science.

Responses were recorded on a five-point Likert scale with indicators of 1, 3 and 5 representing *strong disagreement*, *neutral response* and *strong agreement* respectively.

7.3.1.2 *Demonstrator survey*

In the demonstrator survey, participants' enjoyment of the practicals and their perceptions of their own learning (about students, student learning and chemistry teaching) were gauged using six simple statements. Responses were recorded on a four-point Likert scale with indicators of 1 and 4 representing *strong disagreement* and *strong agreement* respectively. Unlike the student questionnaire, the demonstrator questionnaire did not make provision for a *neutral* response. The neutral response option was omitted from the Likert scale in the demonstrator questionnaire in an attempt to force the relatively small sample of demonstrator respondents to take a stand either in agreement or disagreement of each statement (Cohen *et al.*, 2000).

7.3.2 *Free response sections*

I chose a Stop-Start-Continue format for the free response section(s) of both surveys. The Stop-Start-Continue technique has been recommended (Molloy, 1998) as a tool for generating honest feedback and fostering respectful and effective communication in situations where power relationships exist. The technique requires one person (the respondent) to tell another things he/she should "stop" doing, things he/she should "start" doing, and things he/she should "continue" doing. In this way information about participants' expectations (START responses), and positive (CONTINUE responses) as well as negative (STOP responses) experiences can be generated. At the time when I was exploring potential designs for the baseline study the technique appeared to promise in-depth exploration of a sensitive situation; one in which I held position of authority (and therefore power) but not yet trust.

7.3.2.1 *Student survey*

The student survey instrument required students to respond to three questions about their experience of the demonstrators in their laboratories: "What should your demonstrator STOP/START/CONTINUE doing?"

7.3.2.2 *Demonstrator survey*

The demonstrator survey instrument consisted of three free response questions about demonstrators' experience of the students in their laboratories: "What should the students in your laboratory STOP/START/CONTINUE doing?" and three additional questions relating to their experiences with those structures responsible for creating the learning experience in the laboratory: "In relation to your job as chemistry demonstrator, what should the Chemistry Department STOP/START/CONTINUE doing?"

The completed questionnaires containing the raw survey data were bound and dated and each individual questionnaire numbered. All fixed response data were captured, sorted and analysed electronically using Excel. The free response data of the demonstrator surveys were also captured electronically but the volume of student data was too large to warrant electronic capture. All the free-response data were hand coded, and the codes captured, sorted and counted electronically.

7.4 **Analysis of the fixed response data**

7.4.1 *Student surveys*

In order to compare the fixed response data of the two student surveys the 5-point Likert scale was reduced to a 3-point scale by pooling the *Agree* and *Strongly Agree* frequencies, and the *Disagree* and *Strongly Disagree* frequencies, respectively.

Table 7.3 compares the frequency distributions (with percentage distributions in brackets) for each statement in the fixed response sections of the two student surveys. Survey 1 refers to the "baseline" survey conducted at the start of the study (October 2005), and Survey 2 to the "beyond" survey conducted towards the end of the study (May 2008). The final column shows a calculated chi-square (χ^2) comparing the tests.

Table 7.3: Frequency distributions (% in brackets) and observed χ^2 values of fixed responses in student Surveys 1 and 2.

Statements	Survey 1 (October 2005)			Survey 2 (May 2008)			2
	Disagree	Neutral	Agree	Disagree	Neutral	Agree	
1 I enjoyed the Chemistry practicals.	27 (17.5)	45 (29.2)	82 (53.2)	9 (4.8)	29 (15.4)	150 (79.8)	21.85*
2 The Chemistry practicals taught me useful laboratory skills (weighing, titrating, etc.).	6 (3.9)	24 (15.5)	125 (80.6)	5 (2.6)	16 (8.5)	168 (88.9)	1.08
3 The practicals helped me to understand the Chemistry lectures better.	61 (39.4)	57 (36.8)	37 (23.9)	19 (10.2)	67 (35.8)	101 (54.0)	49.96*
4 The Chemistry practicals helped me use basic laboratory equipment with confidence.	7 (4.5)	23 (14.9)	124 (80.5)	5 (2.6)	23 (12.2)	161 (85.2)	1.10
5 The Chemistry practicals helped me to be more aware of laboratory safety.	8 (5.2)	22 (14.2)	125 (80.6)	8 (4.2)	20 (10.6)	161 (85.2)	0.37
6 The Chemistry practicals taught me to make experimental observations.	6 (3.9)	37 (23.9)	112 (72.3)	7 (3.7)	16 (8.5)	166 (87.8)	2.56

*On these items the differences between the results of Surveys 1 and 2 are significant at the 1% level (see 7.4.1.1. below).

I wish to comment on the data in general before comparing the results from the two surveys. The response frequencies in the table show *agree* responses to dominate almost across the board. This supports a perception amongst students of both cohorts (2005 and 2008) that they had learnt from the laboratory course. The apparent ambivalent response (46.7% *disagree* and *neutral* responses against 53.2% *agree*) to statement 1 (Survey 1) is interesting in light of an early suggestion (Kerr, 1963) that enjoyment of the subject should be one of the affective aims of laboratory work. The same author also suggested another affective aim for laboratory work, namely that students should have a sense of connection with phenomena discussed in the theory. Interestingly, students participating in Survey 1 did not all agree (23.9% *agree* versus

76.1% *disagree* or *neutral* for statement 3) that the practicals helped them to understand the Chemistry lectures better. Nakhleh (1994) confirms students' apparent difficulty in integrating their theoretical knowledge with the physical phenomena observed in the laboratory. An important factor that would have affected this response in Survey 1 was the disarticulation between theory lectures and practicals (an undesirable but sometimes unavoidable reality in laboratory courses) that occurred to some extent during the academic semester preceding the survey. This factor was not present in the semester preceding Survey 2. The apparent increase in *agree* responses to statement 1 (from 53.2% in survey 1 to 79.8% in survey 2) may be linked to the increase in *agree* responses on statement 3. It is possible that the disarticulation between practicals and lectures (Survey 1) may have detracted from students' enjoyment of the practicals.

7.4.1.1 Comparison of the student surveys using the chi-square test

In the final column of table 7.3 the observed χ^2 (chi square) values are given. The chi-square statistic is appropriate (Pretorius, 1995; Sanger, 2007) for comparing datasets that contain observations as frequencies or counts rather than numerical scores. The chi-square test calculates a value (the chi-square statistic) based on the difference between "observed" and so-called "expected" frequencies, and this value is then used to test the relationship between two variables; the variables being "Survey" and "Response". The two opposing hypotheses are:

H_0 Student responses to the item are **independent** of the survey (in other words, of whether they belong to the 2005 or 2008 group). Another way of putting this would be: there is **no significant difference** between the 2005 (survey 1) and 2008 (survey 2) groups on this item.

H_1 Student responses to the item are **not independent** of the survey (in other words, of whether they belong to the 2005 or 2008 group). Another way of putting this would be: there is **a significant difference** between the 2005 and 2008 groups on this item.

The critical chi-square values for this analysis (using 2 degrees of freedom as is appropriate for 2 x 3 contingency tables¹ such as the ones I have used here) are 9.21 ($\alpha = 0.01$) and 5.99 ($\alpha=0.05$).

¹ The "Survey" variable contains 2 categories namely Survey 1 and Survey 2. The "Response" variable contains 3 categories namely "disagree", "neutral" and "agree"; hence a 2 x 3 contingency table. The degrees of freedom are calculated as follows: $df = (\text{number of rows} - 1)(\text{number of columns} - 1) = 2$.

This simply means that:

If the observed chi-square is greater than the critical chi-square (5.99 or 9.21) the null hypothesis should be rejected.

Conversely, if the observed chi-square is smaller than the critical chi-square (5.99 or 9.21) the null hypothesis holds.

The chi-square values in table 7.3 indicate that there is a significant difference between the 2005 and 2008 student cohorts only with respect to statements 1 and 3 of the survey. These were:

Statement 1 I enjoyed the Chemistry practicals.

Statement 3 The practicals helped me to understand the Chemistry lectures better.

More students from the 2008 cohort reported enjoying the chemical practicals than from the 2005 cohort. Can this difference be ascribed to the intercessionary process that was affected on the laboratory community in the period between the two surveys? Since this is not a question to be answered in isolation I will return to it in the final paragraphs of this chapter when the quantitative data is summarised as well as in the final chapter.

The difference in the two cohorts' responses to statement 3 has to some extent been addressed in the preceding paragraphs. Survey 1 was conducted at the end of the second academic semester. Roughly half of the lectures during the second semester are allocated to physical-inorganic chemistry and the rest of the time to organic chemistry. It is traditional for practicals to be scheduled in such a way that the experiment exploring a specific topic or phenomenon comes shortly after it has been covered in lectures. Although ideal, it is not always possible to synchronise the lectures and practicals in this way, and especially during the second academic semester disarticulation sometimes occurs. Understandably, students are disgruntled by this. In the free response section of Survey 1 there were 5 separate references to this issue (2005 student survey, respondents 13, 20, 36, 47 and 138). That this was less of an issue for the 2008 student cohort is understandable given that Survey 2 was performed towards the end of the *first* semester during which the practical experiments are conceptually much less demanding and not linked to specific areas of the theory, and therefore disarticulation poses much less of a problem for students.

In addition to the chi-square test, a series of Wilcoxon rank sum tests² were performed on the items in the student surveys. Rank-based procedures are appropriate for comparisons of items that have scores on an ordinal scale (Pretorius, 1995) and I was interested to see whether the Wilcoxon test results would confirm Bhattacharyya and Johnson's (1977) assertion that it offers

² For reasons I will explain later I selected the Wilcoxon rank sum test for my comparison of the two demonstrator surveys. Its tenets are explained in section 7.4.2.1.

a more sensitive comparison than the chi-square. The Wilcoxon test results showed statistically significant differences for all 6 survey items.

In my evaluation of the results of the two tests I weighed up two possibilities namely that:

1. The Wilcoxon test was detecting “false positives” on items 2, 4, 5 and 6. Errors of rejecting a null hypothesis when it is actually true are called *Type 1 errors* (Dallal, 2007). This type of error occurs when a difference is observed when in truth there is none, thus indicating a test of poor specificity.
2. The chi-square test was detecting “false negatives” on items 2, 4, 5 and 6. Errors of failing to reject a null hypothesis when it is in fact not true are called *Type 2 errors* (Dallal, 2007). This type of error occurs when a difference exists but goes unobserved, thus indicating a test of poor sensitivity.

The fact that I was able to justify the differences between the two cohorts detected by the chi-square test with supporting free-response data strengthened the case for the first possibility above. It led me to conclude that the chi-square test was better able to detect nuances present in my data than the Wilcoxon rank sum test, and that the former therefore provided a more stringent measure of statistical significance.

Finally, on the basis of the results it can be concluded that there was improvement in students' enjoyment of the practicals, and an increase in the number of students who felt that the practicals helped them to understand the Chemistry lectures better over the course of the study.

7.4.2 *Demonstrator surveys*

Table 7.4 compares the frequency distributions of *agree* responses (3 and 4 on the 4-point Likert scale used in the demonstrator survey) and *disagree* responses (1 and 2 on the scale) within and across the two demonstrator surveys. As with the student data (7.4.1. above) Survey 1 refers to the “baseline” survey and Survey 2 to the “beyond” survey.

One of the design requirements (Pretorius, 1995) for the use of the chi-square test for the comparison of data sets is that none of the frequencies being compared may be less than 5. From table 7.4 it is immediately evident that the “disagree” frequency counts in both surveys are all well below 5. On one level this means that both demonstrator cohorts (2006 and 2008) mainly agree with the posed statements, but on another it means that the data for the two cohorts cannot be compared using a chi-square test.

Table 7.4: Frequency distributions (% in brackets) of fixed responses in demonstrator Surveys 1 and 2.

Statements	Survey 1 (N=16) June 2006		Survey 2 (N=17) April 2008	
	Disagree	Agree	Disagree	Agree
1 I enjoyed demonstrating in the first-year Chemistry laboratories.	2 (12.5)	14 (87.5)	0	16 (94.1)*
2 Demonstrating has taught me useful teaching skills.	2 (12.5)	14 (87.5)	0	17 (100)
3 Demonstrating has helped me to understand more about how students learn.	1 (6.3)	15 (93.7)	0	16 (94.1)*
4 Demonstrating has helped me to understand Chemistry better.	4 (25)	12 (75)	1 (5.9)	16 (94.1)
5 Demonstrating has helped me to better understand what students struggle with in Chemistry.	3 (18.8)	13 (81.2)	1 (5.9)	16 (94.1)
6 Demonstrating in the Chemistry laboratory has helped me to improve my own lab skills.	3 (18.8)	13 (81.2)	0	17 (100)

*One respondent out of the cohort did not make a selection on two items (Statements 1 and 3), presumably because there was no "neutral response" option provided.

From the data in table 7.4 it appears that there has been improvement on all 6 of the test items; in all cases the percentage of *Agree* responses have increased slightly. However, what is needed at this point is a test of statistical significance to determine whether the apparent increase in *Agree* responses is indeed meaningful.

7.4.2.1 Comparison of the demonstrator surveys using the Wilcoxon rank sum test

The Wilcoxon rank sum test (also referred to as the Mann-Whitney U, the Mann-Whitney-Wilcoxon (MWW), or the Wilcoxon-Mann-Whitney test) is one of the best-known non-parametric significance tests for testing whether two independent samples of observations have equally large values (Dallal, 2007; Pretorius, 1995). It calculates a rank sum test statistic that takes into account the number of scores in each sample and how they are ranked, and the differences in ranks of scores between samples. Non-parametric tests can offer an advantage over their parametric counterparts in situations in which certain assumptions (eg. normal distribution and homogeneity of variance) have been violated (Pretorius, 1995).

The Wilcoxon rank sum test statistic is linked to a corresponding *p-value*, which represents the smallest significance level at which the the null hypothesis can be rejected. As regards the demonstrator surveys, the two opposing hypotheses are:

H₀ Demonstrator responses from the two surveys **follow identical distributions** for a particular survey item. Another way of putting this would be: there is **no significant difference** between the 2006 (Survey 1) and 2008 (Survey 2) groups on this item.

H₁ Demonstrator responses from the two surveys **do not follow identical distributions** for a particular survey item. Another way of putting this would be: there is **a significant difference** between the 2006 and 2008 groups on this item.

The null hypothesis should be rejected if the *p-value* is less than 0.05 (or 0.01), corresponding to a 5% (or 1%) probability respectively of rejecting the null hypothesis when it is true.

Simple descriptive statistics (mean, median and standard deviation) for each item on the demonstrator survey are given in table 7.5. As before, Surveys 1 (baseline) and 2 (beyond) are compared side by side. The *p-values* in the final column are linked to Wilcoxon rank sum test statistics and were calculated using SAS software.

The Wilcoxon rank sum test results fall short of statistical significance on 5 of the 6 survey items. The sample sizes in the two surveys were relatively small so it has to be accepted that the test has limited power to detect anything other than relatively large differences. Item 4 showed the biggest difference (the mean value increased from 2.94 to 3.47); this is also reflected in the fact that it has the smallest *p-value* (0.0373). This change is significant at the 5% level. This supports a finding from the qualitative data collected after the intercession; on a number of occasions demonstrators mentioned that their participation in the laboratories was affording them opportunities to relearn chemistry that they had forgotten from their first year, as in the following quote from one of the demonstrators in the focus group:

And the nice things is in all the pracs that we do – I don't always recall the stuff that I did in our first year pracs and so I am always learning (from) what they are doing.

(D-FG-01-08, 2008)

Table 7.5: Descriptive statistics (mean, median and standard deviation) and calculated p-values (related to the Wilcoxon rank sum test statistic) for fixed response items in demonstrator Surveys 1 and 2.

Statements	Survey 1 (June 2006) (N = 16)			Survey 2 (April 2008) (N = 17)			p
	Mean	Median	Std Dev*	Mean	Median	Std Dev*	
1 I enjoyed demonstrating in the first-year Chemistry laboratories.	3.19	3	0.66	3.56	4	0.51	0.1433
2 Demonstrating has taught me useful teaching skills.	3.31	3	0.70	3.65	4	0.49	0.2053
3 Demonstrating has helped me to understand more about how students learn.	3.19	3	0.54	3.56	4	0.51	0.1047
4 Demonstrating has helped me to understand Chemistry better.	2.94	3	0.68	3.47	4	0.62	0.0373**
5 Demonstrating has helped me to better understand what students struggle with in Chemistry.	3.00	3	0.63	3.35	3	0.61	0.1551
6 Demonstrating in the Chemistry laboratory has helped me to improve my own lab skills.	3.13	3	0.89	3.29	3	0.47	0.7862

*Std Dev: standard deviation

**Significant at the 5% level

Fisher's exact test is a statistical significance test that is indicated for the analysis of categorical data where sample sizes are small. It is especially useful for sparse or unbalanced data (Agresti, 1992) such as my own. However, the Fisher exact test was unable to detect a significant difference between the two surveys on any of the items in the fixed response section of the survey instrument.

In the case of the demonstrator surveys, which consisted of relatively small samples (N=16 and N=17 for Surveys 1 and 2 respectively), I found the Wilcoxon rank sum test the more stringent measure of statistical significance. This is supported by the fact that I was able to justify the differences between the two cohorts with the qualitative data of my study.

Finally, on the basis of the results it can be concluded that there was improvement in demonstrators' perception over the course of the study that their participation in the demonstrating programme had helped them to understand Chemistry better.

7.5 Analysis of the free response data

As mentioned earlier the survey data had a different purpose from the qualitative data described in chapters 4 and 6. The surveys were intended to provide data about participants' laboratory-related *experiences* before and after the intercession, rather than answer the research questions. For this reason, the analytic framework used with the qualitative data (described in chapter 2) was not considered appropriate for the analysis of the free response data. Instead I chose to follow an inductive Miles and Huberman approach (Miles & Huberman, 1994; Robson, 2002;), which I will outline in the paragraphs that follow.

7.5.1 Terminology

I wish to insert here a brief justification for the terminology used in the description of the analysis process used with the free response data of the two surveys. For this I need to turn to the field of phenomenography for inspiration.

Phenomenographic researchers place emphasis on describing, analysing and understanding the qualitatively different ways in which people perceive and experience things (Åkerlind, 2005; Marton & Pong, 2005). During analysis the insights emerging from the data are usually sorted into categories of description and these are linked with regard to their logical relations (often following an extended iterative analysis process) to form an *outcome space*. I found the following quote (Marton & Booth, 1997: 133) useful in articulating my own understanding of the concept of an outcome space:

All of the material that has been collected forms a pool of meaning. It contains all that the researcher can hope to find, and the researcher's task is simply to find it.

In my conception an outcome space is a structured set of meanings, *and* the hierarchies and linkages between different meanings that will allow the researcher to make sense of that which is relevant to the phenomenon under investigation from the data in the pool. According to Åkerlind (2005: 322)

"the structure of the outcome space represents one of the least understood aspects of phenomenography ... The phenomenographic proposition, that ways of experiencing represent a relationship between the experiencer and the phenomenon being experienced, leads to the expectation that different ways of experiencing will be logically related through the common phenomenon being experienced".

Typically the relationship between the 'different ways of experiencing' the phenomenon would be hierarchical and this logically inclusive structure relating the different meanings is at least as important to the analysis as the meanings themselves.

The free response data of my surveys most certainly fall into the category of data that can be used to describe, analyse and understand "the qualitatively different ways in which people (students and demonstrators) perceive and experience things (each other)" [the bracketed phrases in the quote – from the second paragraph of this section – are my own insertions]. Although the fit with phenomenographic studies ends here – the different aspects of students' and demonstrators' experiences (reflected in the categories of description in tables 7.7 to 7.9 below) are related, but not necessarily *hierarchically*³– I found inspiration for structuring the data of my study in the notion of an *outcome space*. I decided to use the term *response space* to describe the collective experiences and expectations of each group (students and demonstrators).

According to Marton and Booth (1997) the quality of a phenomenographic outcome space hinges on three primary criteria, namely:

1. Each category of the outcome space should be unique, that is: it should identify something that is distinctive about the way in which the phenomenon is experienced or understood.
2. Categories should be logically related; the overall relational structure may be linear or branched and is often hierarchical.
3. The outcomes should be parsimonious, in other words the number of categories in the outcome space should be the minimum number that allows for adequate description of the way in which the phenomenon is experienced or understood.

These criteria were kept in mind when I defined the response spaces of my own data, which will be discussed next.

7.5.2 *Three response spaces*

Starting with the "baseline" set, the same content analysis procedure was followed with both student and demonstrator surveys, and separate response spaces were developed for each survey. An explanation of the process follows:

1. I read through the data several times until I felt I was reasonably familiar with them.
2. I then constructed a set of categories which I felt adequately represented what the participants were trying to say. Codes were assigned to these draft categories.

³ Participants' experiences might be hierarchical in terms of *quality* of the experience but I did not investigate this.

3. Over the duration of the study, I periodically cycled back and forth between the categories and data, refining the categories with every iteration, until I obtained what I considered to be a reasonably stable set of categories to which final codes were assigned.
4. In the process of constructing and refining the response spaces, a relational structure emerged within which the categories of description settled themselves (sometimes after several rearrangements). In defining the final coding schemes for each survey, I paid attention both to the explicit *and* implicit variations within participant responses around a certain aspect of experience.
5. The final stage was to return to the original data and analyse them in terms of the final set of categories. This was done with both sets of surveys, “baseline” and “beyond”.

Three response spaces were developed for the free-response data of the semi-quantitative study. They will now be discussed in turn.

7.5.2.1 *Students’ experiences of the demonstrators*

Five primary categories emerged from the student free response data namely: Communication issues, Student Teaching and Learning issues, Leadership/Management issues, Professional Conduct issues and Affective issues. The categories of description defining the coding scheme are listed in Table 7.6, together with some typical participant responses from the survey data. Category codes for each of the secondary categories are also listed.

Table 7.6: Response space for the description of students’ experiences and expectations of the demonstrators.

Categories of description		Some sample phrases from the data	Category code
Primary categories	Secondary categories		
Communication issues	Effective communication	Explain clearly and well	Com-1
		Use good language (that we can understand)	
	Don’t over-explain		
Communication issues	Clarify expectations	Tell us what needs to be done	Com-2
		Don’t talk in riddles	
Communication issues	Listen effectively	Listen to the students	Com-3

Table continues on following page.

Categories of description		Some sample phrases from the data	Category code	
Primary categories	Secondary categories			
Student Teaching and Learning issues	Attitude to practice	Model good practice	S-TeLe-1	
		Model and encourage ethical behaviour Do not tell us to manipulate results		
	Facilitator function	Assist us Guide us Interact with us Check up on us	S-TeLe-2	
		Views on the Nature of Science (NOS)	Link theory with practice Clarify significance and relevance of the practical work	S-TeLe-3
		Progression of learning	Encourage students towards independence	S-TeLe-4
Attitude to learning	Make practicals enjoyable Help us develop a love for chemistry Be encouraging Show enthusiasm for demonstrating role	S-TeLe-5		
Leadership/Management issues	Fair and even-handed	Treat all students the same Pay equal attention to all Be unbiased/ consistent	Man-1	
	Reasonable and realistic	Be reasonable, open, uncritical, authentic, transparent, non-racist Have realistic expectations of students	Man-2	
	In control	Be confident Be calm under pressure Be firm with respect to discipline Do not turn a blind eye when ...	Man-3	
	Safety-conscious	Be attentive/observant/vigilant Be knowledgeable about safety aspects	Man-4	
Professional Conduct issues	Professional qualities	Be present, prepared, punctual, proactive, organised, professional	Pro-1	
	Quality of work	Hard-working Do good/quality work Focused on task (don't waste time)	Pro-2	

Table continues on following page.

Categories of description		Some sample phrases from the data	Category code
Primary categories	Secondary categories		
Professional Conduct issues (<i>continued</i>)	Meeting student's own standards	Everything/my demonstrator is perfect Everything is the way I like it My demonstrator is doing everything right Nothing I can think of (to complain about)	Pro-3
	Attitude towards students	Be supportive/helpful Be approachable/available/unselfish	Af-1
Affective issues	Disposition	Be friendly/kind/sweet/nice Smile and be "fun" Be humble	Af-2
		Interactions	Be polite/respectful
		Be patient/understanding/empathic/caring Be trusting/flexible	Af-4

7.5.2.2 Demonstrators' experiences of the students

While analysing the demonstrator data I was immediately aware of the similarity of the emerging categories of description with those that had emerged from the student data. I have attempted to reflect the overlap of issues in the two coding schemes by using the same category titles and codes for both schemes. The response space for the description of demonstrators' experiences of the students is shown in table 7.7.

Table 7.7: Response space for the description of demonstrators' experiences and expectations of the students.

Categories of description		Some sample phrases from the data	Category code
Primary categories	Secondary categories		
Communication issues	Clarify expectations	Ask questions	Com-2
	Listen effectively	Listen to the demonstrator Pay attention	Com-3
Student Teaching and Learning issues	Attitude to practice	Engage in good practice Engage in ethical behaviour	S-TeLe-1

Table continues on following page.

Categories of description		Some sample phrases from the data	Category code
Primary categories	Secondary categories		
Student Teaching and Learning issues (continued)	Views on the Nature of Science (NOS)	Look for the “bigger picture” Look for connections with the theory Stop looking for the “right answer” Think about what you are doing	S-TeLe-3
	Progression of learning	Work towards greater independence Work towards increased competence	S-TeLe-4
	Attitude to learning	Enjoy chemistry Value chemistry learning Take the practicals seriously	S-TeLe-5
Leadership/Management issues	Safety-conscious	Engage in safe practice Be informed about safety aspects	Man-4
Professional Conduct issues	Professional qualities	Be prepared, punctual, organised	Pro-1
	Quality of work	Do good/quality work Focus on task (don't waste time) Work collaboratively	Pro-2
Affective issues	Interactions	Be polite/respectful/appreciative	Af-3

The reader will notice that some of the categories shown in the student survey are absent from table 7.7, namely:

- Com-1 (communication issues);
- S-TeLe-2 (student teaching and learning issues);
- Man-1, Man-2 and Man-3 (leadership/managment issues);
- Pro-3 (professional conduct issues); and
- Af-1, Af-2 and Af-4 (affective issues).

The reason is that the demonstrators' responses about their experiences of the students did not cover all the categories represented in the response space of the student surveys. Interestingly, the “demonstrator response space” is completely contained within the “student response space”.

7.5.2.3 Demonstrators' experiences of the chemistry department

There was considerable overlap between the categories of description emerging from the collection of demonstrator responses of their interactions with the chemistry department

(summarised below in table 7.8), with the response spaces describing student and demonstrator experiences and expectations of each other (tables 7.6 and 7.7). Communication issues, Student Teaching and Learning issues, Professional Conduct issues and Affective issues were once again present in demonstrators' responses. Additional Student Teaching and Learning issues emerged that were not part of the joint student-demonstrator response space, and had to do with the department providing students access to learning materials and other resources (S-TeLe-6 and S-TeLe-7). Two additional primary categories of responses were identified namely Labour issues (to do with the employer-employee relationship between the department and the demonstrators) and Demonstrator Teaching and Learning issues (to do with demonstrator professional development and recognition for their teaching role).

Table 7.8: Response space for the description of demonstrators' experiences and expectations of the chemistry department.

Categories of description		Some sample phrases from the data	Category code
Primary categories	Secondary categories		
Communication issues	Effective communication	Communicate effectively about all aspects of practicals (to students and demonstrators)	Com-1
Labour issues	Remuneration and other rewards	Pay demonstrators more Pay demonstrators timely Award certificates for participation	Lbr-1
	Workload	Reduce the student-demonstrator ratio Broaden demonstrator participation Make reasonable demands on demonstrator	Lbr-2
	Grievances	Attend to demonstrator grievances	Lbr-3
Demonstrator Teaching and Learning issues	Training	Provide demonstrator training	D-TeLe-1
	Progression of learning	Involve demonstrators in pre-lab talks	D-TeLe-2
	Authority	Uphold demonstrator authority Be consistent when enforcing laboratory rules	D-TeLe-3

Table continues on following page.

Categories of description		Some sample phrases from the data	Category code
Primary categories	Secondary categories		
Student Teaching and Learning issues	Views on the NOS	Make connections with the theory	S-TeLe-3
	Attitude to Learning	Introduce measures to improve student preparation, understanding and appreciation of pracs	S-TeLe-5
	Access to learning materials	Lower cognitive demand of practicals Improve clarity of written materials Provide prac manuals to students free of charge	S-TeLe-6
	Access to resources	Increase academic staff presence in the labs Provide adequate resources	S-TeLe-7
Professional Conduct issues	Expectations	Insist on high levels of commitment and responsibility from students and demonstrators	Pro-2
	Meeting own standards	Everything is the way I like it Doing great/everything right Nothing I can think of (to complain about)	Pro-3
Affective issues	Interactions	Show respect and appreciation for demonstrators' efforts	Af-3

7.5.3 *How the response spaces relate and overlap*

I wanted to be able to visualise how the response spaces of the student and demonstrator surveys may be related and for this reason I have attempted (in table 7.9) to show a comparative overview of the three spaces. I have placed all the observed response categories (for all three code schemes discussed above) on the vertical, and all three free response sections on the horizontal. The table does not contain data, but I have shaded the cells in each column where a given issue (from the overall response space) was present in the data from a given free response section.

Table 7.9: Comparative overview of the overall response space

Categories of description		Students experiences and expectations of	Demonstrators experiences and expectations of	
Primary categories	Secondary categories and codes	demonstrators	students	department
Communication issues	Effective communication Com-1	■		■
	Clarify expectations Com-2	■	■	
	Listen effectively Com-3	■	■	
Student Teaching and Learning issues	Attitude to practice S-TeLe-1	■	■	
	Facilitator function S-TeLe-2	■	■	
	Views on the NOS S-TeLe-3	■	■	■
	Progression of learning S-TeLe-4	■	■	
	Attitude to learning S-TeLe-5	■	■	■
	Learning materials S-TeLe-6			■
	Resources S-TeLe-7			■
Leadership/ Management issues	Fair and even-handed Man-1	■		
	Reasonable and realistic Man-2	■		
	In control Man-3	■		
	Safety-conscious Man-4	■	■	
Professional Conduct issues	Professional qualities Pro-1	■	■	
	Quality of work Pro-2	■	■	■
	Meeting standards Pro-3	■		■
Affective issues	Attitude towards students Af-1	■		
	Disposition Af-2	■		
	Interactions Af-3	■	■	■
	Af-4	■		

Table continues on following page.

Categories of description		Students experiences and expectations of	Demonstrators experiences and expectations of	
Primary categories	Secondary categories and codes	demonstrators	students	department
Labour issues	Rewards	Lbr-1		
	Workload	Lbr-2		
	Grievances	Lbr-3		
Demonstrator Teaching and Learning issues	Training	D-TeLe-1		
	Progression of learning	D-TeLe-2		
	Authority	D-TeLe-3		

Table 7.9 serves to summarise the overall *coverage* of the free response data of the study, and shows that similar issues were brought up in the responses across groups. The student data did not contain reference to labour issues or demonstrator teaching and learning issues, and the demonstrator data did not contain much on leadership and management issues apart from 2 mentions (see table 7.11 *Man-4*) of laboratory safety. Demonstrators had expectations relating to student access to materials and resources (S-TeLe-6 and S-TeLe-7) not expressed by the students themselves. Here it is important to bear in mind that the students were not asked about their experiences and expectations of the department; this issue and other issues may well have surfaced if this had been the case. In fact, though not part of the data collection of this study, this issue had come up in the bi-annual course evaluations at the time of the study (see Appendix 7.1).

7.5.4 How the quasi-numerical data interlace with the qualitative data

In table 7.10 I have attempted to capture the ways in which the quasi-numerical data interlace with the framework used for interpreting my qualitative data. I have reproduced the framework matrix in the table (the shaded areas) and indicated where I saw the framework linking to categories of description from the quasi-numerical data. Some links are general, such as the ones made between *affective issues* and *engagement* and *imagination*. Other links are more specific, like the links between the secondary categories of description and specific propositions from the framework. The link between clear expectations (Com-2), labour issues such as appropriate remuneration and rewards, a fair workload, and attending to demonstrator

grievances (Lbr-1 to Lbr-3), and management issues relating to having realistic expectations and enforcing fair and consistent discipline (Man-2 and Man-3) clearly link with the intersection of mutuality and alignment on the matrix, as embodied in the proposition *Clear definitions of the roles, norms, codes of behaviour, shared principles and negotiated commitments and expectations exist and are upheld in the community.*

Table 7.10: Links made between categories of description identified in the free-reponse survey data from the quasi-numerical study and the conceptual framework used for analysis of the qualitative data.

Dimensions of progress Modes of belonging	Enterprise (learning energy)	Mutuality (social capital)	Repertoire (self-awareness)
Engagement	Demonstrators identify the gaps in their (and their students') knowing and work (together) to address them.	Events and interactions exist that provide for discussion of issues and development of trust amongst demonstrators, students and the lecturer.	A shared demonstrating experience has accumulated with potential for further development.
Primary category	Affective issues (Af-1 to Af-4) link to all three statements of engagement.		
Additional secondary categories		Com-1,3 (Effective communication) D-TeLe-3 (Authority) Man-1 (Equal treatment for all)	D-TeLe-1 (Training) S-TeLe-6,7 (Materials and resources)
Imagination	Visions of the potential of the community inspire participation amongst demonstrators.	Demonstrators know about the meanings that participation in the laboratory makes in their and their students' lives.	There is a language that talks about the community in a reflective mode.
Primary category	Affective issues (Af-1 to Af-4) link to all three statements of imagination. Student Teaching and Learning issues (S-TeLe-1 to S-TeLe-7) link to all three statements of imagination.		
Additional secondary categories	D-TeLe-2 (Progression of demonstrator learning)		

Table continues on following page.

Dimensions of progress Modes of belonging	Enterprise (learning energy)	Mutuality (social capital)	Repertoire (self-awareness)
Alignment	Demonstrators have articulated a shared purpose; they subscribe to it, and feel accountable to it. Leadership is distributed widely in the CoP.	Clear definitions of the roles, norms, codes of behaviour, shared principles and negotiated commitments and expectations exist and are upheld in the community.	Methods, standards and routines exist to define good demonstrating practice, and these are upheld and transmitted to new generations.
Primary category	Professional conduct issues (Pro-1 to Pro-3) link to all three statements of alignment.		
Additional secondary categories		Com-2 (clear expectations) Lbr-1,2,3 (Rewards, workloads and dealing with grievances) Man-2,3 (Realistic expectations and discipline issues)	S-TeLe-1 (Attitude to practice) Man-4 (safety-consciousness)

The synthesis above also serves to show how the quasi-numerical data may be used to strengthen and support the qualitative data of my study.

7.6 Comparing the free response data

In order to compare the free response data across the “baseline” and “beyond” surveys, I populated the response spaces of each separate survey with the frequencies with which each of the issues defining a particular space was mentioned. The following section outlines some of the procedures followed and challenges encountered during the interpretation of the STOP-START-CONTINUE responses. The actual comparisons of the two surveys will follow in subsequent paragraphs.

7.6.1 *Interpreting the STOP START CONTINUE format*

To illustrate the value of the STOP START CONTINUE format for eliciting respondent expectations and experiences, one could consider the following question set: “What should [X] STOP/START/CONTINUE doing?”

CONTINUE responses reflect positive experiences of whatever [X] is doing. Thus if [X] is experienced as being polite the respondent might answer: “[X] should CONTINUE being polite.”

STOP responses reflect negative experiences of whatever [X] is doing. Thus if [X] is experienced as impolite the respondent might answer: “[X] should STOP being impolite or rude

(the latter is a word favoured by the students)".

Now, consider that the respondent has an unmet expectation of [X] being polite. The respondent can reasonably be predicted to state that "[X] should START being polite" and therefore START responses reflect respondents' expectations of their interactions with [X].

On the face of it, these kinds of responses initially seemed simple enough to analyse. CONTINUE responses especially tended to be low inference expressions of expectation and hence were captured in the "Experienced" columns of the data tables that follow. However, when it came to analysing the STOP and START responses, the process became more complicated. There appeared to be three types of alternatives to "Experienced", namely "Not experienced", "Not experienced often enough" and "Experienced the opposite". Consider, for instance, that [X] is experienced as being impolite. Now the respondent might answer: "[X] should STOP being impolite." This would be an example of a STOP response falling into the "Experienced the opposite" category. Now, consider that the respondent has an unmet expectation of [X] being polite. The respondent can reasonably be predicted to state that "[X] should START being polite." Hence, this type of START response would fall in the "Not experienced" category. Lastly, the respondent may have experienced some intermittent politeness on the part of [X], but expects [X] to be polite all the time, and may then state that "[X] should START being *more* polite". Responses of this kind could be categorised as "Not experienced often enough".

To avoid overcomplicating the analysis all expressions of the types "Not experienced", "Experienced the opposite" and "Not experienced often enough" have been recorded as counts of "Not experienced" in the data tables below.

Another phenomenon that complicated the data analysis was the way in which some respondents tended to overstate a particular issue of concern. In the following excerpt from a student questionnaire (2005 student survey, respondent 6), the respondent raises the same three issues in both the STOP and START sections of the questionnaire (analysis codes are in square brackets):

What should your demonstrator STOP doing?

The demonstrator should stop being rude [Af-3] and coming to the laboratory unprepared [Pro-1], like not knowing what the experiment is all about. Also stop having unnecessary conversations with students during the practicals [Pro-2].

What should your demonstrator START doing?

Demonstrator should start being courteous, polite [Af-3] and prepared for the practicals [Pro-1]. Demonstrator can chat with students after practicals. (*One possible interpretation: Demonstrator should not chat casually with students during practicals, therefore [Pro-2].*)

I opted to count instances like the above example as a single mention of each of the categories identified, since it appears that the student is simply restating negative experiences (in the STOP segment) as expectations (in the START segment). In some cases however, a student might mention the same issue as having been “Experienced” and (under a separate set of circumstances, presumably) “Not experienced”. The following excerpt (2008 student survey, respondent 5) offers an example:

What should your demonstrator START doing?

Pay more attention to those he is in charge of. [S-TeLe-2: *Interact more – “Not experienced”*]

What should your demonstrator CONTINUE doing?

Always ask if I’m OK and to check up. [S-TeLe-2: *Check up on us – “Experienced”*]

In such cases one count would be recorded in each of the *Experienced* and *Not Experienced* categories. As a consequence of all the different permutations of ways in which issues could be mentioned, the data became very difficult to analyse with consistency.

A third situation that occurred with some frequency was that a respondent would make two separate mentions about the same broad issue, as in the following example (2008 student survey, respondent 31):

What should your demonstrator CONTINUE doing?

My demonstrator should continue helping me and checking if I am on the right track. [S-TeLe-2]

To guide us into getting the right answer. [S-TeLe-2]

In the above instance I was at first unsure whether to count two mentions or one. I decided in the end that it would have to be two counts, since I had made the decision to record a count for every mention that was not simply an expansion or repetition of the exact same issue. The reason why I felt that the two lines in the above response were essentially different was because one dealt with assistance and the other with guidance, which the response space defines as related but different actions.

7.6.2 Comparing the student surveys

Applying statistical analysis to determine whether a significant difference existed between the data of the two surveys was problematic. It is a design requirement of the chi-square test (and other tests like it that compare frequency data within categorical variables) that each observation should not fall into more than one category (Pretorius, 1995). This is referred to as ‘independence’ of the data. While it is true that the 2005 and 2008 student cohorts did not overlap, it was indeed possible for a student to report a particular issue as *Experienced* as well as *Not Experienced* (see the explanation given in section 7.6.1 above). The way in which I

chose to analyse the data meant that the two categories *Experienced* and *Not Experienced* were therefore not mutually exclusive (independent), and hence disqualified the chi-square test as a means of comparing the two datasets. Colleagues (R. Blignaut, R. Madsen, personal communications, 2010) from the Statistics Department at UWC were in agreement that the data did not lend themselves to further statistical analysis and for this reason I will limit my discussion to the issues that emerged upon qualitative comparison of the surveys.

In table 7.11 the two student surveys (2005 and 2008) are compared in terms of the number of times a specific issue was reported as *Experienced* and *Not Experienced* by the student respondents. What follows is a brief explanation of how the percentages in table 7.11 were arrived at. Each number (frequency) in the table is also expressed as a percentage of the number of times that particular issue was mentioned by all participants in the survey. Hence, issues that could be categorised as Com-1 were mentioned 37 times in survey 1; 7 out of 37 (19%) of those responses represented positive experiences and 30 out of 37 (81%) represented either unmet expectations of that particular experience or experiences opposite to students' expectation with respect to this particular issue.

Table 7.11: Comparison of the number of Experienced and Not Experienced responses in the free response sections of student surveys 1 and 2 (Percentages are given in brackets).

Category codes	Survey 1 (N = 155) (October 2005)		Survey 2 (N = 190) (May 2008)	
	Experienced	Not Experienced	Experienced	Not Experienced
Com-1	7 (19%)	30 (81%)	11 (46%)	13 (54%)
Com-2	2 (33%)	4 (37%)	0	0
Com-3	0	4 (100%)	1 (33%)	2 (67%)
Category total: Communication issues	9 (19%)	38 (81%)	12 (44%)	15 (56%)
S-TeLe-1	0	1 (100%)	1 (50%)	1 (50%)
S-TeLe-2	12 (23%)	41 (77%)	41 (52%)	38 (48%)
S-TeLe-3	3 (38%)	5 (62%)	2 (29%)	5 (71%)
S-TeLe-4	1 (100%)	0	3 (33%)	6 (67%)
S-TeLe-5	3 (100%)	0	7 (88%)	1 (12%)
Category total: Student Teaching and Learning issues	19 (29%)	47 (71%)	54 (51%)	51 (49%)

Table continues on following page.

Category codes	Survey 1 (N = 155) (October 2005)		Survey 2 (N = 190) (May 2008)	
	Experienced	Not Experienced	Experienced	Not Experienced
Man-1	2 (10%)	18 (90%)	2 (11%)	17 (89%)
Man-2	0	19 (100%)	0	2 (100%)
Man-3	1 (10%)	9 (90%)	3 (38%)	5 (62%)
Man-4	3 (43%)	4 (57%)	6 (38%)	10 (63%)
Category total: Leadership/Management issues	6 (11%)	50 (89%)	11 (24%)	34 (76%)
Pro-1	3 (5%)	60 (95%)	6 (17%)	29 (83%)
Pro-2	9 (22%)	32 (78%)	22 (41%)	32 (59%)
Pro-3	11	0	71	0
Category total: Professional Conduct issues	23 (20%)	92 (80%)	99 (62%)	61 (38%)
Af-1	41 (67%)	20 (33%)	74 (94%)	5 (6%)
Af-2	15 (71%)	6 (29%)	41 (93%)	3 (7%)
Af-3	2 (13%)	14 (87%)	2 (50%)	2 (50%)
Af-4	5 (21%)	19 (79%)	15 (56%)	12 (44%)
Category total: Affective issues	63 (52%)	59 (48%)	132 (86%)	22 (14%)
TOTAL	123 (30%)	286 (70%)	315 (63%)	184 (37%)

The first aspect worth noting (table 7.11, final row) is that the total number of *Not Experienced* responses outnumbers the total number of *Experienced* responses in Survey 1, and the situation is reversed in Survey 2. This may be interpreted to mean that students in the second group (towards the end of the study) overall had more experiences of having their expectations met than students in the first group. In fact, all the category totals (represented by the shaded rows in the table) showed an increase in *Experienced* responses (and a corresponding decrease in *Not Experienced* responses) overall. The most dramatic increase was in the category *Professional Conduct issues* (Experienced responses increased from 20% to 62%) and the least was in the category *Leadership/Management issues* (Experienced responses increased from 11% to 24%).

The frequencies in table 7.11 become easier to compare when they are presented visually as percentages on a bar graph. Such a graph has been provided in a fold-out format as figure 7.1 on the page that follows. In figure 7.1 the free-response data from the two surveys are graphically represented alongside each other. In the graph the blue bars represent numbers of *Experienced* responses as percentages of the total number of times an issue was mentioned in a particular survey, and the red bars represent the *Not Experienced* responses as percentages.

It is clear from the graph that most of the categories showed an increase in the percentage of *Experienced* responses from Survey 1 to Survey 2. Exceptions are S-Tele-3, S-TeLe-4, S-TeLe-5 and Man-4. In the graph I have used colour intensity to indicate the relative response frequencies of the different categories. Higher colour intensities indicate higher response frequencies and allow for the identification of “hot spots” in the response space. From the more intensely coloured regions on the graph, it can be deduced that relatively high response frequencies (more than 40 mentions) were observed in the categories Com-1, S-TeLe-2, Pro-1, Pro-2 and Af-1 in Survey 1, and in the categories S-Tele-2, Pro-2, Pro-3, Af-1 and Af-2 in Survey 2. Relatively low response frequencies (10 or fewer mentions) were observed in the categories Com-2, Com-3, S-TeLe-1, S-TeLe-3, S-TeLe-4, S-TeLe-5, Man-2 (Survey 2 only), Man-3, Man-4 (Survey 1 only), and Af-3 (Survey 2 only). Com-2 was not mentioned at all in Survey 2.

The issues about which students felt most strongly were effective communication, the facilitator role of the demonstrator (assisting, guiding, and interacting with students), professional conduct issues (professional behaviour and quality of work) and affective issues (attitude towards students and demonstrator disposition). All of these issues saw an increase in *Experienced* responses from Survey 1 to Survey 2, which indicates an improvement in students’ experiences of their interactions with the demonstrators with respect to these issues.

Two final comments are worth making here: First, the category Man-2 (dealing with demonstrators being reasonable, open, uncritical, authentic, transparent, and non-racist towards students and having realistic expectations of them) was an issue of intermediate prominence in Survey 1 – nineteen mentions (all in the *Not Experienced* category) were counted. In Survey 2 this issue had low importance – only two mentions (also *Not Experienced*) were counted. I have written at length (chapter 4) about the “us-versus-them” culture that prevailed in the demonstrator community in the early stages of the study when Survey 1 was conducted, and speculated that it may have had a knock-on effect on student-demonstrator relationships in the laboratories. Intermediate numbers of counts in the *Not Experienced* category of Survey 1 for codes Af-3 (14) and Af-4 (19) (dealing with affective issues such as showing respect, empathy and understanding towards students) support this contention. In Survey 2 Man-2 and Af-3 are scarcely mentioned (total counts of 2 and 4 respectively), indicating that towards the end of the study, the issue had been resolved. My second and final comment concerns category Pro-3, which I have described as “Meeting own standards”. Essentially I have used this category as bin for responses of the type: “Everything is the way I like it”, “My demonstrator is doing great”, “My demonstrator is doing everything right” and “Nothing I can think of (to complain about)”. There is a dramatic increase in responses in this category from Survey 1 (11) to Survey 2 (71).

To my mind the above results offer convincing evidence of complete turnaround in the students’ experience of the demonstrators towards the end of the study.

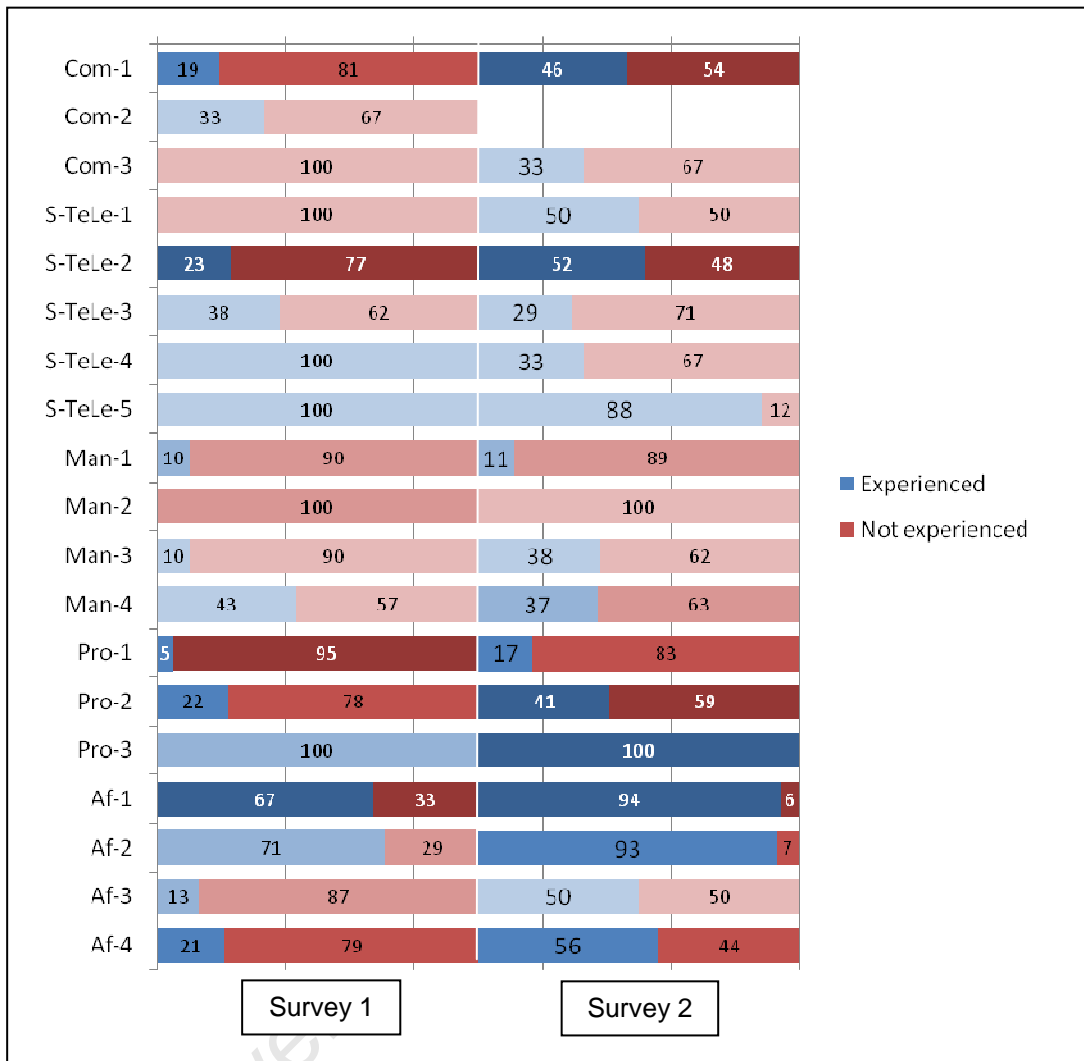


Figure 7.1 Comparison of the percentage of Experienced and Not Experienced responses in the free response sections of student surveys 1 and 2.

7.6.3 *Demonstrator surveys*

7.6.3.1 *Demonstrators' experiences of the students*

Table 7.12 compares the two demonstrator surveys (2006 and 2008) in terms of demonstrators' experiences and expectations of the students. Demonstrators' responses to the STOP START CONTINUE questions are compared in terms of the number of times a specific issue was reported as *Experienced* and *Not Experienced*. Here, the same constraints that excluded statistical analysis of the student survey (section 7.6.2 above) applied and I will once again limit my discussion to a qualitative comparison of the frequencies in the table. Since the sample sizes of the two surveys are comparable I have not deemed it necessary to convert the frequencies in the table to percentages.

I found it interesting that the total frequency counts (final row of the table) are so similar, despite the fact that the two survey samples contained different individuals surveyed at completely different times in the history of the laboratory community. Looking at the individual response frequencies on the table in detail, the similarity in count and in distribution (between the *Experienced* and *Not Experienced* columns) is almost surprising, given the small sizes of the two survey samples. One interpretation to attach to this result is that, while the students' experience of the demonstrators changed completely, the same could not be said of the demonstrators' experience of the students. Allowing for the fact that the samples consisted of different individuals, it may also support a point made elsewhere (section 7.1.2), namely that the students of the two surveys are from the same *population*.

The category attracting the highest number of responses (in both surveys) was Pro-1 (relating to being adequately prepared and organised during the practical). This issue was mentioned 26 times in Survey 1 (6 mentions in the Experienced and 19 mentions in the Not Experienced columns); clearly a "hot issue" for the demonstrators in the early community. Perhaps the fact that the issue is mentioned less often in Survey 2 (15 times) can be related to the fact that students were expected to draw flow diagrams prior to the laboratory sessions in order to encourage greater engagement with the practical manual (discussed in chapter 6 section 6.2.4). However, Survey 2 demonstrators still have an issue with students' level of preparedness as reflected in the relatively high number of *Not Experienced* responses in this category.

A non-issue at the time of Survey 1 that has become a moderately hot issue at the time of Survey 2 with a moderately high number of *Not Experienced* responses, is category S-Tele-1, relating to students attitude to laboratory practice (engaging in good, ethical practice). Many of the responses had to do with students copying from each other, and leaving their benches in a mess after the practical. The students at the time of the first survey were either not engaging in these behaviours as much as those that were in the laboratories at the time of the second survey, or if they did (which is probably the more likely scenario) it did not bother the demonstrators of Survey 1 as much as it seemed to bother the demonstrators of Survey 2.

Could it be that the demonstrators of Survey 1 cared less about students copying from each other or leaving their workspace a mess? In chapter 4 (section 4.7.1) I talk about demonstrators “keeping their heads down and getting on with it” during practicals.

Table 7.12: Comparison of the number of Experienced and Not Experienced responses in the free response sections related to demonstrators’ experiences of the students in demonstrator Surveys 1 and 2.

Category codes	Survey 1 (N = 16) (June 2006)		Survey 2 (N = 17) (April 2008)	
	Experienced	Not Experienced	Experienced	Not Experienced
Com-2	3	0	3	4
Com-3	1	3	2	3
Category total: Communication issues	4	3	5	7
S-TeLe-1	1	3	4	10
S-TeLe-3	1	12	2	9
S-TeLe-4	3	11	2	11
S-TeLe-5	2	3	2	2
Category total: Teaching and Learning issues	7	29	10	32
Man-4	6	0	2	0
Category total: Leadership/Management issues	6	0	2	0
Pro-1	7	19	2	13
Pro-2	1	8	4	10
Category total: Professional Conduct issues	8	27	6	23
Af-3	1	1	4	0
Category total: Affective issues	1	1	4	0
TOTAL	26	60	27	62

The response distribution in category Com-2 may provide some confirmation of demonstrators’ disengagement at the time of the first survey. The reader will note that *Not Experienced* counts feature in Survey 2 but not in Survey 1. This category has to do with students asking questions, and the following example typifies the four responses in the Not Experienced column of Survey 2:

(Students) must start doing their work with understanding and if they are not sure they must ask.

(D-Su-03-08-D17, 2008)

Disengaged demonstrators are less likely to be concerned when students are not asking questions, and for this reason I am inclined to interpret the fact that some Survey 2 demonstrators are mentioning the issue as *Not Experienced* (and therefore an expectation), considered together with the result of category S-TeLe-1 discussed in the preceding paragraph, as evidence for a greater degree of engagement in the community at the time of Survey 2.

7.6.3.2 Demonstrators' experiences of the chemistry department

Table 7.13 compares the two demonstrator surveys (2006 and 2008) in terms of demonstrators' experiences and expectations of their interaction with management structures in the chemistry department. Once again, the possibility of statistical analysis was excluded, and a qualitative comparison of the frequencies in the table is the best I am able to offer the reader.

Table 7.13: Comparison of the number of Experienced and Not Experienced responses in the free response sections related to demonstrators' experiences of management structures in demonstrator surveys 1 and 2.

Category codes	Survey 1 (N = 16) (June 2006)		Survey 2 (N = 17) (April 2008)	
	Experienced	Not Experienced	Experienced	Not Experienced
Com-1	2	6	0	1
Category total: Communication issues	2	6	0	1
Lbr-1	3	10	1	18
Lbr-2	2	2	10	2
Lbr-3	0	1	0	0
Category total: Labour issues	5	13	11	20
D-TeLe-1	0	0	0	2
D-TeLe-2	1	0	0	0
D-TeLe-3	1	4	0	0
Category totals: Demonstrator Teaching and Learning issues	2	4	0	2
S-TeLe-3	0	0	0	1
S-TeLe-5	2	4	0	1
S-TeLe-6	0	2	0	0
S-TeLe-7	1	0	0	4
Category total: Student Teaching and Learning issues	3	6	0	6

Table continues on following page.

Category codes	Survey 1 (N = 16) (June 2006)		Survey 2 (N = 17) (April 2008)	
	Experienced	Not Experienced	Experienced	Not Experienced
Pro-2	1	1	0	1
Pro-3	0	0	5	0
Category total: Professional Conduct issues	1	1	6	1
Af-3	0	4	1	0
Category total: Affective issues	0	4	1	0
TOTAL	13 (28%)	34 (72%)	18 (38%)	30 (62%)

Looking at the response totals in table 7.13 there is a small but significant shift towards *Experienced* rather than *Not Experienced* responses from survey 1 to survey 2. In Survey 1 28% of all the responses were *Experienced* responses (therefore expectations that had been met) and in survey 2 this number increased to 38%. One “moderately hot” issue in Survey 1 (Lbr-1: payment issues, with a total of 14 mentions) has become even “hotter” in Survey 2 (19 mentions). This may be the result of an increased demand for demonstrating and tutoring positions as enrolments in the postgraduate courses rose over the 4 years of the study (see table 7.14).

Table 7.14: Numbers of postgraduate chemistry enrolments, 2006 – 2009*

Cohort	2006	2007	2008	2009
BSc Honours	5	11	12	16
MSc	30	24	29	37
PhD	26	29	29	34
TOTAL	61	64	70	87

* Data supplied by the Management Information Systems division, UWC.

The unofficial departmental policy continues to be to provide some financial assistance to as many of its postgraduate students as possible, and appointing them in demonstrating and tutoring positions has been one way of achieving this aim. With more demonstrators and tutors needing to be assisted financially, and the centrally administered work-study budget not keeping up with departmental needs, the “slice of the pie” available for each demonstrator and tutor has become smaller from one year to the next. This situation is exacerbated by another departmental policy that determines that participating in the demonstrating programme is

compulsory for all Honours students, and so the opportunities for the senior postgraduates (MSc and PhD students) are further diminished. The increased number of *Not Experienced* counts in category Lbr-1 from Survey 1 to Survey 2 is therefore not surprising.

The category Lbr-2 has seen a dramatic increase in mentions; the issue is mentioned 4 times in Survey 1 and a total of 12 times (10 of which are in the *Experienced* column) in Survey 2. This category represents issues around workload, broadening demonstrator participation and reasonable expectations on the part of the department; demonstrators are giving acknowledgement to the changes that have been implemented in the demonstrating practice in this regard (discussed in chapter 5, section 5.3.5).

Four issues that attracted small numbers of responses in Survey 1, but have all but disappeared from the response space in Survey 2 are: Com-1 (relating to effective communication), D-Tele-3 (relating to upholding demonstrator authority), S-TeLe-5 (relating to the introduction of measures to improve student engagement in the practicals) and Af-3 (relating to showing respect and appreciation for demonstrators' efforts). I will now discuss each one briefly in turn.

Firstly, measures to improve communication with the demonstrators, such as weekly demonstrator briefings and printed briefing notes for each practical were introduced between the two surveys and have been discussed (chapter 5, section 5.3); their introduction probably accounts for the disappearance of issue Com-1 from the response space.

Secondly, the demonstrator manual (appendix 3.9) contains a section clarifying what lies within and outside of the demonstrators' authority. Some guidelines are also given on dealing with challenges to demonstrators' authority, and demonstrators having access to this information may account for the disappearance of this issue (D-TeLe-3).

Thirdly, the virtual disappearance of S-TeLe-5 probably has to do with the introduction of flow diagrams (see related discussion in section 7.6.3.1 above).

The final category to almost disappear from the response space was category Af-3. This issue attracted 4 *Not Experienced* responses in Survey 1, and 1 *Experienced* response in Survey 2. This category represents the issue of (lack of) respect for demonstrators and appreciation for their efforts. One of the central issues that I identified and wrote about (chapter 4) regarding the demonstrator community in the early days of the study was the "us-versus-them" culture characterised by a lack of trust and mutual respect. The change in demonstrators' experience of the issue from Survey 1 to Survey 2 is borne out in the interview data and other qualitative data collected after the introduction of the intercessionary process described in chapter 5. I would argue that the absence of evidence in Survey 2 of the rift (that existed between the demonstrator community and the department in the early stages of the study when Survey 1 was conducted) means that it is diminishing.

A final comment concerns category Pro-3, which I have described as “Meeting own standards”. As I explained before (section 7.6.2) I used this category as a bin for responses of the type: “Everything is the way I like it”, “I don’t have any complaints”, and the like. Survey 1 contained no responses of this type, but Survey 2 contained no less than 5. I took this as evidence of a more positive experience of their relationship with the department on the part of the demonstrators towards the end of the study.

In the following section I wish to reflect on the surveys and the fitness of purpose of the instruments used.

7.7 Reflecting on the surveys

In the context of phenomenographic research, to which this quasi-numerical study has some parallels, it is not unusual for analysis structures to be influenced by the impositions of the researcher (Åkerlind, 2005). This is defensible on the grounds that phenomenographic and indeed all variations of naturalistic research do not search for the “right” interpretation of a set of results, but rather for one that is justifiable (Marton & Booth, 1997). Inasmuch as I attempted to allow the logical structure of the response spaces to emerge as directly as possible from the data, I had to concede that they were probably also influenced by my own judgments and impositions. For this reason I asked two colleagues who are also chemistry lecturers of some years’ experience to code samples of each survey using the coding schemes that I had developed. Their results corresponded well with my own which I took as evidence of acceptable credibility of the analysis process.

7.7.1 Fitness of the survey instruments

In this section I want to reflect on the surveys and the usefulness of the chosen formats for the purposes of tapping into participants’ experiences and expectations and providing a broader context for the qualitative findings of my research. I also want to focus on some additional difficulties encountered during data analysis that were not mentioned in paragraph 7.6.1, and suggest ways in which the survey designs might be improved for future use.

7.7.1.1 Fixed response sections

Rating scales such as Likert scales are useful from the point of view that they allow the researcher to attach a numerical dimension (in the form of a frequency) to a scalable response (Cohen *et al.*, 2000). Their most serious limitations include that equal intervals between response categories cannot be assumed, that they constrain participants’ responses to those issues covered by the survey, and that they may be subject to distortion from such phenomena as central tendency bias (when respondents avoid extreme response categories such as

strongly agree/disagree), acquiescence bias (when respondents agree with all statements as presented) and social desirability bias (when respondents attempt to portray themselves in a more favorable light).

While the fixed response sections in the surveys did cast some light on participants' perceptions of their own learning in the laboratories, and to what extent these perceptions may have changed over the course of the study, I was much more interested in the issues revealed by responses in the free response sections of the two questionnaires. As expected, the open-ended format yielded rich data, which was not always easy to interpret, as I will explain in the following paragraph.

7.7.1.2 *STOP START CONTINUE format*

Surveys are generally not considered suitable for exploratory work (Robson, 2002), and work best in situations where there is a good likelihood that different respondents will all interpret the same standardised set of questions in the same way. Unfortunately, as is often the case at the outset of a new study, I did not know which questions to ask in order to better understand the situation in the laboratories. I opted for the STOP START CONTINUE format (justified in paragraph 7.3.2. above) because it offered precisely the "shot-gun approach" to data collection that was needed at the start of the study to determine the lay of the land. I was able to use the data generated in this manner to show what students' and demonstrators' initial areas of concern were, and how these shifted as the study progressed. I have written at some length (paragraph 7.6.1) about the kind of difficulties encountered in interpreting some of the responses, and how they were handled. Once interpreted, the STOP START CONTINUE format also presented some difficulties around deciding how to count participants' responses. It was not simply a matter of counting START responses as statements of expectation, STOP responses as negative experiences and CONTINUE responses as positive experiences, as I had originally anticipated. Students would sometimes write a START or STOP statement in response to a CONTINUE question as shown in the following example (2005 student survey, respondent 11):

What should your demonstrator CONTINUE doing?

Some of our demonstrators are helpful and should continue being that way... [*Af-1; CONTINUE response*]

... however some of them should sit in for the pre-prac so that they know what's going on in the prac. [*Be prepared, Pro-1; START response*].

These kinds of issues meant that every response had to be weighed and classified very carefully, making the process laborious and time-consuming. In retrospect it would perhaps have been prudent to employ the first set of student and demonstrator surveys as pilot instruments for the development of a pair of structured questionnaires for the follow-up surveys.

A format consisting of rank ordered exercises, for instance – requiring respondents to assign priorities to the issues identified in the pilot exercise – may have offered a more unambiguous and time-efficient alternative to the STOP START CONTINUE questionnaire. An open format question inviting additional comments/issues could have been added to allow for responses not included in the proffered list of issues to be rank-ordered. This may also have allowed for the baseline and beyond data sets to be compared using inferential statistics. It has to be conceded however that the STOP START CONTINUE format did deliver on the promise (Molloy, 1998) to provide honest and fast feedback. It also allowed me to make a surface comparison of the baseline and beyond situations that stood up to scrutiny, as explained at the start of this section. Also, a more structured survey format would probably not have provided quotes as telling as the ones with which I will conclude this chapter. The next section offers a summary of the results discussed in this chapter.

7.8 Summary

In this chapter I have given details of four surveys (two student surveys and two demonstrator surveys) that were used to collect global data about student and demonstrator expectations and experiences of the laboratory sessions. The first pair of surveys was conducted as a baseline study during proposal development for this research project in order to establish the issues that the research needed to address. The baseline study consisted of a student and a demonstrator survey probing each community's expectations and experiences of the first-year laboratory course. Towards the end of the study both surveys were repeated.

Most of this chapter has dealt with comparisons of the data generated in the two sets of surveys. Some of the issues considered were:

- *What were students and demonstrators perceptions of their own learning from participation in the laboratory programme at the start (baseline) and towards the end (beyond) of the study?* This question was addressed using fixed response sections in the student and demonstrator survey questionnaires and the results of the baseline and beyond surveys were compared statistically for each group. There was some improvement in students' perceptions of their own attainment of the learning outcomes of the practical course over the course of the study. In the demonstrator survey participants were required to respond to statements about their own learning around aspects of laboratory teaching. Demonstrators rated their own learning quite high, but there was no significant difference in demonstrators' perceptions of their own learning about teaching following their involvement in the demonstrating programme.
- *What were students' experiences and expectations of their interactions with the demonstrators in the laboratories at the start (baseline) and towards the end (beyond) of the*

study? This question was addressed using a free response STOP START CONTINUE format. Students in the “beyond” survey (towards the end of the study) overall had more experiences of having their expectations met than students in the “baseline” group. Most of the categories making up the response space of the students showed an increase in the percentage of *Experienced* responses from Survey 1 to Survey 2 which was taken as evidence that students’ experiences of their interactions with the demonstrators had improved with respect to these issues.

- *What were demonstrators’ experiences and expectations of their interactions with the students in the laboratories at the start (baseline) and towards the end (beyond) of the study?* The demonstrator survey questionnaire contained two free response sections, the first of which addressed this question. There were many similarities between the “baseline” and “beyond” surveys in terms of the individual response frequencies in each category, and I found this quite surprising given the small sizes of the two survey samples. The data show that demonstrators participating in the “beyond” survey are less concerned about student preparation and more concerned about students’ attitudes to their practice than the demonstrators participating in the “baseline” survey. I offered explanations for these changes and concluded that they may point to a more engaged demonstrator cohort towards the end of the study, than at the start.
- *What were demonstrators’ experiences and expectations of their interactions with the chemistry department on issues relating to the practicals at the start (baseline) and towards the end (beyond) of the study?* The second free response section in the demonstrator surveys addressed this question. Unmet expectations about salary issues head the list of emergent issues, and is even more prominent in the “beyond” survey than in the “baseline” data. Changes in the demonstrating programme that are part of the intercessionary process may be responsible for more positive experiences reflected in the “beyond” data compared to the “baseline” – one such issue centres on demonstrators’ workload and reasonable expectations on the part of the department. These changes may also account for the disappearance of certain concerns from the response space towards the end of the study, such as effective communication, demonstrator authority issues, student engagement issues, and respect and appreciation shown to demonstrators by the department.

Some significant changes are reflected in the comparisons drawn between the “baseline” and “beyond” data that have been discussed in this chapter. In conclusion I have put together a selection of quotes (table 7.15). In offering the quotations below I do not wish to infer that participants experiences of the before or “baseline” situation were only negative, nor that the “beyond” situation generated only positive experiences. I concede that the quotes that I have chosen represent extremes from the data that do not necessarily reflect the considerable degree of overlap in responses evident in the data tables (tables 7.11, 7.12 and 7.13). However,

I have chosen segments of text that I felt contributed most to the overall *tone* of the responses in a particular survey as a whole. The contrast between the “baseline” and “beyond” quotes is marked and serves to corroborate the contention that, on the whole, students and demonstrators experienced their interactions with each other more positively, and demonstrators experienced the department more positively after the implementation of the intercession.

Table 7.15: Quotes from students and demonstrators in the “baseline” and “beyond” surveys.

BASELINE	BEYOND
The students said (about the demonstrators):	
<i>...for them to be able to stop doing something they would have to be doing something in the first place.</i> [S-Su-01-05-32]	<i>I like our relationship; (she) never makes me feel uncomfortable or nervous.</i> [S-Su-02-08-21]
<i>They should start doing what they are paid for to do.</i> [S-Su-01-05-52]	<i>Just between you and I, I like her, she will make a very nice big sister.</i> [S-Su-02-08-35]
<i>...some of the demis are often uncertain about the practicals and are therefore of no or little use to us.</i> [S-Su-01-05-129]	<i>If she does not know answers herself she quickly finds out, in order to help me. She is also always positive and excited which is very good.</i> [S-Su-02-08-18]
<i>.. The demonstrator (should) stop spending so much time with one another instead of with the students.</i> [S-Su-01-05-69]	<i>He knows exactly what to tell you when you ask him a question.</i> [S-Su-02-08-50]
<i>Stop being so horrible to the students.</i> [S-Su-01-05-140]	<i>He has a lot of patients (sic) with us when we don't get things first time.</i> [S-Su-02-08-82]
The demonstrators said (about the students):	
<i>I can't really think of something the students are doing properly at the moment.</i> [D-Su-01-06-02]	<i>I demonstrated for 1st years in 2006 and I have seen a marked improvement in ... the students understanding of the practicals generally.</i> [D-Su-03-08-15]
<i>Stop asking too many questions concerning experiment after being demonstrated to by the lecturer in charge.</i> [D-Su-01-06-10]	<i>They should continue to show respect and appreciation towards each other and the staff in the lab. They are really pleasant to work with.</i> [D-Su-03-08-11]
<i>I found students did not listen when you are trying to explain something to them and they also don't want to think for themselves. You find students will go from demi to demi until they find someone who will solve the problem for them.</i> [D-Su-01-06-02]	<i>(Continue) being competent, hard-working as well, because I see a lot of confidence in most of them.</i> [D-Su-03-08-13]
The demonstrators said (about the department):	
<i>Demonstrators are not treated with respect by coordinators.</i> [D-Su-01-06-11]	<i>Continue with (the) current relationship between the demonstrators and the department, including the studies (referring to the demonstrator research project) that are currently being done by the department.</i> [D-Su-03-08-07]
<i>(Stop) treating us like we are desperate to (do) the demonstrating cos at the end it also interferes with our work.</i> [D-Su-01-06-12]	<i>The chemistry department is on the right track at the moment.</i> [D-Su-03-08-06]

The next and final chapter of this thesis will draw the findings of the study together, and in doing so will highlight how the survey data supports and contextualises the qualitative findings of this study.



Chapter 8

Conclusions and implications

In this chapter I stitch together the findings of my study by drawing together the discussions in the preceding chapters into a composite characterisation of demonstrator participation at my institution. I examine implications for postgraduate students' involvement in peripheral teaching activities in tertiary chemistry courses that may be generalisable to other scientific disciplines. The chapter concludes with some recommendations arising from the implications and suggestions for future research work.

8.1 Introduction

The research component of (post)graduate chemistry training bears a close resemblance to the key attributes of cognitive apprenticeship theory (Stewart & Lagowski, 2003). Even the training postgraduate students receive during teaching assistantships may be overtly structured as cognitive apprenticeships (Bond-Robinson & Bernard Rodriques, 2006). This perspective sees the postgraduate learner acquiring cognitive and metacognitive skills through structured modelling and coaching of relevant activities in real-world situations (Brown *et al.*, 1989).

I have studied a community of senior undergraduate and postgraduate chemistry students tasked with teaching responsibilities in the first-year laboratories of an academic department at a South African university. Since these students are learning to teach as they are doing the work of facilitating undergraduate student learning I looked to perspectives that recognise the situated nature of learning to frame the study. Instead of individualistic models I opted for a theoretical framework that views learning as participation in a community of practice for characterising demonstrators' engagement with their task of facilitating student learning or, to borrow from Wenger (1998: 3), one that *places learning in the context of demonstrators' lived experience of participation in the laboratories*. Learning-as-participation is more than engagement in the activities and practices of a social or professional group of people; it encompasses both *active participation* and the *construction of an identity* in relation to the group and its practices. Both of these issues are reflected in the aims of my study articulated as follows at the start of my research journey:

In the first instance the study aims to characterise the nature of demonstrators' participation in the first-year Chemistry laboratory. Secondly, it will explore the extent to which demonstrators' participation in the undergraduate laboratories is helping them to become better teachers. [K Wallace Proposal March 2007]

My choice to frame the study in communities of practice (CoP) theory stems from this approach's dual foci on *changing participation* and *identity transformation*. The gradual cultivation and transformation of an identity within a CoP provides a useful framework for describing what I perceive (and have personally experienced) as an organic progression to becoming a full participant in a certain community (Lave & Wenger, 1991; Wenger, 1998). At the same time the CoP framework offers a means to study how groups of people learn through the development of shared knowledge (Macklin, 2007).

In the present chapter I will synthesise the findings of the data chapters of my thesis to show the ways in which demonstrator participation shifted over the course of the study. I will start with an overview of the thesis, followed by summarised characterisations of demonstrating practice with which I hope to answer my research questions. I will discuss in turn: demonstrator engagement, imagination, and alignment with institutional processes, before reviewing methodological and additional findings. This will be followed by a critical reflection on my study. I will conclude by addressing the implications of the research for demonstrator involvement and training and suggesting matters that could be considered in future research.

8.2 Overview of the thesis

The thesis consists of eight chapters, starting out according to convention with (1) an introductory chapter, (2) a literature review chapter in which my theoretical framework is developed, and (3) a methodology chapter. The data of my study are presented in four chapters (4 – 7). I used the same theoretical framework to characterise demonstrator participation in the first-year laboratories at two stages, early and later, towards the end of the study. These characterisations are termed “baseline” and “beyond” respectively to reflect the fact that they described practice at two pivotal stages of the study. They are the foci of chapters 4 and 6. Chapter 5 deals with that which separated the “baseline” from the “beyond”, and is not a data chapter *per se*. It described the nuts and bolts of the intercessionary process that was implemented with the aim of improving demonstrating practice in the laboratories. In addition to characterising demonstrator participation in the laboratories, I conducted “baseline” and “beyond” surveys to monitor the quality of students' and demonstrators' experiences of their interactions with each other, and demonstrators' experiences of the chemistry department. The survey results are the topic of chapter 7 and they support and provide a broader context for the qualitative findings of chapters 4 and 6. In addition to presenting a collective demonstrator

perspective, the surveys also ensure that the voices of the first-year students in the laboratory (not present in the qualitative data) are recorded. Finally, the findings of my study are drawn together in this, the concluding chapter in the octet.

The next section briefly revisits the framework used for characterising demonstrator participation before going on to a summary of the findings of the research, presented in terms of the three elements of belonging to a CoP, namely engagement, imagination and alignment.

8.3 Characterising demonstrator participation: The research questions answered

Wenger (2000) captured different forms of participation within communities by outlining three distinct constructs that he termed *modes of belonging*. They are *engagement*, *imagination* and *alignment* and they provided the foundational elements of my theoretical framework.

The centrality of these constructs to my study is clearly reflected in the first three research questions:

- Q1. How do demonstrators *engage* with and within the community and what do they end up knowing from their participation?
- Q2. What *images* do demonstrators construct of themselves, and how do they interpret their own participation within the community?
- Q3. To what extent is demonstrators' participation *aligned* with other processes within the community?

In this section I will summarise the findings of the study in three separate subsections, each relating to one of the constructs above. The titles chosen for the three subsections reflect which research questions each one proposes to answer: *Demonstrator engagement* (Q1), *Imagination and the development of an identity in practice* (Q2) and *Alignment with institutional processes* (Q3).

My fourth and final research question related to the potential impact of an intercession on the quality of learning in the laboratory:

- Q4. How does an intervention in the form of a formalised training program combined with demonstrators' guided reflections on their practice change their participation in the laboratory?

I will not be answering the fourth research question in isolation, but will address it during the discussion of the first three questions. I have explained (section 6.6) how the reluctance of demonstrators to participate in the research at the early stages of the project meant that I did

not have the opportunity to ask certain questions of the early community. For this reason, and also because different issues emerged from the two datasets, it was not really possible to directly map “baseline” and “beyond” data onto each other in exploring the transformation in demonstrating practice of the community. Hence, in the subsections that follow I have summarised my characterisations of the “baseline” and “beyond” communities in terms of the *aspects* that best describe each stage. Tables 8.1 to 8.3 contain the summaries and serve to anchor the discussions in each of the subsections; they also go some way towards contrasting “baseline” and “beyond” in terms of the three modes of belonging. In the tables I have retained the original format from my conceptual framework (section 2.7.3) in which the dimensions of progression¹ (*enterprise*, *mutuality* and *repertoire*) are placed on the horizontal axis to provide structure to the tabulated summaries. The first subsection, in which demonstrator engagement is considered, follows.

8.3.1 *Demonstrator engagement*

The aspects of engagement that have emerged from the research data are summarised in table 8.1 on the next page. Bin codes and propositions (framework statements) are also given in the table.

8.3.1.1 *What engagement means in the demonstrator community*

According to Macklin (2007: 204) *mutual engagement* in a community of practice refers to “negotiated activity where individuals work to establish a frame of reference for behaving and communicating within the group”. What makes this particular group of postgraduates a community of practice is their mutual engagement in the demonstrating programme. They are not a community simply because they belong to the same group or category (postgraduate chemistry students, for instance), but because they are organised around what they are there to do. Being part of the community means they set aside their own research interests for a couple of hours every week, don their red coats and make their way down to the undergraduate laboratories to “demonstrate to the first-years”. They participate for a variety of reasons; some to make extra money, others to make a difference, but they work together in roles that are similar and yet each one is unique. Everyone’s unique contribution is important in this socialized learning process (Soden & Halliday, 2000) and through mutual engagement they develop a *shared practice*; a way of doing things that is both similar to the way things were done “last year” but also subtly different because a different set of individuals are involved. They *engage* with each other, and their individual experiences of who they are within the community are shaped, as they learn how the community responds to their actions.

¹ Three elements for the description of competence within a community of practice were introduced in chapter 2. They are joint *enterprise*, *mutuality* and shared *repertoire* (Wenger, 2000). In non-stagnant communities these elements serve as dimensions of progression.

8.3.1.2 Style and quality of engagement

At the start of the study the style of engagement of some of the demonstrators was to be present but disengaged; to go through the motions of helping students solve mainly procedural problems, but without much enthusiasm. Their preferred interactions were with each other and mainly social in nature; this came at the cost of productive interactions with the students in their charge who were often left feeling neglected and dissatisfied as a result. This was of course not true of all demonstrators; there is evidence in the survey data that at least some of the students had positive experiences of their demonstrators.

Table 8.1: Aspects of engagement emerging from the “baseline” and “beyond” data

Dimensions of progress	Enterprise (learning energy)	Mutuality (social capital)	Repertoire (self-awareness)
Bin code	E1	E2	E3
Proposition	Demonstrators identify the gaps in their (and their students’) knowing and work (together) to address them.	Events and interactions exist that provide for discussion of issues and development of trust amongst demonstrators, students and the lecturer.	A shared demonstrating experience has accumulated with potential for further development.
BASELINE	Limited engagement Focus on the procedural Tension between interventionist and non-interventionist teaching styles Demonstrators misinterpret students’ motives Low lecturer involvement	Low trust / uneasy atmosphere Unsymmetrical power relations Poor communication Demonstrators negatively experienced Demonstrator resource is overstretched Superficial interactions and impersonal relationships	Strike action adopted into repertoire Established practice exists with informal mechanisms for transmission
BEYOND	Increased interactions More incidences of pro-active engagement Evidence of higher levels of PChK in some demonstrators Tension between interventionist and non-interventionist teaching styles remain Importance of building student confidence recognised	Increased interaction leads to better communication Improved demonstrator commitment More positive student experience of laboratories and demonstrators Value of involvement of younger demonstrators recognised - “buddy” role Greater appreciation for demonstrators’ role	Repetition of strike New aspects of practice emerging from within community Broker role expanded Procedural changes are paying off Student absenteeism and cheating reduced Non-coercive control measures adopted

8.3.1.3 Transforming engagement

Following the intercession, but not necessarily only as a result of it, demonstrators were engaging in ways that were qualitatively different from before. Generational change had probably also contributed to the changes in demonstrating practice, if not directly. New

community members did not necessarily bring new practices – the shared *purpose* of the community namely to facilitate student learning in the laboratories did, after all, remain unchanged – but they may have brought fresh attitudes and perspectives that contributed to the community being more open to transformation.

The intercession by its very nature brought changes to the demonstrating practice; some imposed, some negotiated and some spontaneously adopted or developed. I have described the procedural changes that were introduced in the way the laboratories were run, and how they contributed to increased opportunities for interaction between demonstrators and students and improved communication between demonstrators, students and the department. Not only did the opportunities for interaction increase, but survey data showed a qualitative increase in the number and quality of demonstrators' interactions with the students.

8.3.1.4 *Differences between the engagement styles of experts and novices*

Relating to the role of novice participants, communities of practice are distinguished from traditional learning communities in terms of two important aspects (Johnson, 2001). First, CoP theory gives consideration to variability in experience and contribution. Not all community members are able to contribute equally due to differences in, amongst other things, experience, confidence levels and intellectual and emotional maturity (Gardner, 1983). The second aspect of distinction between CoPs and traditional learning communities is the fluid peripheral-to-center progression experienced by newcomers to the community, as they work collaboratively with experts. The role of the novice demonstrator is not necessarily subordinate to that of the expert. Circumstances may even sometimes lead to a reversal in roles – where the novice becomes the expert and the other way around. For instance, one of the qualities novice demonstrators in the community are valued for is their ability to relate to the students in the laboratories. The experienced demonstrators, valued on their part for their expert knowledge and maturity, are further removed from the students' laboratory experience. Their memories of their own experiences as students have become attenuated by the intervening years, and along with that their ability to relate to students. Members contribute at different levels of expertise and their engagement and participation lead to the development and evolution of a collective knowledge base.

8.3.1.5 *Seeing the demonstrator strikes in terms of engagement*

It is likely that demonstrators' style of engagement was influenced by the strained collective relationship between the department and the postgraduate students at the time. At the start of the study this relationship was still recovering from a demonstrator strike during the year preceding the start of the study that had been precipitated by a departmental decision that demonstrators perceived as disadvantageous to themselves. The strike itself was a form of mutual engagement that became a part of the repertoire of the community when the department

capitulated and reversed their contentious decision. The second strike that occurred a few years into the study is evidence that rebellion as form of participation had found a place in the repertoire of the community. Wenger (1998: 77) contends that “rebellion often reveals a greater commitment that does passive conformity”. The strike can be seen also in terms of agency for its value insofar as it set in motion a chain of events (of which this research is a part) that ultimately led to a shift in the practice of the community.

8.3.1.6 *What demonstrators end up knowing from their participation*

Social theories of learning focus on learning as participation, but I felt it necessary also to consider what demonstrators learnt *from* their participation. The data contained many examples of demonstrators acknowledging their own learning in the process of facilitating student learning. Some even expressed surprise at what they had learnt. Utterances about demonstrator learning covered the broad categories of (i) chemistry content, (ii) pedagogical content knowledge (PCK), (iii) knowing about the academic profession, (iv) knowing about self and identity, and (v) knowing about community. Each of the categories is briefly explained below.

Content: Some demonstrators saw their involvement as an opportunity to revise first-year chemistry concepts.

PCK: The demonstrators learnt about teaching and student learning and some of the requirements for learning to occur. They learnt that teaching and learning are reciprocal and enduring processes.

The academic profession: By engaging in academic work alongside expert professionals, albeit peripherally, demonstrators learnt more about the academic profession and what it entails.

Self and identity: I will present the argument later that demonstrators learnt about their own identities and priorities (sections 8.3.2.5 and 8.3.2.6).

Community: The demonstrators learnt that they can rely on each other for support.

In the next subsection I will draw together my findings in relation to the extent to which demonstrators see themselves as participants in groupings and processes that reach beyond their direct engagement in the practice of the demonstrating community.

8.3.2 *Imagination and the development of an identity in practice*

8.3.2.1 *The interrelated nature of imagination and identity*

Imagination and identity are separate but interdependent constructs that are both central to Wenger's (1998 & 2000) work. Imagination is one of the three modes of belonging to a CoP and therefore fundamental to my characterisations of demonstrating practice. In his later work Wenger (2000) expands the notion of CoP by ascribing its modes of belonging, namely

engagement, imagination and alignment also to *social learning systems* (SLSs). SLSs are built up of multiple CoPs, but they have two additional structuring elements besides CoPs namely *boundary processes* between CoPs, and *identities* that are shaped by participation in CoPs.

I will return to a discussion of the interrelatedness of imagination and identity when I critique my choice of theoretical framework later in the chapter (section 8.6.1.3: *Notions of imagination and identity*). For this section, in which I will be focussing on both constructs, imagination should be understood as a *process* of learning, which involves interaction and negotiation between the individual and the community. Identity has elements of both *process* and *product* in the context of learning. Moreover, as I will argue later, it is also a *requirement* for learning.

The aspects of *imagination* that have emerged from the research data are summarised in table 8.2. References to the bin codes and proposition statements have also been included.

Table 8.2: Aspects of imagination emerging from the “baseline” and “beyond” data

Dimensions of progress	Enterprise (learning energy)	Mutuality (social capital)	Repertoire (self-awareness)
Bin	I1	I2	I3
Proposition	Visions of the potential of the community inspire participation amongst demonstrators.	Demonstrators know about the meanings that participation in the laboratory makes in their and their students' lives.	There is a language that talks about the community in a reflective mode.
BASELINE	Non-participation has become shared practice Demonstrators unite to oppose department Transmission-notions of teaching and learning Teaching style is instructive		
BEYOND	Some demonstrators are aware of intrinsic rewards of participation such as <i>ubuntu</i> Growing network of social connections in community	Money remains an important motivator Many examples of negotiation of meaning (participation-reification interaction) evident	Evidence of construction of trajectories/futures Participation has potential as recruitment mechanism into postgraduate community Demonstrators recognise personal and professional benefits of participation

8.3.2.2 What imagination means in the demonstrator community

Part of the work of imagination is to shape our participation in a learning environment into an *identity* (Wenger, 2000). Wenger (1998: 176) relates the story of two stonemasons who are asked what they are doing.

One responds: “I am cutting this stone in a perfectly square shape”. The other responds: “I am building a cathedral.” Both answers are correct and meaningful, but they reflect different relations to the world.

The first stonecutter is concerned with the immediate, while the second imagines his work to be part of “something bigger”. In a parallel situation, with the laboratory as context, let us imagine for a moment a trio of demonstrators engaged in exactly the same activity, such as assisting students with the process of transforming a set of variables into a graph, for instance. Like the stonecutters, each of the three may have a very different experience of self in that particular situation. One might simply be focussed on the job: “I am helping the students to draw this graph”. Another might be recognising her younger self in the struggles of the students. It is the work of imagination when we see our own practices as continuing histories that transcend time and space (Wenger, 1998), as Nofanele did when she was reflecting about her own laboratory experiences as a student:

As a student it was hard, some people would just brush you off: “She is struggling”, but other people would go out (of) their way. And that for me worked, so I thought no, I have to give back. That’s the way I just regard it. I have to do the same for my students because other people believed in me. So if they did that for me, why not do the same for them?

(D-In-03-08, 2008)

Nofanele was able to imagine being in her students’ shoes. As a demonstrator, her own style of interaction with students was strongly influenced by her interactions with the demonstrator she had as a student. In the same way her own influence may extend beyond her own participation as it did for Joanne, the demonstrator who was her role model:

Yes ... Joanne, I wished I was (like) Joanne, she was so smart. Yeah, she loved her work. You see her in the lab, she was like, wow – I wanted to be like Joanne ... It made me look to myself and try being a better person. She was the better person; she was the role model, so I was trying to be like her.

(D-In-03-08, 2008)

8.3.2.3 *Imagining a possible future*

The third demonstrator in the trio is also helping her students to draw the graph. She has collected a copy of the worksheet for herself² that will be filed away later. Perhaps she is aware that her engagement is preparation for a career in which she might one day be expected to create a similar learning opportunity for students herself. She might be envisioning a future for herself in which the worksheet proves useful.

Some demonstrators have aspirations to become lecturers, and they see demonstrating (and tutoring) as preparation for that role. In the following quote Nofanele acknowledges that demonstrating is preparing her for a possible future in which she might have to “deal with students”:

² I have observed, countless times over many years of teaching, demonstrators and tutors collecting copies of the study materials handed out to first years for themselves.

For me without the hands on training as a teacher, or in instructing students, this is my only way of getting to deal with students.

(D-In-03-08, 2008)

Three of the four novice lecturers interviewed started participating in demonstrating and or tutoring while they were still undergraduates. All four conceded that, though they found being a lecturer very different from being a demonstrator or tutor, they learnt skills from their participation that have proven useful as preparation for their academic careers.

8.3.2.4 *Trajectory*

In the context of a CoP, identity can be defined in terms of possible *trajectories* (Wenger, 2000); here the term trajectory refers to a path, progression, or line of development resembling a physical trajectory³. Trajectories encompass both where we came from and where we are headed, and since most of us are heavily invested in our trajectories, they determine what takes priority in our lives and in our learning.

Also, it is possible that Nofanele's trajectory can be traced back to the time when she first started interacting with her demonstrator, Joanne:

(As a student) you get to talk to these (demonstrators):

"What are you doing Joanne?"

"I am doing my PhD."

"In what?"

"Organic chemistry."

So she (Joanne) explained her work. So you get exposed to chemistry. It's not just (the) ... theoretical chemistry that you are doing in class. Here is somebody who actually spends her whole day in the lab working on this.

(D-In-03-08, 2008)

8.3.2.5 *The centrality of identity*

Identity is well recognised as central to science learning (Kozoll & Osborne, 2004) and learning in professional contexts (Bhattacharyya, 2008; Hunter, Laursen, & Seymour, 2007; Tracy and Naughton, 1994). Bhattacharyya (2008: 90) contends that "an individual's conceptual development is inextricably linked to the individual's sense of professional identity, *i.e.*, one aspect of becoming a practicing chemist is identifying oneself as a practitioner". This implies that, learning-as-participation *produces* a sense of identity, but also that a sense of identity is *required* for learning to take place.

³ I prefer the following definition from the context of engineering and aeronautics because it is suggestive of the susceptibility of career trajectories to a multitude of influences: "*The path described by an object moving in air or space under the influence of such forces as thrust, wind resistance, and gravity*". Source: Collins English Dictionary – Complete and Unabridged (2003) HarperCollins Publishers.

It can be assumed, from the fact that they are all either senior or postgraduate students of chemistry and therefore engaging in and encountering chemistry through the opportunities afforded by working on authentic research problems, that the demonstrators already imagine themselves becoming 'chemistry persons' (Gee, 2000; Kozoll & Osborne, 2004). They are being prepared for full membership of the scientific community by their involvement in many different aspects of chemical research (conceptualising, planning, experimenting, reporting, and so forth) and their participation is shaping their identities as chemists (Bhattacharyya, 2008). Chemistry already features very strongly in their individual futures as it is very likely that most will assume positions in or related to chemical industry when they complete their postgraduate studies. Our imagination directly influences what we focus on during our learning experiences. The same is true also of our identities: "Identity formation ... helps the individual define which activities are meaningful" (Bhattacharyya, 2008: 91). Wenger's description (1998: 153) of identity as "not an object, but a constant becoming" emphasises both the dynamic and negotiated dimensions of identity. Identity work is ongoing, and constantly renegotiated in social contexts (Tracy & Naughton, 1994).

8.3.2.6 *Multiple identities*

Identity may incorporate membership of many communities of practice (Wenger, 1998). Some of the older postgraduate students already have families of their own – they are parents, some are church-goers, some are foreigners, some live together in the university residence, some are demonstrators. All of these different life-aspects and practices contribute to their identities (some centrally and others incidentally) by allowing them to construct different aspects of themselves and gain different perspectives. Sometimes these different aspects of identity are in conflict, as when the demands of participation in demonstrating programme (which carries no credit but offers financial reward, albeit small) competes with the demands of their postgraduate research agendas. Demonstrators allow themselves to be distracted from their duties by their research commitments perhaps because they have so much invested in their emerging identities as chemists. Nofanele's reference to "their personal work" in the following quote points toward postgraduates' *ownership* of their research work:

They (the demonstrators) are committed but their supervisors take priority; their personal work takes priority, so if there is (a) conference (or) there is something going on, people they won't be as committed (to demonstrating as) they want to be.

(D-In-03-08, 2008)

Their commitment to their own research competes with their teaching duties for attention, and this means that their commitments to the demonstrator community are not always upheld. As a result their participation in the first-year laboratories still sometimes falls short of the expectations of the community and the larger teaching enterprise of which it is part.

In the final subsection I will be considering the ways in which the practices of the demonstrating community are aligned with other processes in the department and the institution.

8.3.3 Alignment with institutional processes

8.3.3.1 What alignment means in the demonstrator community

Alignment is what allows us to be a part of the “bigger picture”; of coordinated enterprises on a scale larger than can be described by our own participation alone. Demonstrators align their practices with directives and expectations of the department and their participation becomes an expression of their belonging to a broader social system. They are recognised as occupying a “niche” in the academic enterprise (Park, 2002 & 2004) and may formally manifest their alignment when they apply for work later on and indicate on their CVs that they were *employed* in the chemistry department at UWC. For many their participation in the demonstrating programme will be their first real jobs, and four out of the 12 demonstrators in the WiM2baD survey cited either *job experience* or a *reference* amongst their reasons for participating in the programme. The following demonstrator mentions both in response to the prompt: *I decided to become a demonstrator because...*

I wanted to have a reference on my CV and gain some sort of experience in Chemistry as I am a Chemistry student.

(D-Su-02-07-Q1-D2, 2007)

Table 8.3 summarises aspects of alignment that have emerged from the research data.

Table 8.3: Aspects of alignment emerging from the “baseline” and “beyond” data

Dimensions of progress	Enterprise (learning energy)	Mutuality (social capital)	Repertoire (self-awareness)
Bin	A1	A2	A3
Proposition	Demonstrators have articulated a shared purpose; they subscribe to it, and feel accountable to it. Leadership is distributed widely in the CoP.	Clear definitions of the roles, norms, codes of behaviour, shared principles and negotiated commitments and expectations exist and are upheld in the community.	Methods, standards and routines exist to define good demonstrating practice, and these are upheld and transmitted to new generations.
BASELINE	Strike as evidence of misalignment of community with broad educational enterprise of institution Limited stratification of community Limited recognition given to demonstrating experience as form of leadership	Poor definition of roles, commitments and expectations Limited definition of demonstrator role	Accumulated experience not concretised Methods, standards and routines not formalised Some aspects of practice imported by community leadership Evidence of transmission of practice

Table continues on the following page.

Dimensions of progress	Enterprise (learning energy)	Mutuality (social capital)	Repertoire (self-awareness)
Bin	A1	A2	A3
BEYOND	Stratification in community based on: <ul style="list-style-type: none"> academic level (informal) and seniority (formal) Strong social coherence evident Overt transmission of practice	Expectations concretised Demonstrator roles formalised Expanded definition of demonstrator role Broker roles evident Research agendas take priority over teaching commitments	Methods, standards and techniques concretised Improved demonstrator confidence results from formalised procedures Demonstrators matched up in terms of experience <i>and</i> competence

8.3.3.2 Alignment as power

Alignment represents considerable responsibility and power. It can even be *disempowering*, for instance when it is coerced through threat or force (Wenger, 1998). When the department attempted to force the demonstrator community to align with their disempowering directives, the demonstrator community mobilised their own collective energy to align *against* the department to strike on two occasions during the study. I have described (chapter 4) how damaging the resulting misalignment was to the trust relationships in the laboratories at the time and how widely its knock-on effects were felt.

8.3.3.3 Brokering: alignment as bridge

Through demonstrators' alignment, their contribution to the larger educational enterprise that is the core business of the university is magnified. They play a very important role as representatives of the department because they are the first line of contact for first-year students in the laboratories. The demonstrators will be the first to welcome the students when they are ushered into their laboratories at the start of their very first chemistry practical session of their first year at university. Moreover, throughout the year each demonstrator will be the most important person in the laboratory to their small group of students – the one the students will go to for advice about a difficult calculation, assistance with a complicated reaction step, encouragement when in spite of students' best efforts their titration values are scattered, sympathy when their product is spilled on the way to the weighing room, and celebration when their reaction yields a crop of beautiful crystals. At the same time they will be the ones modelling laboratory-specific scientific styles and discourses, making explicit the links between laboratory practice and theory and in doing so enable students to align their own practice with the styles and discourses of the discipline. Recall the "bridging the gap" metaphor, used in the following quote by a demonstrator in one of the guided reflection exercises:

Therefore it is our duty as demonstrators to narrow that gap by communicating with students when they are having problems or misunderstandings.

(D-RW-01-08-TM, 2008)

The notion of a “demographic bridge between undergraduate students and full-time academic staff” is listed by Park (2002: 55) as one of the benefits of the use of TAs for academic departments.

In the transforming community the superdemonstrator brokered across the department-demonstrator boundary and ensured, by relaying and interpreting departmental directives, that their activities in the laboratory were aligned with departmental objectives for student learning. I will return to the notion of brokering across boundaries later in this chapter, as this is an important aspect of the interaction between communities, and an important contributor to the transformations achieved in the demonstrator community of the study.

8.3.3.4 *Defining roles and expectations*

In the following quote, Paki describes the situation in the early community where things had been done in the same way for so long that lines had begun to blur, and no one was sure of their exact role:

You know, sometimes, when something has been done for too long, people end up not knowing what is the role of other people, and there will be that ignorance that is coming.

(D-In-01-08, 2008)

Demonstrators were sent into the laboratories to demonstrate without being given clear expectations and instructions so they made things up as they went along. If they fell short of the department’s unexpressed expectations they were labelled useless. One of the demonstrators in the focus group (when asked to recall the early demonstrating community) used words such as *monitor* and *attendant* to describe the role of his own demonstrator back then, and described his duty as little more than keeping an eye on things “so (the students) don’t burn the lab down” (D-FG-01-08, 2008).

During the intercession (chapter 5) the demonstrators’ role was defined and the departmental expectations concretised in the form of a demonstrator manual. Methods and standards for demonstrating practice were formalised in this document and in subsequent demonstrator briefings. The demonstrators of the transforming community used terms such as *mentor*, *instructor*, *teacher*, *advisor*, and *role model* to describe their role; these terms are qualitatively different from *monitor* and *attendant* in that they imply a more active role for the demonstrator than passively standing on the sidelines and watching over the students. In the following quote Paki explains that documented directives and expectations (what he calls “structured, organised material”) helps the demonstrators to do a good job:

If I demonstrate for you this year, you having such kind of organised material, when I come back next year I'll come back as a better demonstrator. So what makes a good demonstrator is the material the demonstrator has, the way it is structured, the organisation of it. That makes a demonstrator very good. (D-In-01-08, 2008)

In the early community the roles of demonstrators were defined in a limited and one-dimensional way, and the value of demonstrating experience was not recognised. Over the course of the study the community stratified themselves into a hierarchy that saw (i) the novice demonstrators placed with more experienced ones, (ii) marking jobs given to the most experienced demonstrators (recall that these jobs were sought after for allowing demonstrators freedom to perform their duties in their own time), and (iii) the “top structure” of the community developed into roles for one or two superdemonstrators and a practical administrator/laboratory manager (Thandeka's role). Thandeka had much to do with the conceptualising and implementation of the structure, and also created a management system for capturing student and demonstrator attendance and marks awarded to students for practical assignments and tests.

8.3.3.5 *Alignment as shared purpose*

I have argued that during the two strikes that occurred before and during the study, the demonstrators aligned themselves with a common purpose against what they perceived as an oppressive force. First, their purpose was to signal their dissatisfaction with the department's decision to make demonstrating both compulsory and unpaid. The following is an excerpt from Paki's interview:

So, it... when it was announced that there will be no payment... the demonstrators will do it for free, it will be not optional (but) compulsory, that you should do that but no payment. So, and then people were unhappy about that, you see, because of many reasons.

Later in the same interview Paki talks about the second purpose of the strike, namely to raise awareness for the *value* of the demonstrators, without whom the department would not be able to cope with the large group of students in the laboratories:

...if you look at the number of first-year students specifically, and the number of academic staff, it would be difficult to cope without the postgraduate students, and I thought that strike, if one studies it very well, it is a lesson it gave that each one needs the other.

(D-In-01-08, 2008)

In the transforming community demonstrators are also aligning their activities in more productive ways, as the following quote from Nofanele's interview shows:

Karen: So there is a sense that you are in it together?

Nofanele: Yes, there is we are in it together. We have sections to work in the lab but still, if somebody is not there we just won't leave them. If one of the students comes to me, I won't say no, you are not my student, so ja there is that thing. Like, it's a big group but we try to share the duties amongst us, so there is that sense of community.

(D-In-03-08, 2008)

8.3.3.6 *Alignment as constraint*

Sometimes alignment may of necessity be constraining. The detailed marking schemes that are routinely provided to the marking demonstrators (or markers) for assessment of the students' written submissions are a means of ensuring evaluative consistency across the large group of first-year students. As such they are examples of proceduralised prescriptions intended to align practice across the cohort of markers. They do so by localising the activity of marking in a relatively small number of demonstrators and then narrowing their scope of responsibility. Though unavoidable when evaluating the work of large groups of students, they restrict imagination and discount the knowledge and ability of the demonstrators who are expected to apply them. Hence, what the community gains in alignment, it loses in engagement and imagination (Wenger, 1998).

In the preceding discussions I have attempted to summarise the findings of my research in a way that answers the research questions posed at the start of the study. The next section deals with the methodological findings of the study.

8.4 **Methodological findings**

In addition to the main findings of the study, there are a number of findings related to my research methods which are important to draw attention to here.

8.4.1 *Guided reflections*

I have referred to the difficulty of generating sufficient momentum to write reflective journals in chapters 3 and 5 (sections 3.4.2.1 and 5.3.2) and how this was in part circumvented by using "sentence-completion items" (Oppenheim, 1992: 56-7, cited in Cohen *et al.*, 2000) to guide demonstrators' reflections. Sentence-completion items were used in two ways in my research:

- The *What it means to be a demonstrator* (WiM2baD) questionnaire (appendix 3.7) was used with a relatively large sample of demonstrator participants. The intention was to survey the entire cohort but only 12 demonstrators chose to participate.
- Writing prompts were emailed to a small number of demonstrators (4) on a weekly to bi-weekly basis, over a period of approximately six weeks.

The use of writing prompts was found very valuable for stimulating reflection and exploring meaning, but I found an interesting difference in the quality of responses generated by the two methods. Responses to the WiM2baD questionnaire were short, ranging between one and 41 words each (not counting the blanks), and often lacked depth. Some were truncated, which made them difficult to interpret accurately. The following quote is an example:

In response to the prompt: *When I think back on my job as 1st year demonstrator, the most important thing I learned was ...*, one demonstrator responded:

The mentality of the student.

[D-Su-02-07-D11, 2007]

Does the demonstrator mean that he/she had learnt about the mentality of the students as a *collective*, or is the reference to a *particular* student? More importantly (and frustratingly), the demonstrator does not say *what* was learnt about the mentality of the student(s).

This phenomenon probably arose from the fact that there were many items in the questionnaire (16 in total, of which 14 were sentence-completion items). I write from personal experience when I say that most people would be quite willing to participate in a survey where all that is required is to tick a few boxes, but having to write long responses to what seems like a never-ending list of probing questions would be quite a different story for most. I also allowed only four lines per item which may have signalled to participants that I did not expect more than a few words. In retrospect I could have condensed and distilled the questionnaire to perhaps three questions, and allowed much more space for participants to write their responses.

Responses to the e-mailed prompts were much longer by comparison, and consequently much richer in content; they ranged from 107 to 256 words each. This method held additional benefits for researcher and researched alike. The demonstrators could formulate their responses in their own time, and edit (and perhaps even add to) them before returning them to me by e-mail. This allowed for longer and (I contend) deeper reflection. Benefits for the researcher included the fact that the data was already in electronic format, so that there was no need for transcription. Also, following up on issues emerging from a given response would in theory be a simple matter of sending a reply e-mail. Over time such an exchange can assume the nature of a conversation between participants, with the option to open up the conversation (as with focus group discussions) so that participants can see and counter the responses of other participants. The demonstrators in my experiment did not have access to each other's responses mainly because I was uncertain how to address confidentiality issues around this. Potential users of this approach would need to give careful consideration to how they hope to handle this aspect in terms of research ethics. A further issue to consider would be how this method could be used in way that would ensure anonymity of the research participants, if this was a requirement of the research.

8.4.2 *Laboratory observations*

Two major difficulties presented themselves during video recording of the laboratory interactions between demonstrators and students. The first arose from the configuration of the laboratories, which made it difficult to do the video recordings in an inconspicuous way. The idea was not to film secretly the demonstrators' interactions with the students and with each other, but rather to do so in a manner that would be unobtrusive, and would capture these interactions as naturally and as free of self-consciousness as possible. The physical space in the laboratories has been configured in such a way that a service duct runs down the middle along the length of each laboratory bench at approximately chest height (see figure 8.1 below).



Figure 8.1 Photograph showing the service duct running along the length of the laboratory bench.

This obstruction made filming frontal views of people interacting in the laboratories a challenge. The cameraman tried different alternatives including side views and over the shoulder shots, but they presented difficulties of their own. The main difficulty with all the filming options was that one had to move in really close to be able to capture the audio component of the interaction (because of the high level of background noise). The close proximity of the camera would make people self-conscious and they would often stop their interaction and move away. Only the more confident and experienced demonstrators would continue interacting under these circumstances.

In the end I used the video footage mainly to confirm my macro observations of demonstrating practice and to supplement my field notes. For future research that requires video recording of smaller-scale phenomena such as interactions between pairs or small groups of individuals I would have to experiment more to find the ideal vantage point and recording technique.

8.5 Other findings

8.5.1 Boundaries

Wenger (1998: 103) contends that “communities of practice cannot be considered in isolation from the rest of the world, or understood independently of other practices” and that “the very notion of community of practice implies the existence of boundary” (2000: 232). Boundaries exist as discontinuities between CoPs and they are important because they create opportunities for learning when members cross over from one CoP to another. In chapter 4 (section 4.6.4) I described the chemistry department as a “constellation of interconnected practices” (Wenger, 1998: 127) rather than a community of practice, because at the level of practice different communities all with their own enterprises constitute the overall constellation. I used figure 4.1 (reproduced with adjustments as figure 8.2 below) to illustrate how I saw the interrelatedness of different communities within the department. The lines in the diagram bind the membership (but not necessarily the practices) of each one. It is important to realise that boundaries are not *barriers* but rather *discontinuities in practice*; they may be seated in differences in enterprise, ways of engaging with one another, history, repertoire and capability, among others (Wenger, 2000: 232).

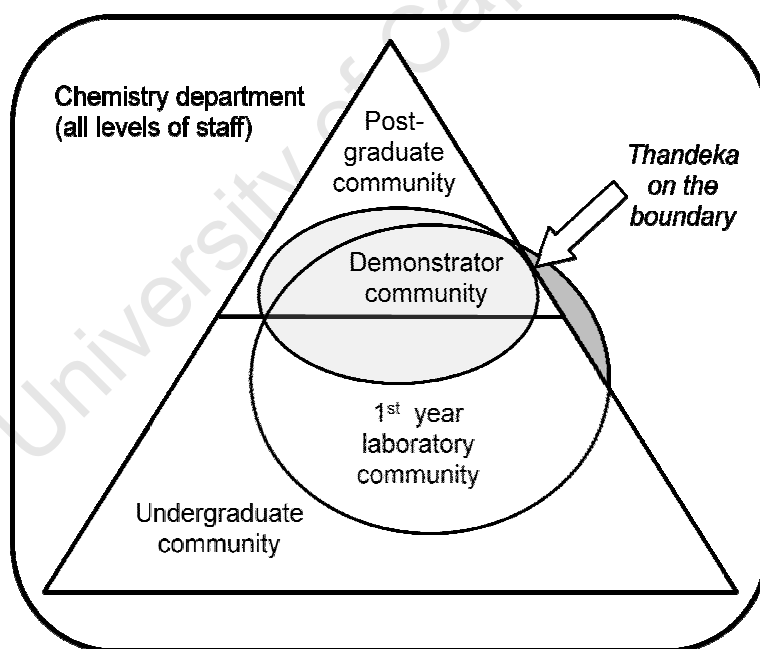


Figure 8.2: Related communities within the chemistry department

Wenger (2000) recommends the promotion of three key elements when attempting to create bridges across communities; they are *brokering*, *boundary objects* and *boundary interactions*. Boundary processes are interrelated and supportive of each other, and the ways in which they are manifested in the demonstrator community can be summarised as follows:

- *Brokering* refers to using key people to act as brokers between communities. The role of Thandeka (the superdemonstrator) as *broker* on the boundary between the demonstrator community and the academics in the department has received attention (sections 6.3, 6.5.1 and 6.5.3) and will be discussed further in this section. Other brokering roles in the community have also been identified; for instance the demonstrators themselves act as brokers between the department and the first-year students in the laboratory. Recall the “demonstrator as bridge” metaphor used by the demonstrator in the focus group discussion (D-FG-01-08, 2008).
- *Boundary objects* refer to artefacts, discourses and processes that support connections between different processes. The printed materials (manuals, briefing sheets, directives and marking schemes), agreements and lines of communication that have been implemented to facilitate communication between the department (through its representative, the practical coordinator) and the demonstrator community are examples of boundary objects.
- *Boundary interactions* refer to encounters, practices and peripheries that contribute to creating bridges between communities. In relation to the demonstrator community they refer to meetings, face-to-face and telephonic conversations, email exchanges and the like that contribute to the smooth running of the practicals and the demonstrators’ roles duties and responsibilities in this regard.

8.5.1.1 *Thandeka on the boundary*

At this point I want to return to Thandeka and the pivotal brokering role she played in the transforming demonstrator community during the course of the study. First, however, I wish to draw attention to figure 8.2, specifically the shaded area towards the right hand side of the sketch – where the oval shape representing the first-year laboratory community protrudes over the edge of the triangle shape that represents all the students (undergraduate and postgraduate) in the department. This shaded slice signifies *departmental staff* that form part of the first-year laboratory community, such as the practical coordinator (my own role) and the technical officer responsible for managing the laboratories. Thandeka’s position on the boundary between the demonstrator community and the department is indicated on figure 8.2. Ostensibly appointed to lead the community of demonstrators, spanning the boundary between the two communities quickly became one of her main functions. According to Wenger (1998: 109) “the role of managers is often construed in terms of directing people, but ... a good part of their activities have more to do with brokering across boundaries between practices”. Thandeka had one foot in each community without actually belonging to either. “Brokering often entails ambivalent relations of multimembership” that are “not always comfortable” (p109) – recall how Thandeka and Nofanele attempted to protect the defaulting demonstrators who missed sessions when they were working on their honours projects (section 6.5.3).

Three processes are involved in the job of brokering namely: translation, coordination and alignment between the perspectives of the adjoining communities (Wenger, 1998). Furthermore, brokering requires (i) sufficient legitimacy to exert one's influence, (ii) the ability to link practices by mediating between them, and (iii) the ability to "cause learning by introducing to a practice elements of another" (p109). Thandeka had all the attributes of the ideal broker. First, her appointment as leader of the demonstrator community and her status as "laboratory manager" or "practical administrator", and the level of departmental support and degree of autonomy she enjoyed in relation to the role gave her ample legitimacy in the eyes of the demonstrator community while also confirming her legitimacy from the point of view of the department. She came into the role from a position in industry, where the respect of colleagues and her superiors would undoubtedly have contributed to her sense of confidence, competence and worth as a manager of people. Second, she was able to link practices: she mediated between the department and the demonstrators by translating departmental directives, coordinating demonstrators' activities and playing a part in ensuring that students' and demonstrators' activities were aligned with the departmental vision for learning in the laboratories. Third, she was able to adapt useful practices from another community (her previous job in Transnet) and introduce them into the practice of the demonstrator community. She also assisted me to introduce elements from the demonstrating practice at another institution, where I had been employed previously, into the demonstrator community of the study. Not only was she able to understand how the changes in practice would benefit the community, she was also able to convince everyone in the community to adopt these changes.

Brokering can also take the form of a personal relationship between two people from different communities (Wenger 2000: 236). The relationship between the pair then "acts as a brokering device". I experienced this in my relationship with Thandeka. There were many informal meetings in my office during which we would discuss plans for the community and strategies for implementing them. We worked as a team and one of us would often stand in for the other when circumstances necessitated. When I was away from work to attend a conference or to an urgent personal matter, Thandeka would take over my responsibilities in the laboratory for the day. It happened as often that her research commitments took her away from campus for a period of time, and during that time I would be her stand-in. It made no difference that I was the academic and she the (super)demonstrator.

The use of appropriate brokers across the boundaries of communities is a way of developing the boundary infrastructure in a learning system (Wenger, 2000). It is important not to underestimate their value as negotiators of change.

8.5.1.2 *The red coat as reification of boundary*

The most obvious marker of membership of the demonstrator community – the red coat the demonstrator wears in the laboratory – is a *reification* of the boundary of the community.

In support of this statement I want to relate an interesting observation: I reported earlier that the demonstrators initially wore their coats with pride. However, in the second year after the introduction of the red coats, I started to notice that demonstrators would sometimes “forget” their red coats and wear white coats to the practicals instead. This happened with greater frequency towards the end of the academic year and when I first observed it I dismissed it simply as the “status” connotation losing some of its lustre as the year progressed. I did not think about it too deeply, but I recall also casually postulating in my own mind that such incidences of “forgetting” to wear the red coat were probably *unintentional* omissions due to forgetfulness brought on by mounting academic pressure as the final exams approached. I could not have been further from the truth. Mentioning my observation to one of the superdemonstrators one afternoon I was surprised to learn from him that there was nothing unintentional about the phenomenon. Demonstrators *intentionally* wore white coats so that they could blend in more easily with the white-coated students. This meant that they could more easily disappear from the laboratories unnoticed to check on their own laboratory work. Running their own experiments in the research laboratories when they had demonstrating duties to attend to was strongly discouraged but difficult to control. Towards the end of the year, demonstrators were under much greater pressure to conclude research projects and more likely to be distracted from their demonstrating duties. Dressed in red coats their absence would be immediately evident, but *camouflaged* in white they could risk slipping out of the laboratory and back again without being missed by the supervising lecturer, or even their own students. Wenger (1998: 104) contends that “the degree to which ... markers actually act as boundary depends on their effect on participation”. The demonstrators were temporarily disguising their membership of the demonstrator community by removing the “badges” that identified them as members, namely the red coats. This allowed them to “escape” the community for short periods of time to participate in practices outside the boundary of the demonstrator community.

8.5.2 *Confidence*

Graven (2004) identifies *confidence* (learning as mastery) as a fifth element to accompany Wenger’s (1998) original four, namely *meaning* (learning as experience), *practice* (learning as doing), *community* (learning as belonging) and *identity* (learning as becoming). She argues for a five-stranded model of learning where each of the interdependent and mutually defining strands or elements of learning have equal status. In her own research she explored the notion of confidence in the context of mathematics teachers learning and found it to relate to seven different but interrelated issues namely “classroom practice, access to knowledge resources,

access to community resources, confidence of others in teachers, increased participation, affective factors and understanding one's own limitations" (p197).

The notion of confidence is also very evident in the data of my study despite the fact that I did not ask any direct questions about confidence during the entire project. 20 different utterances by 10 different individuals (including myself, in field notes) occurred. I was interested to see whether these utterances could be classified using Graven's categories, adapted for the laboratory context. I found that this was indeed possible, and in table 8.4 I have given a distribution of all the utterances on *confidence* classified according to category, with one example for each category. In some cases, utterances fitted with more than one category, hence the total frequency count of 27 for a total of 20 utterances. The categories in the table are similar to Graven's original set, except that they have been changed to fit the laboratory context.

Table 8.4: Distribution of participants' utterances on confidence from the research data

Category	Frequency	Exemplar utterances
1 Laboratory practice	4	I have seen the third year (demonstrators), their <i>confidence</i> is not yet there, and I think that I have been in the same position like them ... But it's not yet there, compared to when you are doing PhD or your masters. You have that thing like: "I have been there already, done that." [D-In-03-08]
2 Access to knowledge resources	3	If everything is clear from the material that is given to the demonstrator or the instructions are clear, it makes the whole program very good and it also gives the <i>confidence</i> to the demonstrator. If the demonstrator is <i>confident</i> (and) what he has is understandable (and) very organised and then that makes him a very good demonstrator. [D-In-01-08]
3 Access to community resources	6	You see, sometimes, especially for the new people, when you come to demonstration program, firstly you are scared ... even the students when they ask you a question, some (demonstrators) tend to be very defensive in the way they present themselves to students. If then the coordinators or the academics staff who are ... in charge they are making it easier for the demonstrators so that they gain that <i>confidence</i> . It improves their performance as well. [D-In-01-08]
4 Others' confidence in demonstrators	4	We don't want somebody who is not <i>confident</i> enough because the students tend to sense it. [D-In-02-08]
5 Broadened participation	4	The more time you spend with the students, the more <i>confident</i> your answers. I feel that this is due to the knowledge of the practicals, as well as the fact that the longer the students spend with you, the more trusting they are of you. You gain their trust, so in the end your explanations do not need to be as lengthy. [D-RW-03-08-SM]

Table continues on following page.

Category	Frequency	Exemplar utterances
6 Affective factors	3	First of all they didn't even know our names, I mean if you don't know your students names, that's something else. You won't have <i>confidence</i> in them and they won't have <i>confidence</i> in you, I mean If I call you say please come and help me and you don't know my name somehow I feel like you want to keep this distance between us, you don't even want to involve yourself. I mean there are questions I would love to ask but knowing that you are not interested in my life or my studies, it distances me from asking certain questions. Because you will think I am stupid, or I will think that I am stupid asking ... some other questions. So what I suggest is that demonstrators should know their students names and call them by their names. I means a lot, if a lecturer knows my name ... I really have <i>confidence</i> in myself; it makes it easier for me to approach them. [D-FG-01-08]
7 Understanding one's own limitations	3	We are all students, and we are mostly the same. We like a <i>confident</i> answer, and when we do question, we like <i>confident</i> responses. This does not however mean that you should know everything. When I have been found wanting, I have learnt to find out the answers, as there is a chance that question might be asked again! [D-RW-03-08-SM]

What struck me upon reading through all 20 utterances, was that demonstrators had firm and sometimes unusual notions about confidence in relation to their interactions in the laboratories. I have pieced together some evidence to show that some demonstrators appear to centre the fostering of confidence in *connective interaction* (or from the theoretical perspective of this study, from *engagement*) and in *trust*. The demonstrator in the *sixth* quote of table 8.4 seems to be reasoning as follows: If the demonstrator shows an interest in me ("knows my name") that signals that I can open up and reveal my vulnerability to him/her. Perhaps the demonstrator equates confidence with *trust*. Or perhaps, like the demonstrator in the *fifth* quote, he considers trust a by-product of the development of confidence that follows prolonged interaction in practice. I would argue that this once again fits with the mode of *engagement*, both with the repertoire (he refers to "knowledge of the practicals") and the people of the community. There is also a sense that with increased trust and confidence interactions between demonstrator and student can become more *economical* (not "lengthy") and *productive*.

There is also a link to be made with the mode of *imagination*. Recall that imagination is that element of belonging that allows us to develop a sense of self in relation to our participation in the community. According to the same demonstrator, confidence in one's self leads others to have confidence in you as chemistry demonstrator, and to trust "your answers". Hence, a well developed sense of self in relation to the community engenders confidence:

In essence, demonstrating is all about confidence and your approach to people. The more confident and assertive you are, the more believable your answers.

(D-RW-03-08-SM, 2008)

Furthermore, confidence connotes *trust in one's self* to handle situations appropriately. The demonstrator in the following quote is so confident that he will get what he needs to know about the practical from the pre-lab talk, that he does not even bother to prepare using the laboratory manual any longer. This demonstrator has been demonstrating for some time, and his sense of self-reliance is strong:

The other thing that changed is my confidence towards the students, I do have to admit, sometimes I don't read the manuals before practicals. I just listen to the pre-lab talk (which is very helpful to students and demonstrators) then go to the lab. I am more confident.

(D-RW-03-08-TM, 2008)

In the opinion of the same demonstrator confidence also implies *boldness* that translates to allowing one's self to reach out to people on a personal level.

I never used to talk personal stuff with students but now we just talk about everything. Sometimes they even invite me to their parties ☺. I realised that this is somehow important to them because they are not afraid to ask anything.

(D-RW-03-08-TM, 2008)

There is a third mode of belonging namely *alignment*, which has the role of ensuring that our activities within the community produce synergy for the realisation of higher goals. Wenger's (1998) notion of alignment takes a large-scale view: "The process of alignment bridges time and space to form broader enterprises so that participants become connected through the coordination of their energies, actions and practices" (p178-9). Perhaps there is a sense of alignment in the final quote of table 8.4 when the demonstrator (i) identifies with students the world over ("we are all students") in expecting confident answers to his questions, and (ii) recognises that he does not have to hold those answers within himself, but that he can call upon the collective wisdom of the wider chemistry community ("I have learnt to find out the answers") when an answer is needed and that contributes to his sense of confidence.

Graven (2004) placed confidence alongside the other four elements of learning (meaning, practice, identity and community) and provided convincing evidence and arguments for their interconnectedness. In the section above I have attempted to draw attention to the links found in my own study between confidence and the three modes of belonging to a community of practice (engagement, imagination and alignment). These links may still have a tentative quality due to being forged on a small pool of incidental data. However, I believe that my findings confirm a prominent place for confidence in communities of practice theory that could be further explored in future, in the context of the demonstrator community of my study.

8.5.3 *Different strokes...*

Not surprisingly students sometimes have very different expectations of their demonstrators than do those in charge of the practicals. As an example of this, and also to illustrate how very

differently the individual students in a group experienced the different aspects of their demonstrator's practice, I want to highlight the case of Sandy, my lift partner and the only white demonstrator in the cohort at the time of the "beyond" surveys. The findings I am about to present are from the quasi-numerical study (chapter 7), and the student survey in particular which, the reader may recall, probed students' experiences and expectations of their demonstrators.

As mentioned previously, all the surveys used in this study were anonymous, so that I had no means of connecting the respondents' identities with their responses. However, in the second student survey I devised a method of identifying to which demonstrator each student was responding: I photocopied the survey questionnaires on paper of four different colours and gave the students at each of the four benches in each laboratory survey documents of the same colour to complete. It was then simply a matter of noting which bench was given which colour on a given afternoon and correlating this information to the demonstrators' work schedule, to know which of the responses correlated to which demonstrator. Upon reading through the students' responses I noticed that Sandy – the demonstrator that I had experienced as confident, knowledgeable and pro-actively engaging – was experienced very differently by some of the students in his group. The foremost source of tension – Sandy's tendency to spend much of his time in the laboratory with another demonstrator's students instead of with his own group (*Vignette 2: The redcoats*; section 6.4) – resulted in 8 of the 16 students of his group mentioning this as a STOP response in the survey. Here is an example from this group:

My demonstrator is always at the back of the class, helping others who are not under his "care" instead of helping us who have been assigned to him.

(S-Su-02-08-55, 2008)

Sandy often spoke to me about demonstrating and besides making it clear that he enjoyed the job of demonstrating very much, he seemed confident that he was doing well and that his students were of the same opinion. The next quote reflects one student's contrary opinion:

I honestly cannot think of one good thing that he should continue with!

(S-Su-02-08-45, 2008)

On the occasions that we discussed chemistry, Sandy's understanding of concepts displayed both breadth and depth and, English being his first language, he was able to articulate his ideas very clearly and coherently. He would often expand and contextualise his examples, illustrating a wealth of theoretical knowledge on par with and even sometimes eclipsing my own. His students, on the other hand, experienced his explanations either as not directly related to the laboratory work (first quote) or as him talking over their heads (second quote):

(Stop) talk(ing) about topics which have nothing to do with the practicals.

(S-Su-02-08-47, 2008)

The above student responses confirm that what impressed me about Sandy were clearly not what mattered most to the students. Indeed, the quasi-numerical survey data identified the issues highlighted in the quotes above to be the “hottest” issues in the students’ response space (figure 7.1), namely effective communication, attentive assistance, task-oriented behaviour and an approachable, available, helpful attitude.

Finally, it would not be fair to imply that Sandy (or any of the other demonstrators for that matter) attracted only negative responses; one student [S-Su-02-08-48] in Sandy’s group had nothing negative to say about him and found “everything ... up to standard”.

I have included this discussion to highlight a number of important issues to bear in mind when selecting demonstrators:

- It is often not the cleverest and most articulate students that make the best demonstrators; and
- What experts (lecturers) deem good qualities in a demonstrator are not necessarily the same as what novices (students) would consider most desirable.
- There is wide variation in how students perceive and experience their demonstrators; the same demonstrator may be “doing everything right” in the eyes of some students and at the same time “getting everything wrong” as far as others are concerned. The adage of “different strokes for different folks” most certainly applies in this context also. It is therefore important to include as many student opinions as possible when evaluating the work of demonstrators.

8.6 Critical reflection on the research

In this section I wish to address two issues: First, I look at my choice of theoretical framework, what it was able to deliver in the context of my study, where it fell short, and what alternative ways of thinking allowed me to compensate for its shortcomings. Second, I address some of my concerns around representivity in my selection of research participants by corroborating qualitative findings with global data from the quasi-numerical study.

8.6.1 *My choice of theoretical framework*

In this thesis I have illuminated the usefulness of Wenger's (1998 & 2000) three modes of belonging to a CoP (namely engagement, imagination and alignment) for exploring demonstrator learning, and for developing an understanding of participation from the point of view of the demonstrator community. At the start of the study the demonstrator community was poorly understood and often even completely *misunderstood*. Academics in the department

made decisions that directly affected them without proper consultation, and some considered them “useless”. I wanted to understand the demonstrators’ world from a broader perspective than the usual nuts and bolts viewpoint of “doing the job”.

8.6.1.1 *A low-resolution picture*

I have found the CoP framework ideal for providing a rough-grained, low-resolution but wide-angle view of my research landscape. The way that I have used it for this study has given me a “big picture” perspective on the participation of the demonstrators within which to identify areas for future work. In my experience it is not an easy framework to use for “detail-work”, and I will expand on this statement even further when I talk about my difficulty in separating the two constructs imagination and identity (section 8.6.1.3 below). The interrelated and diffuse nature of these and other constructs that form the framework turned analysis of the data into quite a complex task, discussed at some length in section 4.7.2: *Usefulness of the analytic framework*. Elsewhere (section 3.10.1) I explained how I did not consider it feasible to ask participants directly about abstract issues such as “visions of the potential of the community” or “the shared purpose of the community”, and that my approach was rather to interrogate demonstrating *practice* for evidence of these aspects. Teasing these (and other closely related) issues out of the research data was an interpretive exercise that I often found difficult.

8.6.1.2 *The absence of a role for “teaching”*

Graven (2004: 208) illuminated the absence of a role for teaching in Wenger’s notion of community, stressing “the need for considering the importance of the role of teaching within learning, especially in the case where the learners are in fact teachers”. The demonstrators in my study were also teachers in the sense that they were facilitating student learning in the laboratories. I have not looked in great depth at the “teaching” aspect of demonstrator participation, and I am not entirely sure if I would want to separate teaching and learning from each other in my understanding of *participation* in a CoP.

Where you place teaching in practice depends entirely on how you choose to define the community. I have chosen to define my community as consisting only of those practices where postgraduates with teaching responsibilities engage, in the first-year laboratories of tertiary chemistry departments. Teaching then, in the sense of facilitating student learning, is both part of *practice* (the job) and *boundary*, as it is a process that operates on the boundary that separates the demonstrator community from the community of students. I will return to this idea shortly, but first I would like to consider alternate definitions for *community* in the context that I have chosen to study. In addition to my interpretation of community above, there is also a first-year laboratory community that includes demonstrators, students, and staff from the department. In this community members are at different levels of learning about a specific aspect of chemistry practice, namely experimentation. Some are learning how to perform

experiments and others are learning how to teach others about experimentation. Another alternate framework might be to consider the entire department as a community of chemists fulfilling different roles (teaching, research and community service) at different levels of mastery of their respective fields. All three interpretations above fit Barab and Duffy's (2000) criteria for CoPs namely:

- The members of a community share goals, understandings and practices, and a common cultural and historical heritage.
- When individuals join communities they become part of an independent system.
- Communities have the ability to perpetuate its practice as newcomers work alongside more experienced members.

These interpretations also comply with Wenger's (1998, 2000) requirements for a joint enterprise, mutuality and a shared repertoire.

Why then did I choose to define community as I did? While it is true that most of the engagement in the department is aligned with the overall enterprise of "pushing the boundaries of chemistry forward" or however one wishes to state its mission, I want to argue that the department should rather be interpreted as a "constellation of interconnected practices" (Wenger, 1998: 127). The same argument can be made for the first-year laboratory community. I considered both alternate configurations too broad to give primacy to the participation of the *demonstrators* and the scope of their engagement. In addition, discontinuities that are integral to the processes of learning are not recognised if the definition of community is too large and encompassing. Drawing the circle of community smaller allows for these discontinuities to be recognised as *boundaries* between different but interconnected communities. Boundaries are important because they are sites where "experience and competence are in close tension" (Wenger, 2000: 233); here individuals are exposed to new ideas to incorporate into practice. This is where I believe a space exists for theorising about *teaching*, and for the teacher as *broker* in boundary processes between communities.

8.6.1.3 *Notions of imagination and identity*

Wenger's writing tends to be quite complex and his ideas, though grounded in everyday experiences that are easy to identify with, become somewhat vague when one tries to extend them to other contexts. In particular I found it difficult not to conflate the two constructs imagination and identity when writing about my findings. What follows is an analysis of Wenger's conceptualisations that speak to these two constructs.

Mutual engagement in practice with others allows individuals to construct an image of *themselves* in relation to the *community*. *Imagination* should therefore be understood both in individual and collective terms. On an individual level, imagination is what allows us to develop

a sense of self and a *personal interpretation* of our own participation in our communities and in our world. On a collective level imagination creates, together with engagement and alignment, a space for the negotiation and construction of identities in relation to the community. Our identities on the other hand (Wenger, 2000: 239) “are the living vessels in which communities and boundaries become realised as an experience of the world”.

To organise my own thinking around imagination and identity I have classified Wenger’s descriptions of these constructs (1998: 178-179; 2000, 227-228, 238-239) in terms of whether they are suggestive of process or product in table 8.5 below.

Table 8.5: Wenger’s descriptions of imagination and identity

	<i>Imagination</i>	<i>Identity</i>
Process	<ul style="list-style-type: none"> • Element of <i>identity production</i> • <i>Act</i> of identity • Allows the <i>development</i> of <ul style="list-style-type: none"> • sense of self • personal interpretation of participation in community • Involves <i>interaction</i> (on individual and collective levels) • Can be <i>activated</i> • Component and extrapolation of own <i>experience</i> • <i>Process</i> of expanding self • <i>Production</i> of new images of self and the world • Anchored in social <i>interactions</i> and communal <i>experiences</i> 	<ul style="list-style-type: none"> • <i>Identifying</i> with some communities but not with others • <i>Builds</i> bridges and <i>shapes</i> social structures • <i>Combines</i> competence and experience into knowing • Can be <i>engaged</i> and <i>suspended</i> • Lived <i>experience</i> of belonging or not belonging • <i>Seeks</i> experiences • <i>Identifies</i> with broader communities
		<ul style="list-style-type: none"> • Involves both <i>processes</i> (reciprocity, commitment) and <i>products</i> (connections, histories, experiences)
Product		<ul style="list-style-type: none"> • Can be <i>built</i> • <i>Vessels</i> for the realisation of community and boundary • <i>Vehicle</i> for both participation and non-participation • <i>Structuring element</i> of how we know • Can be <i>carried around</i> • <i>Key</i> to deciding what matters and what does not • Can be <i>opened</i> up to other ways of being in the world • <i>Open</i> to possibilities

Wenger (*ibid.*) describes *imagination* exclusively as a process, and *identity* as both process and product. Identity can be *built* (product), but it can also *build* (process). It can shape, identify, combine, and seek; and can be engaged, suspended and lived (all *processes*). It is a vessel, vehicle, structuring element, and key; and can be carried around, and opened up as if it is an object (all *products*).

In light of the above analysis I have chosen to interpret imagination as a *process* of learning – involving interaction and negotiation between the individual and the community – and identity as both *process* and *product* but also a *requirement* for learning.

In conclusion of this section, the following: the Wenger framework proved sufficiently robust to allow for the construction of characterisations of practice which recognise the agency and identity of the demonstrators and create a space for the democratisation of their practice. At the same time it proved sufficiently sensitive to distinguish between a situation in the early stages of the study where practice was not optimal, and a situation later on in the study where some foundations had been laid for the community to move towards more effective practice. There are specific areas of the framework that have not been optimally explored, such as the issue of teaching, which can be interrogated in further work.

8.6.2 *Representivity of my research data*

While I have addressed issues of validity and reliability in chapter 3 (section 3.10 *Quality of the research*) I have not addressed the extent to which my descriptions of practice were representative of the experience of the entire community, rather than the individuals selected as participants. In this section I want to highlight how the qualitative findings triangulate with global results from the quasi-numerical study (chapter 7).

8.6.2.1 *Data from the early community*

In chapter 4 (section 4.2.1) I wrote of the challenges experienced around getting the demonstrators to talk openly to me at the start of the study and how Paki, the “old-timer” who had been a demonstrator at the height of the difficult period between the department and the demonstrators, opened up to me when he had completed his doctoral degree and was ready to leave the department. Paki’s interview, though not the only data used for describing the practice of the early demonstrating community (chapter 4), formed the basis of that characterisation.

I had concerns that Paki’s level of annoyance over the unfairness of the situation for demonstrators in the department may have led him to overstate certain grievances he felt at the time, and needed to consider to what extent his negative feelings about the department could also be attributed to the demonstrator collective. Looking at the quasi-numerical survey data, specifically the comparison of the number of *Experienced* and *Not experienced* responses in the free response sections related to demonstrators’ experiences of the department (table 7.14;

Survey 1), the *Not experienced* responses outnumber the *Experienced* responses by almost three to one. In all but one of the response categories, the same picture is reflected, with *Not experienced* responses convincingly outnumbering *Experienced* responses throughout. The only category of which this is not true is the one which I have named *Professional Conduct issues*. So, even though Paki may have overemphasised the negative in his interview, there is evidence in the survey data to suggest that other demonstrators from the same cohort may have shared his outlook.

8.6.2.2 *Data from the transforming community*

What about the *beyond* data collected from the “transforming community”, collected after the intercession? To what extent were the qualitative data collected during the follow-up study influenced by my choice of demonstrator participants to include in the research? I have written in chapter 3 (section 3.5.2) of my selection methods, which consisted mainly of using volunteers and by inviting demonstrators who sought me out for conversation during the practical sessions. One could reasonably argue that the more assertive individuals in the cohort would be more likely to volunteer their participation or seek out connection with the academic in charge of the practicals. Some might further argue that these same demonstrators would also tend to have a more positive outlook on the world, which may lead them to view the demonstrating programme more positively than the collective. Of course, this was not true of Paki who – beyond my initial invitation – needed no encouragement to participate in the research yet had a very negative opinion of the department.

The claims I have made on the basis of the qualitative data of this study can be distilled into one overarching statement namely: *there was overall improvement in the quality of demonstrators' participation and practice in the laboratories over the course of the study*. In which ways do the quasi-numerical data substantiate or refute this statement?

The comparison of the number of *Experienced* and *Not Experienced* responses in the free response sections of student Surveys 1 and 2 (table 7.11) shows that there was a qualitative improvement in the students' experiences of their demonstrators. We already know from the qualitative data that demonstrators were participating in different ways after the intercession. Allowing for the fact that it is not known how the student samples before and after the intercession differed from each other, but assuming them to be from the same *population* (of all UWC chemistry first-years enrolled in the years bounded by the beginning and end of the study, for argument's sake), it can be argued that students' improved experiences of their demonstrators can be linked to the changes in demonstrator participation.

The comparison of the number of *Experienced* and *Not experienced* responses in the free response sections related to demonstrators' experiences of the department (table 7.14; Survey 2) still shows *Not experienced* responses outnumbering *Experienced* responses, albeit by a

narrower margin of roughly two to one. However, looking more carefully at the numbers in the table two subcategories are the main contributors to tipping the balance of total responses in favour of *Not experienced*. They are subcategories Lbr-1 (*Remuneration and other rewards*) and S-TeLe-7 (*Access to resources*); two issues that are related to available funding rather than unsatisfactory relations between the demonstrators and the department.

I would argue that the survey data do not refute the qualitative data, on the contrary, there is support for the qualitative improvements reported in the practice of the transforming community.

8.7 Conclusions and recommendations

I am not aware of any other studies conducted in South African or internationally in which demonstrating practice has been systematically explored from a social learning perspective. Other studies that have investigated the use of TAs in undergraduate science laboratories have been framed from cognitive perspectives, and have been concerned mainly with the educational and instructional environments within which TAs operate. The more recent of these studies (Holt, 1999; Cody & Hagerman, 1997) have capitalised on the value of TA involvement as preparation of future academic faculty.

While I would hesitate to claim generalisability to all situations where TAs are used, I suggest that the inferences drawn from my own findings are likely to be useful in similar contexts of undergraduate laboratories in university science departments where senior or postgraduate students hold part-time teaching responsibilities.

My research questions have been articulated in section 8.3 of this chapter and in subsequent sections I have attempted to synthesise my findings in ways that address these questions, and create space for both limited recommendations and suggestions for further research.

I showed that, as regards *engagement*, the relationship between the demonstrator community and the department before the onset and in the early stages of the study could be described in terms of unsymmetrical power relations, low trust, and poor communication, and that this had knock-on effects on the demonstrators' postgraduate experience and on their interactions with the students in the laboratories. Different communities operating in the laboratories (students, demonstrators and staff) experienced each other mainly in a negative manner though there is also evidence to the contrary. An established practice existed but because it was not formalised, mechanisms for transmission of the practice were unreliable and changes to practice were often made without consultation. Elements of the intercession that addressed alignment were: (i) the introduction of procedural changes that saw demonstrators interacting with the same individual students over an extended period of time, and (ii) opportunities for interacting with each other and with academic staff members involved with the practicals outside of laboratory hours. This included demonstrator training and briefing events. Evidence

collected towards the end of the study points to more productive interactions, improved communication, improved student and demonstrator commitment, more positive experiences of other communities operating in the laboratories, and greater appreciation for the demonstrators' role and contribution. Tension between interventionist and non-interventionist styles of engagement are evident in data from both stages of the study, both at the start and towards the end.

As regards demonstrators' interpretation of their own participation in the community in the early stages of the study, the research evidence revealed that an element of non-participation had been adopted into the practice of the community. The first demonstrator strike represented a low point in the history of the community, following contentious decisions made by the department, to which the demonstrator community was opposed. Another strike, unrelated to the first, followed some years later and is further evidence that non-participation had been adopted into the repertoire of the community. Elements of the intercession that addressed imagination were the opportunities for reflection afforded by guided reflection exercises, though not all demonstrators participated in these. The reflections of demonstrator participants, collected after the intercession, revealed that demonstrators were aware that their participation brought rewards, personal and professional, extrinsic and intrinsic. There was also evidence of growing social networks in the community that extended into the wider postgraduate community, with potential to create trajectories for senior undergraduates into the postgraduate community. The "researcher" identities of many postgraduate participants appeared to dominate their "demonstrator" identities, which often led to their commitments to the demonstrator community taking a back seat to their research agendas. Finally, some of the demonstrators were envisioning futures for themselves in academia, and these demonstrators not only recognised the value of their demonstrating experience as preparation for these imagined futures, but also tended to take their demonstrating responsibilities more seriously.

As regards alignment, the research data from the early stages of the study point towards limited definition of demonstrators' roles, and uncertainty about mutual commitments and departmental expectations of the community. Methods, standards and routines were not formalised and the community lacked leadership, which created loopholes for demonstrators to default on their duties. Tied in with my findings about engagement and imagination above, there was convincing evidence (which includes the first strike) that the demonstrator community was not optimally aligned with the broader educational enterprise of the university at the start of the study. Elements of the intercession that addressed alignment were the introduction of printed materials to concretise roles and expectations, and to formalise procedures, methods and standards. There is evidence that these elements provided structure to support progress in the community and increased confidence in individual demonstrators. There is also evidence of the emergence of leadership structures and mechanisms for the transmission of demonstrating experience in the community. However, a second strike occurred after the intercession and this

shows that the alignment of the demonstrator community with the purposes of the department remained tenuous, and relied on a delicate balance of loyalties in which demonstrators' commitment to the postgraduate community took first priority.

While it would not be unreasonable to attribute at least some of the many qualitative changes that occurred in the community to the intercessionary steps that were implemented, there may have been other mechanisms at work that acted as change factors. I have given acknowledgement to "natural" processes of community renewal such as generational change. Another important contributor to transformation that should not be overlooked is the effect of the research *focus* on the community, signalling to the demonstrator community its value as a subject worthy of attention and study. Finally, and perhaps most importantly, the role of a suitable broker in transacting transformation requires recognition.

This study is important for a number of reasons. Firstly, it illustrates the value of communities of practice as framework for studies of postgraduate professional development in particular, and confirms its value for studies in educational contexts in general. There have been a handful of studies on the use of discursive practices to promote science learning in school classrooms that have used the CoP framework (Macklin, 2007). It has also found application in enculturation studies of teachers both in pre-service and in-service contexts (Graven, 2004; Sweeney & Paradis, 2004). However, studies focused on the training of postgraduates to do research and to teach have mostly been framed from social constructivist perspectives that do not recognise the agency of the postgraduate learner, or the role of the collective in learning.

Secondly, the study sheds light on what learning in a demonstrator/postgraduate community might mean: from emerging conceptions about student learning and the learning of chemistry, to a deeper understanding of the meanings of professional behaviour, and academic enterprise. I have shown that demonstrating entails so much more than "learning to teach" by highlighting the important learning that occurs around emerging professional identities and personal priorities and the struggle to find a balance between them.

Thirdly, I have postulated a position for *teaching* in the CoP framework, the absence of which was previously identified (Graven, 2004) as a shortcoming of the Wenger model. I have suggested that drawing a smaller circle of community places discontinuities within the community on its boundary, which opens up a space for considering teaching as a boundary process. My findings also confirm the role of *confidence*, postulated by Graven (2004) as central to learning.

Finally, I have demonstrated the value of electronic conversation (e-mailed writing prompts) as a means of data collection.

A major issue in postgraduate involvement in undergraduate teaching is lack of ownership (Park, 2002) that manifests as participation that is limited and one-dimensional. The

recommendations emanating from my study mainly address strategies for increasing postgraduate ownership of their teaching agenda on a variety of levels, ranging from the institutional level down to the coal face, where facilitator meets student.

- There is a need, especially at the institution where the study took place, for a fair, transparent, consistent, institutional framework for using and rewarding postgraduate students with teaching responsibilities. Within departments this framework should be operationalised into unambiguous definitions of the roles, responsibilities and rewards of those who participate in demonstrating and tutoring programmes. Each appointment should be accompanied by a contract that contains clear statements of the aforementioned roles, responsibilities and rewards.
- Rather than given lip service, the value and importance of postgraduates' contribution to undergraduate teaching should be concretised by: formalising its niche in the employment structure of the institution, apportioning appropriate financial reward, and preparation and ongoing support for the role in the form of training initiatives.
- In the context of a particular course, demonstrators should be supported in their teaching role by regular input from and interaction with more experienced teachers such as academic staff or senior demonstrators. Postgraduates are mentored by their supervisors in terms of their development as researchers, but a more appropriate model for a teaching community (such as a team of demonstrators) might be the use of brokers and boundary processes and interactions to support the development of teaching capacity in the community.
- On an individual level the role of the demonstrator should be expanded to include more teaching and less monitoring.

This last recommendation is closely tied in with the development of a teaching identity. Identity development underpins the following further recommendations:

- Identity formation and engagement in activities that are authentic and meaningful are reciprocal processes. Giving postgraduates opportunities to experience roles performed by actual "teachers" helps them in the formation of "teacher identities" and, conversely, a strong teacher identity will help them to see teaching activities as meaningful. Students with teaching responsibilities need to participate in activities that they associate with practising academics. For example, demonstrators could present their teaching experiences at institutional colloquia, or be involved in some small way in educational research work that could be presented at a conference.
- Involving senior undergraduate students in demonstrating programmes is important because it creates contact between the undergraduate and postgraduate communities in ways that minimise the status differentials between the two communities. Apart from other

advantages – such as the fact that they are closest to the experience of younger students and therefore better attuned to their educational needs – involving undergraduates in teaching opens trajectories for them into postgraduate communities. The same applies to honours students who have formal postgraduate status in South African institutions, but are often not accepted as “true postgraduates” by the postgraduate communities themselves.

8.8 Future research

My study has focused primarily on learning in a specialised community, defined by the practice of senior and postgraduate chemistry students with teaching responsibilities in an undergraduate laboratory, viewed from a social perspective. The study has several limitations which could be addressed in future research. Firstly, there are many additional aspects of postgraduate professional development to consider in order to develop a more comprehensive understanding of the postgraduate experience and how it might best be brought in line with institutional charters of graduate attributes. Increasing numbers of PhDs are being granted in chemistry yet it is well recognised that scientific achievement alone is not sufficient for obtaining faculty positions. While it is true that not all postgraduates aspire to academia, the issue of preparing future academic staff could be explored further. Special attention should be given to the development and retention of women and Black South African candidates and, as an institution that draws the majority of its students from Coloured and African communities, UWC is uniquely placed to produce PhDs to fit that particular niche.

I have used a framework that is well suited to investigate macro aspects of demonstrating practice; however, there are many details of practice that my study ignored. While the framework has been useful in characterising learning as participation, and I now have a fair idea *what* the demonstrators have learnt, the teacher in me is still not satisfied that I know exactly the internal mechanisms of *how* they have learnt. Other perspectives of learning may enable me to address this issue more directly in future work. Selected aspects of the CoP matrix could also be refined into structures that would allow for more in-depth research of specific aspects of demonstrating practice.

It would be interesting to explore the conceptualisation of the chemistry department as a “constellation of interconnected practices” in greater depth, and to investigate student learning in the laboratory more directly from the CoP viewpoint. On the issue of teaching, the exploration of boundary processes between communities may contribute fresh perspectives to existing social learning theories.

8.9 Endpiece

There are many issues worthy of a special place in this thesis. I have settled on three quotations addressing a similar theme with which to end. All three touch on the issue of money and its secondary importance to the satisfaction of helping students and seeing them progress. In my view all three quotations highlight the dedication of the demonstrators to their students. One of the demonstrators who had been part of the community the longest wrote:

I have also realised that I'm also not doing it for the money, I just go to help students. Sometimes I even go to the lab three times in a week just to go and check out how they are doing.

(D-RW-03-08-TM, 2008)

Bakari, who had been a teacher in Kenya before he enrolled for postgraduate studies, talks about a "real teacher" as someone who is motivated by the reward of seeing his student's progress. The following quote is from his interview:

Now, if you get to interact with a real teacher, who has got the interest of the students at heart, that person is going to look beyond the money, because the monetary remuneration itself is not enough to satisfy a teacher. But if you see a student that you have taught and the student is appreciating, the student is progressing on well, that one in itself has go a lot more satisfaction that the monetary value itself. So you will find a real teacher even giving out extra time at no cost to assist a student. So in my opinion the issue of the monetary value is actually one of the factors that motivate, but it is not the only factor. Yes, that is my opinion.

(D-In-04-08, 2008)

Nofanele acknowledged the influence of her demonstrator, Joanne, when I asked her about the special rapport she had with her own students in the laboratory. Nofanele noticed and appreciated Joanne's kindness and dedication and chose to pay it forward, and so it is fitting that she should have the final word, taken from her interview:

When we started it was all about the money: "I am clocking per hour", and "Hey guys, finish up, I am not getting paid for it". But it's not that, you actually get to enjoy it. I enjoy this job. I go there, you look at these kids who are so willing to learn, and you just want to help them out. It doesn't really matter if the lab is running, so be it. As long as they get something at the end of the day. So, well, that's the way I look at it. I don't know how other people look at it, but for me, that's the way I see the whole demonstratorship thing.

(D-In-03-08, 2008)

Epilogue

In chapter 2 I cited an important report published by the UK Council for Graduate Education (UKCGE) entitled *Preparing Postgraduates to Teach in Higher Education* (Holt 1999) that provided a summary of practices around the use of GTAs in higher education in the US and the UK. A follow-up report by the UKCGE has since appeared (Lee, Pettigrove, & Fuller, 2010), the aim of which was

“to identify what universities (in the UK) are expecting of their Graduate Teaching Assistants (GTAs) and what they are doing to prepare and support them both in their work as lecturers and as early career academics who may aspire to hold significant teaching roles in higher education” (p6).

The second report is entitled *Preparing to Teach in Higher Education* and addresses some of the significant changes in demands placed on GTAs in the ten years since the first UKCGE report. Frustratingly, it appeared as I was preparing to submit my thesis, and I made the decision not to include it in my literature review, as it would have meant rewriting a significant part of it.

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Interview schedule for demonstrators

Interview schedule for Paki

1. Can you remember what years you were a demonstrator, and what years you were a tutor? Were you a demi first and then a tutor?
2. What can you remember about how the practicals were run when you started out as a demonstrator? What were the duties of the demis?
3. How did the demis know what to do? Did you receive any printed materials other than the prac manual?
4. Who told the demis what to do?
5. *When* were you told what you had to do?
6. How many demis were there per lab?
7. Who supervised the process?
8. Who did the pre-lab briefings?
9. How did you make sure that the students prepared for labs?
10. Who graded the prac worksheets?
11. Who administered the marks?
12. What can you remember about the strike in 2004?
13. How did it start?
14. How long did it go on for?
15. How was it handled by management?
16. How did the demis feel about the way in which the situation was handled?
17. What were the demis demands?
18. Were these demands met?
19. Did they go back to work? What made them go back to work?
20. Can you think of something important that you learnt about Chemistry teaching during the time you were a demi and later as a tutor?
21. Who did you learn this from – a student, another demi, the lecturer, or was it perhaps your own insight?

22. What makes a demonstrating program good? Why do you say so?
23. What type of person makes a good demonstrator? Is age important? What about level of Chemistry training? Why do you say so?
24. How do you feel about the idea to use younger students as demonstrators in the first year labs?

Interview schedule for Thandeka

1. Tell me a little bit about your demonstrating history.
2. When did you become the lab manager?
3. How did you become the lab manager?
4. It is well known that you are a good lab manager. Why do you think people say that?
5. What are your conditions of duty (are you paid, for how many hours, who pays you?)
6. What are your duties?
7. How do you decide which demonstrators to select each year?
8. How do you decide which jobs to give to which demonstrators?
9. What made you decide you needed help managing the labs?
10. How did you select first FXX and later TXX and now Nofanele to assist you with managing the labs? (What are the qualities you look for?)
11. How does it work when a demi can't work on a particular day?
12. How does it work with the marking at the moment? What is the process?
13. Who has been the greatest influence on you in this particular job and why?
14. You do this job with so much energy and enthusiasm. What motivates you?
15. Why do you think it is important to the department to have a lab manager if they already have a prac technician and a prac coordinator?

Additional questions for demonstrator interviews

1. Who is your supervisor? How does he/she feel about your demonstrating?
2. When did you come to this University?
3. When did you start demonstrating in the first year laboratories?

4. Did you have prior experience of demonstrating? Can you tell me about it? Were you trained and what did the training consist of?
5. What do you think that is the secret to developing a good relationship with students?
6. Would you say that there is a sense of community amongst the demonstrators?
7. There seems to be a sense of community amongst postgraduates. Can you tell me about that?
8. How committed do you think the post graduates are to their demonstrating duties?
9. Did anyone inspire you for your role as demonstrator?
10. How has your way of being with the students changed over the year?
11. Is there any message that you are hoping to convey to your students?
12. How do you show a student that what he or she is doing in the lab has value?
13. Has it ever happened that another demonstrator has asked you for advice on a particular practical or aspect of a practical? Does it happen often?
14. Are there interactions amongst the demonstrators about the practicals outside of practical times? Can you tell me more about those?

Interview schedule for novice lecturers

Introductory email

My research is about... I would very much like to interview you because I know you have many years of experience both as demonstrator and tutor. It will take approximately...

Questionnaire for collecting demographical information (emailed)

1. When did you start demonstrating? (Approximately: month and year)
2. When did you start tutoring? (Approximately: month and year)
3. When did you get your PhD? (Month and year)
4. When were you appointed as lecturer? (Month and year)
5. Do you have a postgraduate qualification in teaching? If yes, please specify.
6. Can you indicate who you demonstrated to (first year / second year etc)?

Interview schedule

1. (In case person demonstrated to first years and senior students:) I noticed in your email that you demonstrated to first years and senior students. How was demonstrating to first years different from demonstrating to senior students?
2. When you applied for the position as lecturer, did you have your demonstrating/tutoring experience on your CV?
3. Why/why not?
4. Can you remember whether you were asked about your experience as demonstrator/tutor in the interview?
5. What was the question?
6. Why did you sign up for demonstrating/tutoring duties?
7. Did you have an academic career in mind when you started your studies?
8. Can you remember when you first started considering lecturing as a career option?
9. How has demonstrating/tutoring benefited you in your career? [*Lecturer may respond with X, Y and Z; make a list of benefits for the questions that follow.*]
10. Can you give me a specific example of X?
11. Can you give me a specific example of Y?

12. Can you give me a specific example of Z?
13. Who did you learn most from when you were a demonstrator? Was it your students, your fellow demonstrators, or a senior person, like the lecturer or scientific officer?
14. Can you give me a specific example of something invaluable that you learnt during your time as a demonstrator, that is helping you in your present job?
15. Is there anything else you can think of that we haven't discussed?

Thank you for your time. Would you like to see a transcript of the interview? (Give small gift.)

University of Cape Town

Sample: Demonstrator interview

Interview with PXXX NXXX: 2008-10-02

KW	Peter, thank you very much for agreeing to come and talk to me.
PN	You are most welcome.
KW	I have explained to you that you are not in any way obliged to do this interview, and that I have to abide by certain codes of ethical conduct and you have signed a consent form, so I'm assuming that you are OK to have this interview with me.
PN	I am OK.
KW	The first thing I want to ask you about is your demonstrating experience. What experience do you have as a demonstrator; how long have you been demonstrating and where have you demonstrated?
PN	I began demonstrations here, at the beginning of this year.
KW	So this is your first experience.
PN	It is my first experience to demonstrate in a chemistry laboratory at university level.
KW	That is amazing, because you are good at it, you are. And what are you studying at the moment?
PN	I am taking Masters in chemistry.
KW	OK and you are in your first year of Masters?
PN	This is my second year of my Masters.
KW	When did you do Honours?
PN	I did my Honours from 2001 to 2005 back in Kenya.
KW	OK, so you're from Kenya. I am happy that you made your way to Cape Town and you ended up in our demonstrating program.
PN	Thank you.
KW	We were talking on Tuesday about demonstrating and why people do it when the money isn't really that great and I've really been thinking about that a lot this week, because many of the demonstrators haven't been coming to the labs. So, you are one of the guys who are there, and who are not staying away, and I'm thinking, having found out how much people are getting paid for this, it is perhaps not really worth their while, and that might be the reason they're staying away. So, do you have any ideas about that?
PN	It could be a reason to some people; it could not be a reason to others. I'm talking from the point of view of a teacher. Now, if you get to interact with a real teacher, who has got the interest of the students at heart, that person is going to look beyond the money,

	because the monetary remuneration itself is not enough to satisfy a teacher. But if you see a student that you have taught and the student is appreciating, the student is progressing on well, that one in itself has got a lot more satisfaction than the monetary value itself. So you will find a real teacher even giving out extra time at no cost to assist a student. So in my opinion the issue of the monetary value is actually one of the factors that motivate, but it is not the only factor. Yes, that is my opinion.
KW	Do you have any teaching experience?
PN	Yes, I am professionally a teacher of mathematics and chemistry, and I taught from April 2005 to July last year (2007). So all along I've been a teacher and also holding some disciplinary and administrative duties in the same school.
KW	And this was in Kenya?
PN	Ja, this was in Kenya high school.
KW	That's interesting. So you have that perspective of a teacher, and you have experiences all of the rewards that comes with teaching that are not necessarily monetary rewards?
PN	OK, when I finished my university education, I was not directly absorbed by the government. So I was employed by the governor of the school to teach, and as expected, the monetary remuneration is not equivalent to my level of education in such cases as in I would not be getting the same amount of money as that teacher of the government would be getting. But then you find that I would at times even perform more than those who were paid a lot more money than I was getting. That why I am seeing the interest of the student at heart is much better when you look at the services that you are affording the students, than the monetary value.
KW	And how is teaching school children in Kenya different from demonstrating to university students in South Africa?
PN	The difference... I am just relating the high school experience to the university experience that I've seen here. Generally, students have got very similar aspects. A lot of interest towards the teacher will be paid when maybe a test is coming, or there is an examination. That is the same thing that I saw when I was teaching, that students would bombard the teacher or instructor with questions when the teacher announces a [cut?] or a test or an examination. But during these normal teaching it is not very many students who would approach the teacher for some follow up interaction after the class work. It is the same thing that I am seeing here. Besides being a demonstrator, I am also a tutorial fellow. Now, when we go for the tutorials the number of students that we get for the tutorial actually depend on what the students are also expecting like if they are expecting a test during a certain week, we usually experience a very large number of students coming for the tutorials, even after the tutorials some students usually visit me to the lab for some consultations. But when they do not have this test, we do not find most of the students coming to ask questions, so these are similar aspects that I've been able to observe amongst students that I have so far interacted with.
KW	Do you find it very different when you are in a laboratory environment?
PN	No, I do not find it different.
KW	Did you do practicals in your high school experience?
PN	Yes, the curriculum that I went through is such that the moment you report to Form 1 high school, you begin practicals right away.

KW	Now Form 1 would be what age equivalent?
PN	That would be at the age of 15, 16. That is when most of the students in Kenya go to high school. So, they are taught to be independent; the first year the teacher will assist the students in most cases like handling the apparatus, but as they progress especially when they reach their third year in high school, they are taught to be independent, whereby they are given manuals, then independently stations are set by student. So it is upon the student to read the manual and follow instructions, execute the task and come up with findings, and give some report after that. This is in preparation for the national exams at the fourth year, because the requirement of the examination is that a student has to carry out some practicals, examinable, and these are individual. So a student is supposed to have acquired the skills of reading the manual, or a set procedure, interpret it, execute them using whatever is available, synthesise that and be able to give some interpretation. My interaction with the laboratory started right away in the year 1996 when I joined high school. When I finished high school I went to the university. It was the same thing, that you are given a manual or you will not find the lecturer doing much. We do not have demonstrators back at home. We have the lecturer and the lab technicians, so a lot of the work is done by the student, unless there is a technical thing that you have to ask, that is when you move from your station, you go to either the technician or the lecturer, but they teach us to do the work on our own. And if anybody is taking chemistry, for every unit of chemistry that you are taking, there has to be a practical every week. And this practical is done and you are given two weeks to give a comprehensive report on the findings of that particular practical.
KW	Even from the first year level?
PN	Even from the first year, actually we were not spared [laughs]. But it is assumed that you have already acquired the basic skills, so we are not finding that laboratory environment new.
KW	Would you say that this is true of all high schools in Kenya, that kids are comfortable in the laboratory by the time they finish school?
PN	Yes, in fact what they would meet new, maybe is the nature of the building. You would expect high school laboratories to be simpler than university laboratories. You would also expect some equipment found in the university to be missing there at high school level, so these are the new things that you find. But generally the handling of these volumetric glassware and the basic apparatus, in most cases students will be very comfortable with that.
KW	That's interesting. So is there any suggestions, any advice, that you would ... or ideas that you would want to see implemented that is from your experience in Kenya, that you think would benefit out system at the university at the first-year level?
PN	Something that I have observed here is this: I may not be aware of the kind of exposure they are given at high school, but it is evident that when these students report to the university they look very, very new as far as the laboratory is concerned. So, in my opinion, it would be good to have these students exposed to the laboratory while even at the high school.
KW	Ja, that is the ideal, but it is not happening.
PN	In which case if this one has to take place and for it to be successful, then something of that nature has to be incorporated into the curriculum, because if, say, the curriculum requires that students be exposed to some laboratory work at high school, which is not examinable at the national examination, it would be useless, because they will not pay much attention. Remember we have seen that the motivation behind a student putting

	effort in a particular aspect is the examination [laughs].
KW	That's true.
PN	So, if you expose a student to some curriculum and this curriculum is not examined, the it means that even when you have these students in the lab for the sake of exposure, they will not be paying much attention to it. I am not very different from the students when I was at their age. I remember computer studies were introduced into our school when I was in Form 4. So, we were allocated a lesson every week for the exposure purposes, but most of us including me would just go there to relax, because we knew these one would not be tested in the final examination. That is expected. So for some of these things to be effective, honestly, there has to be some mechanism of evaluation at a national level.
KW	Ja, I guess you are right there. I was going to ask you a question about your own participation; you are obviously someone who has experience of teaching if not of demonstrating. I think it is very much the same thing...
PN	It is not different.
KW	Do you think your participation in the labs have changed over the course of the year, or not really?
PN	Umm, I have not seen much change because I see myself the very teacher.
KW	You have reached a level of experience that is seen in all your actions, I suppose, it comes out in all you interactions with the students.
PN	Mmm.
KW	So you wouldn't say that there has been a change in the way that you interact with your students, over the year?
PN	I have not actually seen much change. Yeah, because the good thing here is I've just realised that most of the students that I'm directing within the laboratory are the same age of the students that I was dealing with at high school.
KW	Ja, they would be about 18, 19.
PN	Ja, and you know, in Kenya, by the time a student is in the fourth year, Form 4, most kids they are 18, 19.
KW	So you have been a choice as a demonstrator.
PN	Thank you [laughs].
KW	The following questions have bearing on your experience as a teacher, and how it differs from someone who has walked into a demonstrating position from a point of no experience. What I'm asking you know is about the actual practice of demonstrating: how do you know when a student is struggling with something?
PN	Obviously, when a student is struggling they will not look at ease. They will not look at ease, although different students will express their struggling nature differently. But when a student is struggling, you will not find such a student at ease and the student may have the manual here [points to the right] and the apparatus here [points to the left] then the student is trying to interpret this one and transfer the same thing into the practical skill, but then you can see there is no coordination between what is being read

	here and what is being taken to action. In most cases you can see that. That is why, when you sense it, it is good to ask: "Could there be any problem" or "Are you stuck somewhere?" In most cases somebody would know.
KW	And then they would say: "Yes, I'm stuck, I need help?"
PN	Yeah, and others may be shy to ask you for some assistance, until the time they realise that you have noticed it, that is when they are forced maybe to raise up their hand, or now open up.
KW	So there are definitely signs that one can interpret. Some students will ask you directly?
PN	Some will ask yes.
KW	And other won't ask directly and then you have to interpret the signs?
PN	Yeah, until you approach the problem yourself.
KW	Now, when you have to go about finding what it is that is that a student is struggling with, how do you find out what it is?
PN	Now, when you suspect or when a student raises a concern over something that he or she is not understanding, you go right away to the station, and find out what the problem could be as in: is it a problem of not interpreting the thing or is it a problem of not knowing how to handle the apparatus? Once you identify whether it is interpretation or the handling of the apparatus, then you ask them to show you how they have attempted it. So that you can identify the actual mistake. So as they do it you will be able to know this is where the student is making a mistake and you ask them: "Now at this point, you are supposed to have done this." So when that student corrects that and he is able to connect the next step, I think the student will feel OK.
KW	Now, let's say that you don't know. Let's say the student asks you a question that you can't answer, who are you most likely to go to for advice?
PN	If it is in the lab we usually have these managers, like Combs, we usually have Combs. I can go for advice. We also have other colleague demonstrators, I can seek their opinion about the same thing so that if all of us cannot find a solution to that, then we go to the lecturer.
KW	And does it happen that you sometimes go and ask another demonstrator?
PN	True, I have done it, severally [laughs].
KW	And do they come and ask your advice?
PN	They do, especially this Honours student, XXX. She is free to come and consult . No the problem comes with these third year students, I don't know it like there is a sense of inferiority that they feel a little bit shy when they want to consult. It is like they see that when they consult form us we are going to take them to be [unclear] maybe [laughs].
KW	Take them to be?
PN	People who are not well conversant with what they are supposed to be doing. I have just seen that kind of interpretation, but it is normal that you can't know everything, and asking the opinion of somebody is actually building the knowledge.
KW	I have also noticed that in the third years. They don't have the confidence yet. Maybe

	they haven't learnt that it is OK to not know everything.
PN	All right.
KW	They still think that it is important to know everything.
PN	Not really.
KW	Not really? Do you think that it is not important or do you think that is not what they think?
PN	They think that they are supposed to know everything and when they come across something that they do not know, they again fear asking. Because to them that is maybe exposure of their "ignorance", that is what maybe they call it, you see?
KW	Yeah, that's how they interpret it?
PN	Yeah, but it is quite normal to consult. In fact, I have worked in a system whereby the school principal of the particular school that I was teaching is a teacher of mathematics and it so happened that he taught me at high school. So even as a fellow staff member and his worker, I was his former student and because we were sharing some streams of classes, he would come and consult me not as a principal that time but as a colleague teacher, in the department of mathematics. So it meant us very free, so free that you would not see anything like ignorance or inferiority when you are going to consult from him. This is an officer, the head of the school, but again he would set an examination and bring it to us for moderation. He would at times also require that we take our exams to him for moderation. So it was meant to learn that knowledge... you see nobody is a master of knowledge actually, we also learn through interactions. Like I don't think I can know everything that one I appreciate. So I don't find it difficult to consult in cases whereby I don't understand, that is why I had to ask you: "Ms Karen, is this the normal hydrochloric acid that we really know?" because to me it looked funny. And when he students asked me I told them: "For sure, let me consult, because I'm not also very sure of what could be wrong with this."
KW	But it seems to me that you need to be an experienced teacher to realise that it is OK not to know everything?
PN	Yes.
KW	That knowing comes with experience, isn't it?
PN	It comes with experience, but it is part of the training. You see, for those that have trained as teachers, like me, in the Kenyan system, besides taking courses in the particular subjects that we would be teaching, you also take some education related courses. Like by the time you are graduating as a teacher, you are supposed to be a manager of a school, so you are also taught managerial courses, you are also taught some curriculum development and interpretation courses, the psychology of the student must be with you and very many other things, evaluation modes and everything. So it is in this training where you are taught to appreciate some of these basic aspects.
KW	You are right. Do you think there are enough opportunities for demonstrators to discuss issues around the practicals?
PN	Enough opportunity for them to ...during the practicals, or ...
KW	Well, even outside of the practicals.

PN	There is a need but the opportunities are not there. Because the majority of us only see each other during the practicals and it is like the contract ends there.
KW	What I have found is that if I try to get the demonstrators together outside of the practical times then they don't come. I mean, at the moment they are not even coming to the practicals. So there is not a lot of incentive for them to actually be there, I was wondering whether you perhaps have some ideas on how one would get them to participate in meetings outside of the practical times, where one could discuss issues and build confidence and talk about the problems that they are having and so on? How could one get them to take part, because I have tried and it hasn't worked.
PN	I don't know, do we have anything like seminars for the demonstrators? I can remember when I was joining this demonstration issue, we had a kind of introduction or induction meeting whereby you were given some basic guidelines. Maybe if we had a one-day seminar, probably for the demonstrators, whereby we can share some of these issues freely, maybe it can work.
KW	I am planning something like that. What are you getting out of the demonstrating? What does it mean to you? Why are you doing it?
PN	One, I'm getting some monetary value. Let us appreciate that that is a fact. Two, I feel that I am delivering my services as a teacher, so that satisfaction that I had left back at home, I am still getting it here. And it is also worth to mention that I am also finding some new things besides myself (of) that chemistry of the university, first-year, second year, that I learnt in Kenya. So there are some basic things that I am actually getting. Honestly, I feel satisfied as a teacher when I'm directing the students and when I get to see them appreciate what I am putting in them.
KW	Do you think it will help your career?
PN	Very much.
KW	How?
PN	Every day comes with its own experience. I have got to know the experience of the learners in South Africa. I have the experience of learners back in Kenya, I am sure by the end of the exercise I will have learnt some basic things that maybe we need to use to improve our learning, and maybe in the process I am suggesting something either officially or unofficially that we are practicing that you are not practicing that may also improve your system, somehow. So we are actually building the career in some way.
KW	Absolutely, you are. Speaking of career, after your Masters, what is your next step?
PN	Umm, that is a very good question. If opportunities allow, I am planning to take a PhD.
KW	Here?
PN	If all goes well.
KW	And then?
PN	Let us leave the next to God [laughs].
KW	But I mean, if you could dream any dream for yourself, in ten years time, what would that be?

PN	Umm, I am new in the field of research, so my interest is growing, I am not very sure of how much interest in the field of research I will have by the time I will be finishing all these courses, but if somebody asked now, what I would like to do, I would be very fast to go for lecturing. Because of that satisfaction I am talking about.
KW	Yeah, I know exactly what you are saying, I have that too, and it is in my blood.
PN	Yeah, exactly!
KW	I can go and make some money somewhere else, but it won't be a satisfying.
PN	Sure.
KW	Well, thank you , Peter. If I think of anything else, can I phone you and ask you for another five or ten minutes?
PN	Yes, feel free to do so.
KW	Thank you very much, PXXX.

University of Cape Town

Sample: Lecturer interview

Interview with GXXX AXXX (2008-08-21)

KW	<p>Thank you very much for agreeing to do this, as I said before. I explained to you that my project is about demonstrators and how they learn and what they learn in the first-year laboratories and how they apply it then later in their careers.</p> <p>I noticed in your email that you demonstrated to first years and up to fourth year level.</p>
GA	Yes.
KW	How was demonstrating to first years different from demonstrating to senior students (for you)?
GA	<p>Well, certainly the first year students know a lot less. You know, they are coming in from a case where in school they haven't used the basics, so you had to be a lot more careful about explaining the most simple things about clamping things on and that type of thing, whereas once you got to your second and third year and honours students, they now, you assume, because they've already had that groundwork, there is less technical explanation that is going on and more theoretical explanation. Sure the technical stuff is there but it starts moving more and more towards the theory as opposed to just the raw technical things. Like the first-year students, they've never done a distillation so they can't, they don't know how to set up a distillation, they've never done a reaction that is a reflux, so first-year is definitely a more technical teaching experience as opposed to a more theoretical one... which I prefer, I prefer the theory, I prefer to... you know technical stuff I just want people to be able to do (laughs).</p>
KW	Ja, as you say, they don't come in with much of that from school, because they don't do a lot of practical work at school.
GA	Ja. For them it is new, that they have glassware that they are going to now set up and do this whole thing and you pick it up in the labs. You see that even after explaining it to them, you stand in front of the class and explain the whole lot, when it actually comes to them doing it, they don't know, they still need to be shown how to put things together and check and make sure that the thing has been assembled correctly and that type of thing.
KW	I agree, a skill develops when they see how it is done, and then they learn by doing.
GA	Ja.
KW	When you applied for the position as lecturer did you have your demonstrating and tutoring experience on your CV?
GA	Yes. I mentioned that was part of the thing, that I had demonstrated to all levels; at undergraduate and postgraduate, with the Honours students.
KW	Can you remember whether you were asked about your experience in your interview? Did they ask you anything about your teaching experience?

GA	I can't remember too much. They didn't ask much about the teaching; I think they took from what they had seen in the CV that I didn't have lecturing experience. They could see I had demonstrating experience, but because I was coming in a lecturer level they weren't worried about the fact that I didn't have a huge amount of actual lecturing experience. But I don't remember them asking about the demonstrating aspects.
KW	I want you to think back to when you first became a demonstrator and think if you can remember the reasons why you demonstrated. You know, I know ... at some institutions it is expected, but some people perhaps have a more long term view of their demonstrating.
GA	Well certainly for me, I started in my third year, which is not usually encouraged. Certainly at UCT they didn't recruit third year students to do that but I knew that I enjoyed chemistry and that I wanted to pursue it, and enjoyed the teaching environment. I enjoy explaining new things, transferring knowledge over to people, so I got involved in that in my third year and then from Honours level it is expected to demonstrate, so then I just fell in to it. Now I already had some experience. I can't remember in my Honours year where I demonstrated to, I think I might have still demonstrated the first-year pracs. Either the first year or I demonstrated the second years then as well. I can't remember. I know one year I just did the second year for one year and I didn't want to do them again because there was too much ... that was the one that Bette was running and there was just too much admin (laughs). I then went on to third year but then I also became a superdemonstrator for the first year course as well. That was the one year where you were giving the pre-prac and organising the demis themselves. The ultimate reasons were that I enjoyed chemistry and I wanted to pursue it.
KW	It sounds to me that you also enjoyed the teaching of chemistry.
GA	Yes.
KW	The whole reasoning around it and building arguments and conversing about it.
GA	Yes.
KW	Just one thing I picked up that you said in Honours it was expected for you to demonstrate. Was there an expectation from the department then that all postgrads... was it said explicitly?
GA	As I remember... the problem is, I know I demonstrated during my Honours but to be honest I can't even remember if it was (expected), or if I am now projecting. You would have to look back at the records. At the stage UCT... around that time was going through a bit of a change in the way it was doing the demonstrating. There wasn't actually an expectation to demonstrate. I might be projecting on the Honours students here (at US) where it is now (expected), and I think at UCT it is now expected but at the time I don't think there was an expectation and so the department used to struggle to find demis. And part of the problem was that they were paying the demis way too little and it just...it became a financial thing, you know they could literally for that time they were going to spend they could go and work somewhere else and that always was an issue. As an example, later on, just at the tipping point, before all this kind of .. and what actually caused that ... one of the things was that my PhD supervisor had expected me to demonstrate to the third years. He wanted me to do that because he needed people to do that kind of thing. I on the other hand chose to do the first years being a superdemi because a superdemi got paid a lot more – a lot more money and it was a lot less work. Coupled into that whole thing it just made more sense, well go and do that there I got

	<p>to also lecture a bit which I enjoyed and that type of thing – do that – it’s a lot less work it’s a lot less admin, marking, all that kind of stuff, and you get paid more so that made the most sense and that made my supervisor very cross because he wanted me on the third years. And I said well you know... and then with that and other people as well ... they then developed a new system (model) at UCT where they started paying the third year demis more because it was more work. Up until then first year demis and a third year demi was paid exactly the same, but the third year demi was working twice as hard. Particularly in the synthetic pracs versus the first year demi ... it was light work really in comparison so you didn’t have students coming to ask you questions and all those type of things you had in third year. They changed it then, I honestly can’t remember if it was an expectation at fourth year but I know I certainly did it then and my peers around me in the Honours course were also being demis so I’m pretty sure that we all did it. I don’t think that any of us didn’t, but then that would have been the first year that people would have been asked to do it and I think people are far more willing the first time, so they’ll give it a try. It’s only later on that they start getting <i>gatvol</i> because the money is bad and it takes a lot of your time and then they start to ... some of them were starting to say OK now I’m not going to do it.</p>
KW	<p>Ja, I am also not aware of an expectation, rather an encouragement. People are encouraged to do it, but I can’t remember if anyone actually chose not to (demonstrate).</p>
GA	<p>It was when EXXX SXXX was there, he was the one who took it on and the next year they went and got more of a budget from the thing and then they reworked it to actually make it fair in terms of how things worked out and they did away with the superdemonstrators and it was a whole lot of things, and at that stage he had a meeting with the postgraduates and said look this is expected of you, you are required to do this. So... which I believe is a good thing. It is important at the postgraduate level, on many levels for students to be involved in demonstrating. On the one level its about they have been taught they much teach back... it’s passing back the knowledge, keeping the knowledge sort of flowing through. But also the act of teaching focuses yourself and reminds you if some elementary things which you might take for granted, and so that helps you to apply that to our own work and your own way of operating. I believe its very important, in fact I’ve been thinking and wanting to speak to my other colleagues that we actually do a proper demonstrator training workshop which we don’t have at the moment. As I recall there was something like that at UCT, they used to have that. That we actually do a formal training and make sure that demis who are coming through that they attend that and that they ... because a lot of people still see the demi-ing as... well they have to do it, you know they go and they just stand around and they are pretty much useless in the afternoon, whereas they should be interacting with the students and helping them.</p>
KW	<p>I like what you are saying about what it means to be a demonstrator. You are encouraged to communicate about your subject and it’s actually quite a safe environment because you are communicating with someone who knows less than you do (laughs).</p>
GA	<p>Hmmm.</p>
KW	<p>And you can try out ideas on these people, I never thought of it that way. Can I ask you, did you have an academic career in mind when you started your studies?</p>
GA	<p>No.</p>
KW	<p>When did you first see it as an option for yourself?</p>

GA	<p>Not at all. In fact, I think it was only later on in my PhD that I started to perceive that. For me the idea of an academic career at one time exciting but also very scary, because academia has two aspects to it and one is the teaching, the other is the research and I found myself definitely liking the teaching aspect but being very scared about having independent research. And its only since the opportunity arose to ... position opened up at Stellenbosch, and it really was just a confluence of things that just allowed that to happen... had a position in industry opened up first ... you know I'd come back from a post doc and I didn't have work so I would have taken the first thing and had I gone into industry the chances of then, once I had settled, to come into academia might not have happened, I don't know. But that's not a path that happened, what happened was that the path to academia opened itself up and when I actually then applied myself to thinking about things on a research level then I discovered actually I can do this, I can get ideas and I can have some thing. So that side has built up. My PhD supervisor had always said to me have you thought about academia, have you thought about going into that, so he was always behind, kind of pushing that and saying that could be an option for you, that's something that you should think about. So presumably he saw within me that potential and was nurturing it at that level. But for me it really only happened once the position became available. I have always enjoyed the teaching aspect though and that has been something which I have always sought out ... the demonstrating and that type of thing, another thing that I did, it was just advertised on the board there that they needed someone to teach a short course in organic chemistry at the then Peninsula Technikon. I went and did that, it was just a four week thing it wasn't long, but I jumped at the opportunities to do that type of thing just because I enjoyed the teaching aspect.</p>
KW	How are you coping with the Afrikaans?
GA	<p>It's OK (laughs). I don't have to lecture in Afrikaans so that's fine although I personally I would like to be able to get there soon. I've focused this year particularly on improving my vocabulary, I'm reading a lot more Afrikaans now and trying to have more conversations in Afrikaans, but it's also the technical Afrikaans is very different so that has to come. When I arrived (at US) I didn't even know what the Afrikaans word for carbon was, and I'm an Organic chemist and carbon is fundamental.</p>
KW	Ja, I never thought about that.
GA	Or just all the elements, you know, nitrogen, oxygen, all those things and they are just words which you've never used before and now all of a sudden you start hearing them...
KW	I have a list of questions here that I've typed out to guide me. The next one was: "How has demonstrating benefitted you in your career?" and I think you have actually answered that. Is there anything you want to add to what you've said already?
GA	No I don't think so. Just the sheer act of demonstrating (coming from the point of view that I was keen) I attempted to get into it a lot earlier than other people because I wanted to do that, so .. I don't know if I consciously took it at the time, its just the fact that I enjoyed it, but what it was training me was how people think and learn and just being able to interact in a teaching environment.
KW	It is teaching...
GA	But it is a different teaching ... it's not a lecturing environment...
KW	It's a learning environment.

GA	Ja... one on one.
KW	You mentioned that it gave you insight into how people think. Can you think of a specific example... I know it's long ago.
GA	Its' not specific things but whenever you are involved in a learning environment and you see someone do something, even though you ... particularly now ... when you stand up and give a pre-prac lecture and you are describing how to put the things together and what you need to do, you are also a lot more aware now of certain things that ... the mistakes that people make. They think, oh this is ... I can do it this way, and you have to re-emphasise things. You get the class, for instance the condenser... you know you say: "Where does the water come in from?" "Think about it." And you have to elicit, and most of them say "from the bottom" some of them say "from the top". No! (laughs) "Think about it, it must work against gravity" and you take that and that comes from knowing that the previous time you did that and you just said to them "OK, from the bottom"... and they didn't actually take that in. And then you walk around and you see people getting it wrong. But now, because of that you know that that is a mistake, so you can actually do it properly the second time. So the demonstrating, the years that I spent doing that, the small things, I mean its not like one specific detail but there was always those types of things which you learn are like common mistakes that people make, and so you learn to pre-empt them the next time you are having to explain it, or the next year you are aware of it and you can say yes, look, a lot of people get this wrong, so focus on this, be careful, watch out what you are doing.
KW	Ja, I agree. By the way I also took the same route. I also demonstrated and was noticed, and was invited then to join the department many years ago. When you were a demonstrator, obviously you were interacting with people on all levels; your supervisor, other lecturers, and students, and other demonstrators. Who do you think you learnt the most from?
GA	mmm...
KW	Was there a specific role model maybe, or someone who really influenced you, someone who really inspired you?
GA	Well, it's multifaceted. From a practical point of view, the best person that I worked with was really my PhD supervisor. He also ran the third year organic pracs and that type of thing and he was just someone that I kind of understood and I thought that he was a good teacher, not the best that I've had but he was also very good from a practical point of view as well. When I came into the research environment he was very good at the hands-on approach of actually explaining how to do things and put things together. From a general teaching thing I've always maintained that someone like MXXX CXXX was an excellent teacher, even though it was a subject which wasn't my thing, I always felt that I could actually understand and follow his lectures and go though and I thought he was a really excellent lecturer. From the demonstrating side I don't think there were any people that I ... when I started in third year to have got to that point I had gone through quite a few different demis myself, but it was always someone different, not just one person who was giving me advice. So by the time I was in third year I had a certain amount of information which I had developed over that time and then starting at the first year level ... well the stuff that is there is fairly basic so it wasn't that I looked to anyone above me to teach me how to teach others. It was more a case of feeling the system.
KW	I think you do ... my experience has been that I demonstrated in the way that I was demonstrated to. I supposed it is an identity that you assume and you don't necessarily remember learning specific things from demonstrators but I can

	remember wanting to be one.
GA	Ja.
KW	Sorry, I interrupted you, that's what I always do...(laughs). Are you involved in practicals here at SXXX?
GA	Oh yes.
KW	What level?
GA	I've got third year this year as well, and second and first year and Honours, ja it's all of them.
KW	Do you use any of your experiences as a demonstrator or of the demonstrating system that you grew up in here, or have you not had that opportunity?
GA	Its' difficult. I haven't exactly had that opportunity, I guess there is still ... the way that I used to do things at UCT I will do here, particularly in the first year course. But the second and third year courses, which I've only just started this year I'm not ... the courses have been running in a certain way and so I'm just ... I've e been told: "Here is the prac, just go and do it, give the pre-prac and that sort of thing, so there is a lot of things about the practicals here which are different to the way things are done at UCT, but I haven't yet had the time to sit down and actually discuss and sit with my colleagues and say: "What are we trying to achieve, what are we doing?" so that I have a better idea and understanding. On one level I'm actually very ill prepared for the second and third years because I don't know the full extent of their evaluation and what is expected of them in terms of handing in reports and stuff like that. I'm just involved at the front end of giving the pre-prac, and doing the practical itself, sort of helping around making sure they get those sort of things right. The evaluations are marked by the demis...
KW	Coordinated by someone else?
GA	Ja. At the first year level I certainly bring in things which I have picked up over the years.
KW	Like what?
GA	Just interacting with the students, looking around for potential problems and that sort of thing, making sure that you are not just standing around and that kind of thing but actually going to the students and actually checking on each thing, asking them if they have problems, being more interactive than just standing back and waiting for them to come to you.
KW	And the demonstrators here, how are they compared to...?
GA	It varies. To be honest, I've seen a lot better. But part of that is because they need to be trained properly. And they need certain...[long pause]
KW	They need structure?
GA	Skills and that sort of thing and at the moment there isn't anything like that. Some groups are better than others, for instance the Honours course people ... because they are going though our system we are taking them now and they are doing first year demonstrating. They do a lot better because they will do it on a Friday, we coordinate it so they are all busy on the one afternoon. So the Friday group of demis

	are good because they are the Honours, mostly Honours students and it's the first time they are demonstrating. They are a little bit more enthusiastic I think and also they are currently in a learning cycle. They are being examined and what have you so they are far more into that. I've had serious doubts with some later other postgraduates and we have recently had some people who are coming over from other universities ... bringing students across ... and I'm just not so sure exactly how good they are. And also the motivation from them has been very bad. That's been a big problem.
KW	Ja, we have exactly the same ... it seems that the old hands have got a way of doing things and it's very difficult to change their ways. The younger ones are more pliable, if you want to bring in a change it's best to do it with a fresh group. Because there is a culture that starts to prevail, and you can't make them do new things if they haven't been doing it.
GA	No, no absolutely.
KW	It's difficult. Ja.
GA	So, ja. But this is where one of the things that we had at UCT was of course the training the demi training and I'd like to bring that in from next year where we do a formal training of them. Work out a clever system of doing it or whatever, make them do some role playing and whatever, just to get them thinking about that sort of thing, and also get them to be prepared (<i>emphasised</i>) for a practical. You know they themselves they can't just walk in and ask OK what are we doing today? They need to be prepared, especially from the theoretical point of view. So I've had some, we have had cases where demis don't know which is a really basic concept, but they don't actually know it. And that is bad.
KW	Thank you very much , I see that we haven't used all the time, so that is great. Would you mind perhaps later, if I can think of anything else to do this again?
GA	Ja. That's fine.
KW	Thanks.

Schedule for focus group discussion of 2008-03-19

1. Please state your name and what study programme you are currently involved in.
2. Did you do your first year at this university?
3. What year was this?
4. Did you do the first year practical course here at UWC?
5. When you were doing your first year chemistry at this university did you have demonstrators in the labs? If not, who were helping the students in the laboratories?
6. Can you tell me about your first year chemistry practicals?
7. Thinking back to your first year as chemistry student, what was it that the demonstrators did during the practicals? What was the job of the demonstrator?
8. How would you describe the ideal relationship between a demonstrator and students?
9. How do you like to be around your students?
10. Would you say that there is a sense of community amongst the demonstrators?
11. If you could be part of such a community what would you want to be able ask from other demonstrators?
12. Is there a sense of support amongst the post grads?
13. Do the honours students feel a part of that post graduate community, or not?

Example of a writing prompt and accompanying demonstrator responses

Writing prompt:

Since I first started demonstrating, my demonstrating style has changed in the following ways...

Responses:

[D-RW-03-08-AI] (107 words)

When I started, I felt that I was focussing too much on a few students and could not help many of the ones who wanted my help because I was busy. As the year progressed, I began to focus less on conveying conceptual information to them and simply insured everyone was following the protocol of the procedure in order to save time and be able to help more students. Now, as the year approaches its end, I've found an equilibrium between the two methods of approaching the students and am able to focus on the vital conceptual information while I ensure they are performing the experiment correctly.

[D-RW-03-08-GM] (183 words)

I have learned to understand and listen the students as this is the only way I think, I should do in order to be able to think back and help with the required information to say. I have come to realise that they know so much and therefore I should be willing to learn from them, which on the other hand helps them in return to thoroughly think and relate to the lecture work they do.

At first, I thought that I needed to make show that they get into the lab and just do the work which is something I used to do during my first year but I realised that learning should be fun and as a demonstrator help them to realise that, which will give them an interest in the practical and do their work properly. I have moved from being demonstrator to being one of them, in that way I can relate easy to them and vice versa. I've moved demonstrating from making it a job to being my life in which is all about sharing information we have.

[D-RW-03-08-SM] (219 words)

1stly, I feel that experience is the best teacher. I feel that ive gotten much better with time. The more time you spend with the students, the more confident your answers. I feel that this is due to the knowledge of the practicals, as well as the fact that the longer the students spend with you, the more trusting they are of you. You gain their trust, so in the end your explanations do not need to be as lengthy. My approach has also changed slightly. Initially i was very uptight, as i felt that i had to instill a bit of discipline. This wears off over time, as you start to make friends. The students are also more relaxed with this, and it helps when they do not understand, as you

are easier to approach. In essence, demonstrating is all about confidence and your approach to people. The more confident and assertive you are, the more believable your answers. We are all students, and we are mostly the same. We like a confident answer, and when we do question, we like confident responses. This does not however mean that you should know everything. When i have been found wanting, i have learnt to find out the answers, as there is a chance that question might be asked again!

[D-RW-03-08-TM] (253 words)

I have bin demonstrating for about five years now and a lot things have changed. In the previous years, practical's used to be run buy Lecturers, it was not that easy because us as demonstrators had to get used to working with different Lecturers, now things are much better in the past two years because one person is responsible for co-ordinating, I believe that the relationship between Lecturers/ Co-ordinators and demonstrators is very important. The other thing that changed is my confidence towards the students, I do have to admit, sometimes I don't read the manuals before practical's . I just lesson to the pre-lab talk (which is very helpful to students and demonstrators) then go to the lab. I am more confident. I never used to talk personal stuff with students but now we just talk about everything , sometimes they even invite me to their parties ☺. I realised that this is somehow important to them because they are not afraid to ask anything . Last year was very interesting(when I was doing my honours) , most of us were demonstrating because we were told it was “ compulsory” to demonstrate, so people were doing because they had to. Now, people are doing it because they want to. I have also realised that I'm also not doing it for the money, I just go to help students, sometimes I even go to the lab three times in a week just to go and check out how they are doing.

Survey instrument: What it means to be a demonstrator (WiM2baD)

5-1

Research project: The role of the Chemistry demonstrator in the first-year laboratory experience

Dear First-year Chemistry Demonstrator

I would like to invite you to participate in a research project aimed at improving the quality of learning in the Chemistry laboratory.

Please be completely honest when you answer the questions. Remember that your responses will be completely confidential and untraceable.

This survey may be followed up with interviews with individual demonstrators. In order for you to recognise your own questionnaire again at a later stage, you should invent a name for yourself (that only you will recognise) and write it down in the block below:

Lolo

A. Please complete the following section by circling the appropriate box:

1. I have been demonstrating for

Less than a year	Between one and two years	More than two years
---------------------	------------------------------	------------------------

2. I am currently doing

1 st year	Honours	Postgrad
----------------------	---------	----------

B. Please answer the following section by completing the following statements:

- I decided to become a demonstrator because...

I needed money but I felt like a mentor
to these 1st year student, they looked up to
me and I was there for them. These student
felt safe and they were open to me.

- When I talk to my demonstrator buddies **about** the practicals we usually talk about...

how long is the practical going to take
to adjust ourselves through our studies

- During practicals, it is the job of the lecturer to...

go around and check if the demonstrators
that are doing their jobs and student

- During practicals, it is the job of the lab manager or senior demonstrator to...

make sure that all the equipments
are also ready

- During practicals, it is the job of the demonstrator to...

help students

- If it was my job to train demonstrators, I would train them to...

help student who always the last
to get out (meaning they are struggling
with somewhere).

- In future, I think that my demonstrating experience will help me to...

for references when I find the job

- When I think back to my own first-year experience, the most important lesson I learned *about demonstrating*, was...

they were nice to us and they were
there for us.

- If I could use a time machine to go back to first-year, I would have the following message for my demonstrator...

no comment, they were good!

- When I think back on my job as a 1st year demonstrator, the most important thing I learned was...

that the student need some one
who is caring

- I learned the most by...

Watching / talking / listening to my student(s)	✓
Watching / talking / listening to another demonstrator(s)	
Watching / talking / listening to the lecturer	
Other (please explain briefly)	

- Being a demonstrator means....

mentor

- My message to next year's demonstrators is...

keep up the good work always be there for students

- Do you have any other comments?

No

Thank you very much for participating in this survey.

Karen Wallace (researcher)
Room 3-48, Chemistry building, Tel: (021) 959 2254

K Wallace: Research notes

[R-JN-30-09-08-Tu]

Tuesday 30 Sep 2008

Lab observations Exp 3.2 (end of demonstrating cycle, penultimate prac)

The prac this week is le Chatelier's principle. During the pre-lab (in Lab A) the students participated (some at least) until one young lady in the front of the class fainted. She was helped by her neighbours, but there was no assistance from the demis. At that point and from then onwards it was difficult to engage the students and I concluded the pre-lab talk shortly afterwards. At the start of the prac there were just two demis in lab A, in addition to the superdemi (Nofanele). Bakari (demi bench 1) stayed in front standing against the side bench, not initially interacting with his students. The students seemed comfortable going about their business. The other demi (XXX) was busily interacting and I saw her laughing with some students at the back. Later (30 minutes into the prac) she was standing on her own at the back of the lab for a short while, after which she started circling the bench and interacting with students again. At this stage Bakari had settled on the other side of the lab with Nofanele, who was busy on the cell phone, texting. Bakari came to me to enquire about the HCl solutions (11M, 6M and 0,1M), two of which were bright yellow (11M and 0,1M). He didn't seem to have much faith in the solutions, suggesting they might be contaminated and speculating about what could have contaminated them. Combs and PN spent quite some time chatting (C texting all the while) in the front while XXX continued to attend to her students.

[R-JN-30-09-08-Tu]

[3:15] In lab B, Tandeka was interacting with students in the front. The content of the interaction seemed mainly organisational and social, there was quite a bit of joviality and occasionally Sarah pointed to something in the lab, indicating its locality. She seemed very comfortable with the students and they seemed to seek her out for conversation. In the mean time the only demi present in the lab (YYY) was circling around, interacting with the students.

[3:25] In lab A, both demis were interacting, XXX was laughing heartily with some students, her head thrown right back. Nofanele came to ask me a question about the prac, about a colour change and how it related to a shift in equilibrium for a particular reaction. Thandeka answered her, adding she knows this because she is lecturing the work at the moment.

[3:30] Bakari is explaining something on paper to some students. Now he is holding a test tube, (the cameraman) is filming his interaction with the students. Nofanele said earlier she is so angry with her demis because they don't pitch up for pracs. Six are supposed to be here, but

today only 3 of the six pitched, the absent ones didn't let anybody know they weren't coming. Even the reliable ones, who would usually phone to say when they can't make it, didn't do so today. I explain that this is how it is with people sometimes; we can encourage them to be responsible but can't always control it when they are not behaving the way we expect them to. Problem is, we have no "teeth". If they are paid very little and we don't have the power to withhold payment when they don't pitch, (or perform) we can't have control. I ask Bakari what he gets paid per session (he is a Masters student) and he says R85.50. I ask YYY the same question (she is a PhD student) and she says R110. Then I ask XXX who is an Honours student, and she says she earns R59 a session. She adds that, if a student's fee account is in arrears, 80% of this wage goes towards settlement of the account, and 20% is paid out to the student. I ask her how it works when a demi doesn't come to work, and she says demis can't claim money if they don't come to work. According to her, (the technical assistant) signs the claim forms. I then ask (the technical assistant) how it works and he says: 2 years ago the department was paying demis even when they didn't work, because if the department didn't use the entire work-study allocation made available for the payment of demis and tutors by the University, it would affect the next year's work-study allocation. Another model the department had tried in the past was to pay salaries to the demis through the departmental budget and HR, but the demis soon learnt that the money would then be paid regardless of whether they worked or not, and some then started staying away. This is all very interesting, I would like to know more about the different models the department has tried and how well they worked relative to each other. I think I should try to interview ZZZ.

[R-JN-01-10-08-We]

Wednesday 1 Oct 2008

In lab A it seems there is just one demi present today namely Mandisa. For the moment she has her hands full; students are putting up their hands, and she is dealing with their requests. She has just walked into the prep room and returned with a piece of equipment for a student. Yesterday I spoke to a few demis about the remuneration issue. It was YYY who said that she doesn't do it for the money but for the experience and to put it on her CV. It seems like the older demis, the more experienced ones are more reliable in that way – I should ask Thandeka about that in our next interview. Mandisa is still in the back with her students, one of them (a male) has his arm around her shoulder for a moment, now she is explaining something to the group. The cameraman comes to have a chat with me and Thandeka comes over and asks to see some of the footage. She is impressed with the clarity of the images, but wonders aloud how the footage will feature in the write-up. I explain as best I can; she then asks the cameraman whether it is difficult to follow the demis around with the camera. He says no, laughs with her then says that, when he is following the "red coats" they sometimes go the other way to try to avoid being filmed.

[15:20] MXX PXX came down from the research labs where he is working on his Honours project, just to say hi. He stayed for at least 30 minutes. I have noticed that some of the demis tend to do this. Another demi, whom I wouldn't have recognise as part of the group if it weren't for the fact that she was wearing the red coat, came to stand next to me and started sorting the pre-lab submissions. She wasn't in the pre-lab and arrived in Lab A around 3:30 (90 minutes into the prac). When I asked she said she was a second year and that she started off assisting with odd jobs around the prep room, and now she is a demi. Clearly this is a way into the community for students who would not otherwise have access to demi jobs (like 2nd years). Her students are in the third row (where I saw Mandisa spending most of her time) and I never saw her going to assist her students once during the prac.

[15:30] In lab B, Sandy is standing by the window with a student. They are both bent over some papers and Sandy is explaining something. He has told me before that he really enjoys the explaining part and he clearly considers himself very good at explaining. I have also noticed (when he explained something to a student in my office once) that he enjoys the conceptual stuff but that he sometimes over-explains, and likes to show off his knowledge of the first year topics. I have on more than one occasion noticed that he explains beyond the level of understanding required for the first-years. He is, however, not at all reluctant to engage his students in conversations about the work, although his style seems to be more talk than listen. (The videographer was filming this interaction at around 15:40.) I have noticed that Sarah knows the students really well; she even knows their first names and often has a sense of how they are performing in their chemistry course even though student performance on the theory tests is not something that I would normally discuss with her. Earlier a student was handing in her work, and Thandeka was complimenting her on how tidy her handwriting is. She immediately noticed that the student had left something crucial out of an equation (an energy term in a thermochemical equation). She showed the student something was missing, and then gave her the opportunity to correct her work before handing it in. I have seen a change in Thandeka since I started working with her. She is much more approachable and her manner with the students is much kinder than when I first started working with her in 2005. Thandeka has a demi register that she said I could copy so we can have a record of demi attendance over the past two years. Perhaps that will come in handy at some point. Sandy left after his group was finished despite the fact that he was the only demi in the lab at the time, leaving at least 25 students without assistance.

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Example: Demonstrator training programme (2006)

UNIVERSITY OF THE WESTERN CAPE
CHEMISTRY DEPARTMENT



1ST YEAR
DEMONSTRATOR
TRAINING SESSION

17 FEBRUARY 2006
11:00 – 12:30
C10 (1ST FLOOR, C-BLOCK)

- 11:00 Welcome and refreshments
- 11:15 The role of the Chemistry demonstrator
in the first-year laboratory experience
Student feedback 2005
- 11:45 Discussion of Demonstrator Manual
- 12:00 Q & A session

This training session is compulsory for all demonstrators involved in the first-year practical course. Any other Chemistry demonstrators interested in attending the session should RSVP with Karen Wallace for catering purposes.

Example: Demonstrator briefing notes

PRE-LAB BRIEFING

EXPERIMENT 1.3

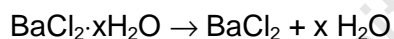
Gravimetric analysis: Determining x in $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$

Notes for demis

1. Students without lab coats, specs, closed shoes, prac manual etc must be told to see Ms Wallace after the pre-lab briefing. We cannot allow them in the lab this week.
2. Students who are unprepared today must be told to see Ms Wallace after the pre-lab briefing. We cannot allow them in the lab this week.
3. Today will be the students' first introduction to the analytical balances. We have to teach them the correct way to use them.
4. Demis need to be briefed on the correct procedure for using the analytical balances beforehand:
 - Zero the balance and weigh the crucible.
 - Use the **same** balance, zero it and weigh the crucible + sample.
 - After driving off the water of crystallisation, use the **same** balance, zero it and weigh the crucible + sample. (Repeat this step until a constant mass is achieved.)

Overview of the practical

Weigh a sample of hydrated barium chloride. Heat the hydrated barium chloride to dry it completely:



Then reweigh the sample. The difference in mass will give you the mass of water that was driven off; from this you can calculate the mass percentage H_2O in the sample, and then the empirical formula of the hydrated compound.

Announcements

1. Students must work in pairs.
2. Students must be warned not to touch the hot crucibles with their bare hands (in case of a burn, the affected part should be held under running water, and the lecturer on duty should assess the injury and act accordingly).
3. In fact, they should not touch the crucibles by hand **at all** today as they may transfer oils etc to the crucible which will affect their results. Handle the crucible with tongs only.
4. Students will find their **pre-weighed** samples of hydrated barium chloride in the weighing boats in the weighing rooms. After determining the mass of the dried crucible, they should tip the entire sample into the crucible and determine the mass of the crucible + $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$.
5. In cases where the crucibles issued are too small to be used with the clay triangle, the wire gauze should be used instead.
6. Students will receive a new locker number before next week's prac. They should check the notice board during the course of the week.

Example: Marking memo

<i>Experiment 4.3</i>						5		
Pre-practical exercise								
Nucleophilic addition to aldehydes and ketones								
SURNAME	MEMO							
INITIALS				DAY	TU	W	TH	
NAME				LAB				
STUDENT NUMBER					Locker			
NAME OF YOUR DEMONSTRATOR								

Official use		
Pre-prac	8	
Report	8	
Flow diagram	2	
Silver mirror	2	
TOTAL MARK (20)		

- 1 Consult the list of carbonyl compounds given at the end of the *Introduction*. If you were told that one of them gave a positive silver mirror test, and that its 2,4-DNP derivative had a measured melting point of 114 - 116°C, which carbonyl compound is it most likely to be?
 Positive silver mirror test means the compound is an aldehyde. ⇒ PHENYLETHANAL ✓✓ (2)

- 2 What other test can be used to distinguish between a ketone and an aldehyde? Which of the two (aldehyde or ketone) will give a positive test? What would you observe if the test was positive?
 The test with Fehling's solution. ✓
 A reddish-brown precipitate of copper metal indicates the presence of an aldehyde. (2)

- 3 Write a balanced equation for the reaction that takes place between silver metal and nitric acid when the silver mirror is washed out of the test tube.

$$3\text{Ag}(s) + \text{NO}_3^-(aq) + 4\text{H}^+(aq) \rightarrow \text{NO}(g) + 2\text{H}_2\text{O}(l) + 3\text{Ag}^+(aq)$$
 (2)

- 4 What would you observe if concentrated hydrochloric acid were added to the silver/nitric acid solution?
 A grey-white precipitate of AgCl would be observed. (2)

Report sheet

Nucleophilic addition to aldehydes and ketones

SURNAME	MEMO.						
INITIALS				PRAC DAY	TU	W	TH
NAME				LAB			
STUDENT NUMBER					Locker		
NAME OF YOUR DEMONSTRATOR							

Results

Summarise your results in the table below:

Determining whether an unknown compound is an aldehyde or ketone

Compound	Result with Tollen's reagent (+ or -)
Pentanal	⊕
Acetone	⊖
Unknown	

✓
✓

(2)

The unknown compound belongs to the following class:

If classification is correct (2)

If classification is incorrect (0)

(2)

Melting point for the 2,4-DNP derivative of the unknown:

If m.p. is given as a single value (1)

If m.p. is given as a temperature range, even if incorrect (2)

Identity of the unknown:

If unknown is correct (2)

If unknown is incorrect (0)

(2)

(2)

Reference system for research data

Data type	Reference format	Data sources
Demonstrator interviews	D-In-<interview #>-<yy>	D-In-01-08: Paki D-In-02-08: Thandeka D-In-03-08: Nofanele D-In-04-08: Bakari
Lecturer interviews	L-In-<interview #>-<yy>	L-In-01-08: CO L-In-02-08: GA L-In-03-08: TL L-In-04-08: SB
Focus group	D-FG-<interview #>-<yy>	D-FG-01-08
Surveys	<D/S>-Su-<survey #>-<yy>-<questionnaire #>	S-Su-01-05 (Student survey 1) S-Su-02-08 (Student survey 2) D-Su-01-06 (Demonstrator survey 1) D-Su-02-07 (WiM2baD survey) D-Su-03-08 (Demonstrator survey 2)
Demonstrators' reflective writing	D-RW-<writing #>-<yy>-<demonstrator initials>	D-RW-01-08-AI to D-RW-03-08-AI D-RW-01-08-SM to D-RW-03-08-SM D-RW-01-08-TM to D-RW-03-08-TM D-RW-01-08-GM to D-RW-03-08-GM
Researcher's journal notes	R-JN-<dd-mm-yy>-<day>-<lab>	
Student interviews	S-In-<interview #>-<yy>	S-In-01-05: 2005 interview S-In-02-08: Sandy interview
Laboratory observations	L-Ob-<dd-mm-yy>-<day>-<lab>	

Ethics statement

Name: PK Wallace
Contact details: Chemistry Department, University of the Western Cape,
kwallace@uwc.ac.za; Tel: (021) 959 2254

Ethics Statement

Participants affected by this research

The participants of this study will be sufficiently informed about my role as researcher and the purposes of the study will be made clear. All participants will be required to agree to the negotiated principles of procedure for the entire time that they choose to remain involved in the study, and will sign a declaration of consent. It goes without saying that participants will be free to disengage from the study at their own time of choosing though it is hoped that all will remain committed for the duration.

Protocols for data storage, sharing and protection

Consideration has been given to ethical protocols regarding data collection and safe storage. Participants will have access to their own data for the express purpose of negotiating meanings to enhance the fairness, relevance and accuracy of the data. Authorization to make professional observations and to use transcripts and attributed observations will be obtained beforehand.

Dissemination of findings

In any dissemination that arises from the research, participants will not be readily identifiable unless prior agreement has been reached.

I consider myself sufficiently informed of the overall purposes with regard to ethical issues involving human subjects namely: informed consent, privacy and dignity. If the research changes in a manner which requires revisiting of its ethical implications, I agree to refer these changes to the Ethics Committee.

Signature: _____

Date: _____

Consent form: Demonstrators

INFORMED CONSENT STATEMENT

Research project: The role of the Chemistry demonstrator in the first-year laboratory experience

To the Prospective Research Participant:

Please read this consent form carefully before you decide whether you want to participate in this research study. You are free to ask questions at any time before, during, or after your participation in this research.

PURPOSE OF THE STUDY

You are being asked to participate in a research study designed to characterise the nature of demonstrators' participation in the first-year Chemistry laboratory. The study will explore the extent to which demonstrators' participation in the undergraduate laboratories is helping them to become better teachers.

YOUR PARTICIPATION IN THE STUDY

You may be asked to:

- Write short statements about your demonstrating experiences in a learning journal;
- Participate in semi-structured interviews and focus group discussions; and
- Allow the researcher to observe you and record field notes while performing your demonstrating duties.

The amount of time required of participants will not exceed 30 minutes per week, and will not exceed 20 hours per participant over the 18 months that is the expected total duration of the study.

Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty and without loss of benefits to which you are otherwise entitled.

RISKS AND BENEFITS

There is no predictable risk of physical injury associated with participating in this study. Since there is no financial compensation for your participation in this research, it is unlikely that you will directly benefit from your participation in this study. However, participants may become more aware of their own personal feelings and beliefs by answering questions.

CONFIDENTIALITY

All the records generated during this research project, including your learning journal, transcripts of interviews and focus groups discussions, and field notes of laboratory observations, are completely confidential. You will not be identified by name on any record or other form of documentation, only by a special number code. All records will be kept locked in a filing cabinet. The results of the study may be published for scientific purposes but will not give your name or include any identifiable references to you.

CONSENT

I have read and understand the above information and I agree to participate in the study. I understand that I will receive a copy of this form.

Participant details

Name _____ Signature _____ Date _____

To enable us to contact you in future, please provide your contact details:

Email address _____ Cell phone number _____

Researcher details

Name **Karen Wallace** Signature _____ Date _____

Email address **kwallace@uwc.ac.za** Cell phone number **083 651 0910**

Consent form: Students

CHE114/116 PRACTICALS: RESEARCH PROJECT

Consent Form

I understand that

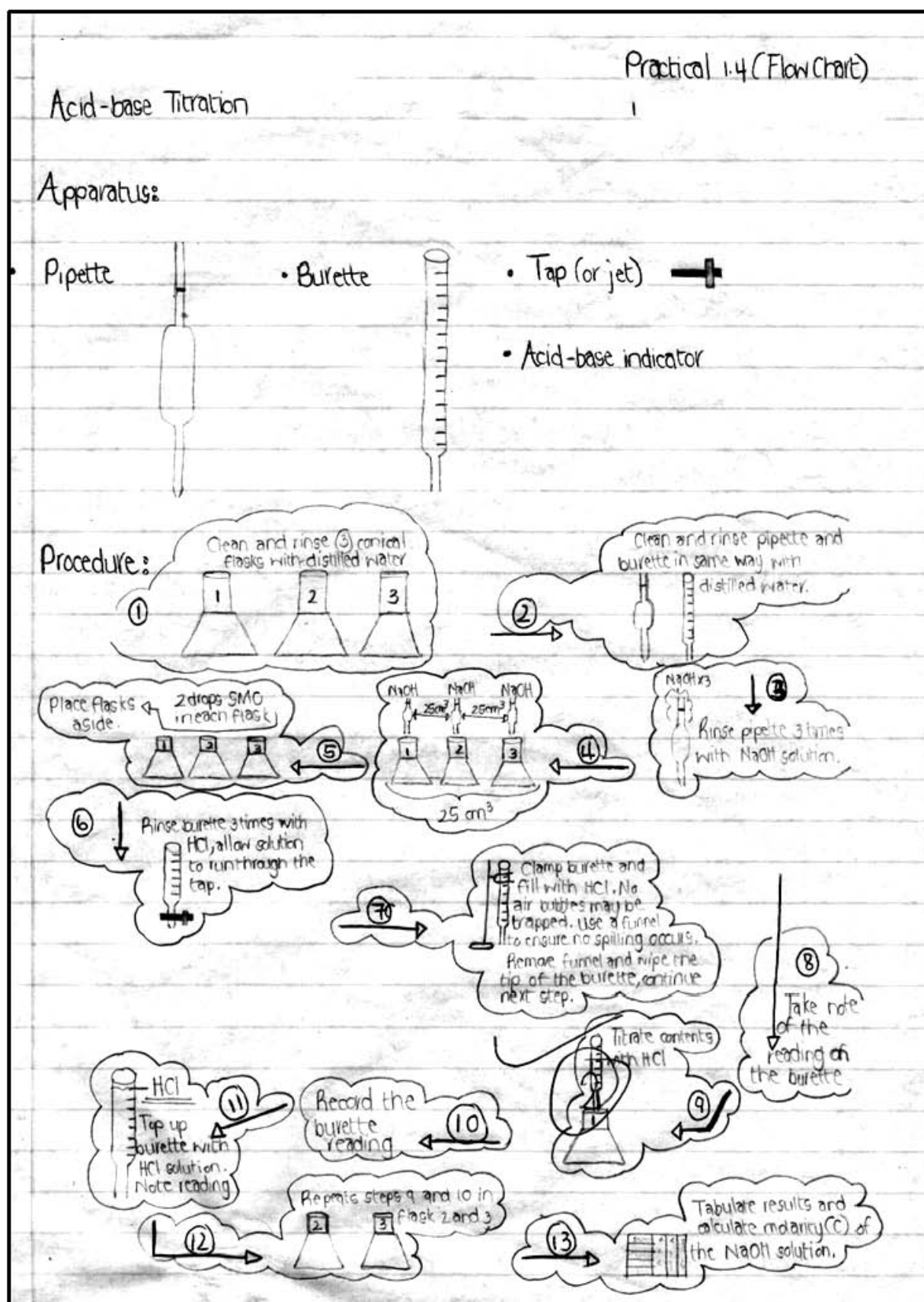
- The purpose of this study is to investigate ways of improving the quality of learning in the Chemistry laboratory.
- My responses in this survey will be deemed completely confidential and untraceable and will not form part of my permanent record at the university.
- I am not waiving any human or legal rights by agreeing to participate in this study.
- My participation in this study is voluntary.

I verify, by signing below, that I have read and understood the conditions listed above.

Signature: _____

Date: _____

Example: Flow diagram



Example: Course evaluation summary**Department of Chemistry: CHEMISTRY 114 COURSE EVALUATION 2005**

Lecturer: PK Wallace

Number of respondents: 59

Number of registered students: 88

Part A

Frequency distribution of student responses to the statements in Part A of the Questionnaire

Statement		Scale				
		Very easy	Easy	Reasonable	Difficult	Very difficult
1	Relative to other courses I am studying, this course was	6.8	20.3	62.7	8.5	1.7
2	Relative to other courses, the workload for this course was	Very heavy	Heavy	Reasonable	Light	Very light
		3.4	15.3	67.8	11.9	1.7
3	For me, the pace at which this course was presented was	Too fast	Fast	About right	Slow	Too slow
		-	5.1	88.1	5.1	1.7
4	Overall, I would rate this course as	Very good	Good	Satisfactory	Poor	Very poor
		52.5	27.1	20.3	-	-
5	Overall, I would rate the lecturer as	Very poor	Poor	Satisfactory	Good	Very good
		-	-	8.5	20.3	66.1

Note: Frequency distributions are in percentage.

Part B

Frequency distribution of student responses to the statements in Part B of the survey

Statement		Scale				
		1	2	3	4	5
6	I understood the subject matter	23.7	49.2	22.0	1.7	-
7	Organisation of the course was poor	1.7	1.7	5.1	25.4	62.7
8	The prescribed text book was useful	28.8	23.7	32.2	6.8	5.1
9	The study guide was a help	10.2	18.6	25.4	13.6	32.2

Statement		Scale				
		1	2	3	4	5
10	Tutorials assisted me	64.4	27.1	6.8	-	-
11	The number of class tests should be decreased	1.7	1.7	11.9	40.7	42.4
12	The lecturer assumed too much background knowledge	6.8	6.8	30.5	33.9	18.6
Statement: The lecturer...		Scale				
		1	2	3	4	5
13	Effective communicator	57.1	27.1	8.5	1.7	1.7
14	Enthusiastic about teaching the course	54.2	25.4	15.3	-	1.7
15	Teaching style held my interest	45.8	39.0	10.2	3.4	-
16	Gave clear, lucid explanations	50.8	33.9	10.2	1.7	1.7
17	Made note-taking difficult	1.7	10.2	5.1	23.7	55.9
18	Stimulated my interest in the subject	33.9	44.1	18.6	-	-
19	Used OHP (and/or blackboard) well	55.9	32.2	5.1	1.7	-
20	Friendly and approachable	78.0	16.9	3.4	-	-
21	Well organised	76.3	22.0	-	-	-
22	Confident and self assured	64.4	30.5	-	-	-
23	I would not go to this lecturer for help	1.7	3.4	3.4	15.3	71.2

Note: Frequency distributions are in percentage.

Note: Frequency distributions are in percentage. The scale ranges from 1 Strongly agree to 5 Strongly disagree.

Part C

Summary of Student Free-Response Answers

24 What improvements to this course, or to teaching, could you suggest? (32 responses)	
Theme	Suggestion
Practicals	<ul style="list-style-type: none"> • Should be more interesting (2) • There should be more of them (2) • More help with practicals needed (3) • Practical reports should be corrected by demonstrators (1) • Better organisation required (1) • Smaller practical groups (2) • Demonstrators need to be better disciplined (1) • Demonstrators should be more friendly (1) • Need improvement (no details given) (1)
Tests	<ul style="list-style-type: none"> • Increase the number of (class) tests (1) • Schedule the tests for an earlier time in the day (1)
Lectures	<ul style="list-style-type: none"> • Should be more interactive (1)

	<ul style="list-style-type: none"> • Should not change (10) • Should link chapters (1) • Should contain more exercises (1) • Should assume less prior knowledge (1) • Number of lectures should increase (1)
Tutorials	<ul style="list-style-type: none"> • More tutors are needed (1) • More tutorials are needed (1)
Lecturer	<ul style="list-style-type: none"> • Presentation should be more lively (1) • Should not give Afrikaans translations of words (1) • Should give more clarification of concepts (2) • Should be less friendly (1) • Should not go too fast (1)
General	<ul style="list-style-type: none"> • Better organisation around text books is required (1) • More handouts (old exam papers) required (1) • Study guide should contain more info on calculations (1)
25 Would you like to give more detail on any problems you have experienced? (16 responses)	
Theme	Problem
Practicals	<ul style="list-style-type: none"> • Not enough assistance during practical sessions (4) • Not enough seating in pre-prac venue (1) • Sessions not organised well enough (2) • Some demonstrators unfriendly (1) and intimidating (1)
Lectures	<ul style="list-style-type: none"> • Lecturer translates some words into Afrikaans and this is unfair on Xhosa-speakers (1) • Not enough background given (1) • Did not understand the lecture content (1) • Pace too fast (2)
Tests	<ul style="list-style-type: none"> • Student did not understand the last two tests and failed both (1) • Multiple-choice questions are a problem (1) • Not enough time given during tests (1)

Other comments:

“I am lectured the way I expect to be.”

“She must keep on teaching the (way) she is doing I just love her.”

“This course has improve(d) my skill and my interest in Chemistry.”

“As for the lectures, they were excellent.”

“There’s no need for improvement everything was perfect.”

“Chemistry lecturers should be everyday.”

“No problems, well organised and that is what we want.”

“It was a great pleasure to be in this class.”

Instrument: Student survey**CHEMISTRY PRACTICALS: RESEARCH PROJECT**

Dear First-year Chemistry Student

I would like to invite you to participate in a research project aimed at improving the quality of learning in the Chemistry laboratory. Please complete the following questionnaire as honestly as possible.

Your responses will be deemed completely confidential and untraceable. Bear in mind, however, that the aim of the survey is not to criticise individuals or their practices, but rather to generate constructive suggestions for improvement.

A. Complete the following section by circling the appropriate box:

1. I am currently enrolled for

CHE114/124	CHE116/126
------------	------------

2. I do Chemistry practicals on

Tuesdays	Wednesdays	Thursdays
----------	------------	-----------

3. I do my Chem practicals in lab

A	B	C
---	---	---

B. Complete the following section by circling the number that most closely matches your response:

1. I enjoyed the Chemistry practicals.

2. The Chemistry practicals taught me useful laboratory skills (weighing, titrating, etc.)

3. The practicals helped me to understand the Chemistry lectures better.

4. The Chemistry practicals helped me use basic laboratory equipment with confidence.

5. The Chemistry practicals helped me to be more aware of laboratory safety.

6. The Chemistry practicals taught me to make experimental observations.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. I enjoyed the Chemistry practicals.	1	2	3	4	5
2. The Chemistry practicals taught me useful laboratory skills (weighing, titrating, etc.)	1	2	3	4	5
3. The practicals helped me to understand the Chemistry lectures better.	1	2	3	4	5
4. The Chemistry practicals helped me use basic laboratory equipment with confidence.	1	2	3	4	5
5. The Chemistry practicals helped me to be more aware of laboratory safety.	1	2	3	4	5
6. The Chemistry practicals taught me to make experimental observations.	1	2	3	4	5

C. Answer the following questions as honestly as possible:

1. What should your demonstrator **STOP** doing?

2. What should your demonstrator **START** doing?

3. What should your demonstrator **CONTINUE** doing?

Thank you very much for your participation.

Karen Wallace (researcher)
Room 3-48
Chemistry building
Tel: (021) 959 2254

Instrument: Demonstrator survey**FIRST YEAR CHEMISTRY PRACTICALS: RESEARCH PROJECT**

Dear First-year Chemistry Demonstrator

I would like to invite you to participate in a research project aimed at improving the quality of learning in the Chemistry laboratory. Please complete the following questionnaire as honestly as possible.

Your responses will be deemed completely confidential and untraceable. Bear in mind, however, that the aim of the survey is not to criticise individuals or their practices, but rather to generate constructive suggestions for improvement.

This survey may be followed up with interviews with individual demonstrators. In order for you to recognise your own questionnaire again at a later stage, you should invent a name for yourself (that only you will recognise) and write it down in the block below:

--

A. Complete the following section by circling the appropriate box:

1. I have been demonstrating for

Less than a year	Between one and two years	More than two years
------------------	---------------------------	---------------------

2. I demonstrate on

Tuesdays	Wednesdays	Thursdays
----------	------------	-----------

3. I demonstrate in lab

A	B	C
---	---	---

Answer the following questions **only** if you demonstrated during 2005:

4. During 2005 I demonstrated on

Tuesdays	Wednesdays	Thursdays
----------	------------	-----------

5. During 2005 I demonstrated in lab

A	B	C
---	---	---

C. Answer the following questions about the practical sessions as honestly as possible:

What should the students in your lab **STOP** doing?

What should the students in your lab **START** doing?

What should the students in your lab **CONTINUE** doing?

In relation to your job as Chemistry demonstrator, what should the Chemistry Department at UWC **STOP** doing?

In relation to your job as Chemistry demonstrator, what should the Chemistry Department at UWC **START** doing?

In relation to your job as Chemistry demonstrator, what should the Chemistry Department at UWC **CONTINUE** doing?

Thank you very much for your participation.

Karen Wallace (researcher)
Room 3-48
Chemistry building
Tel: (021) 959 2254