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Qualitative Research in Postmodern Times

Exemplars for Science, Mathematics and Technology Educators

Springer

CONTEMPORARY QUALITATIVE RESEARCH

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VOLUME 33

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Contemporary Qualitative Research

Exemplars for Science and Mathematics Educators

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A C.I.P. Catalogue record for this book is available from the Library of Congress.

ISBN 978-1-4020-5919-3 (HB)
ISBN 978-1-4020-5920-9 (e-book)

Published by Springer,
P.O. Box 17, 3300 AA Dordrecht, The Netherlands.

www.springer.com

Printed on acid-free paper

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ACKNOWLEDGEMENTS

The editors wish to acknowledge Jenny Donovan and Petrina Beeton for their excellent work in preparing this book for publication. Petrina read initial chapter drafts, liaised with authors, and ensured that formatting requirements and word lengths were adhered to. Jenny completed the formatting, proof read the entire manuscript, checked and corrected all the references, prepared the extensive citation index and topic index, and completed the pagination, bringing the manuscript to a camera-ready state. We thank them sincerely for their tireless efforts and professionalism. Also we wish to thank the anonymous reviewers whose critical comments helped us to improve the 'look and feel' of the book.

SECTION I

MOVING FROM THE GOLDEN AGE OF RESEARCH

This section deals with fundamental issues likely to confront the novice qualitative researcher at various stages of an inquiry, from research design, to fieldwork, to analysis, to report writing. The theme of this section reflects the concerns of Denzin and Lincoln's (2005) Blurred Genres moment of qualitative inquiry in which researchers move from postpositivism towards constructivist and arts-based perspectives, become more ethically and politically astute, and strive to represent equitably the voices of those who participate in their inquiries.

The six chapters focus on qualitative researchers in varying roles:

- **practitioner-researcher**: Pat Forster (Ch. 2), David Lloyd (Ch. 6)
- **historian**: Robyn White (Ch. 4)
- **participant-observer**: Adrienne Gibson (Ch. 3); Judith Mulholland (Ch. 5)
- **semiotician**: Catherine Milne (Ch. 7)

These researchers are concerned to varying degrees with establishing quality standards for their empirical representations of the participants in their inquiries, for representing their own subjectivities, and for connecting meaningfully with their readers.

CHAPTER SUMMARIES

Chapter	Context of the research	Focus of the chapter	Methodological referents	Quality standards
Ch. 2: Pat Forster	A practitioner-researcher investigates/improves her own mathematics teaching practice	The researcher illustrates strategies for improving her interpretative research writing	▪ *Hermeneutic phenomenology* (van Manen, 1990) ▪ *Writing as inquiry* (Richardson, 1998)	▪ interpretative voice ▪ reflexivity ▪ coherence ▪ researcher growth
Ch. 3: Adrienne Gibson	A researcher investigates/improves the science assessment practices of her colleagues	The researcher outlines strategies for dealing with ethical challenges whilst interacting with her colleagues	▪ *Connoisseurship* (Eisner, 1991) ▪ *Narrative configuration* (Polkinghorne, 1995)	▪ ethical safeguards ▪ professional support ▪ member checks ▪ dialogue amongst stakeholders
Ch. 4: Robyn White	A researcher conducts an historical inquiry into her State's science curriculum policy changes	The researcher discusses the role of narrative and metaphor in representing historical research	▪ *Narrative inquiry* (Polkinghorne, 1995) ▪ *Metaphor* (Lakoff and Johnson, 1980)	▪ ethical safeguards ▪ multiple perspectives ▪ resonance ▪ connectedness and coherence ▪ transferability ▪ reflexivity ▪ believability ▪ transparency
Ch. 5: Judith Mulholland	A researcher investigates how beginning primary school teachers learn about science and teaching science	The researcher recounts the role of her subjectivity in conducting constructivist research	▪ *Constructivist-interpretative inquiry* (Denzin and Lincoln, 2000) ▪ *Analytic induction* (Erickson, 1986) ▪ *Narrative case study* (Stake, 2000)	▪ participants' voices ▪ reader engagement ▪ researcher growth ▪ reflexivity
Ch. 6: David Lloyd	A practitioner-researcher explores the 'futures images' of his own high school science students	The researcher portrays the role of his subjectivity and relationship with other participants	▪ *Participatory constructivist inquiry* (Guba and Lincoln, 1989)	▪ truthfulness ▪ multiple theoretical perspectives ▪ negotiation of constructs
Ch. 7: Catherine Milne	A researcher conducts a critical inquiry into the cultural capital of school science textbook stories	The researcher illustrates her development of a strategy for transforming the cultural capital of school science textbooks	▪ *Semiotic circle structure of stories* (Scholes, 1981)	▪ multiple data sources ▪ reader engagement: critical awareness, enhanced agency

PETER C. TAYLOR AND JOHN WALLACE

CONTEMPORARY QUALITATIVE RESEARCH FOR SCIENCE AND MATHEMATICS EDUCATORS

Qualitative educational research has evolved dramatically over the last 25 years, from early participant-observation studies painting descriptive portraits of happenings in classrooms to today's multi-perspectival and critical reflexive studies employing literary devices to transform the consciousness of both the researcher and the reader. This exciting evolution has been wrought by pioneering researchers crossing disciplinary borders into otherwise alien territories (the Arts, Humanities, Theology, Quantum Physics, Philosophy) and returning with a rich array of innovative perspectives and methodologies. But along with the excitement of the new, comes serious challenges. Whilst new methodologies address refreshingly new research questions, the basic notion of what constitutes research, indeed 'valid' research, has become complex, confusing, and not a little confronting, particularly for novice researchers in science and mathematics education.

This is readily understandable when we recognise that science and mathematics educators have been deeply enculturated into a Western Modern Science and Mathematics (WMSM) world view[1] during decades of concerted conditioning, first at school and university and later within their professional culture. This immensely powerful world view determines an objective approach to interacting with and making sense of the natural world and, by logical extension, the social world. On first encountering the subjective nature of qualitative research during graduate studies, not surprisingly, many science and mathematics educators experience the radical difference of the qualitative world view as mystifying, sometimes confronting, and occasionally alienating. Notwithstanding deeply meaningful and potentially liberatory encounters with qualitative research during coursework, especially the poignant pedagogical thoughtfulness elicited by reading narrative research accounts, when it comes to designing graduate dissertation/thesis research, many science and mathematics educators feel that qualitative research is not really legitimate.

The problem is threefold. First, the radical difference of qualitative research is rooted in ways of thinking, being, valuing, conversing, and acting that often are counterintuitive to and transgressive of WMSM practices. For example, whereas

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 1–11.

WMSM practice holds that researchers should free themselves from preconceptions – seen as threats to validity – qualitative researchers presume that understanding of events is constructed through the preconceptions we bring to them (Wallace and Louden, 1997). Second, because qualitative research is a rapidly diversifying discipline it is not readily definable, especially at the level of 'validity', and there are many views about how to judge its legitimacy (Mulholland and Wallace, 2003; Scheurich, 1997). Third, the plethora of high-level abstract theorising about qualitative research is not well supplemented by practical exemplars for science and mathematics educators to get their teeth into. What bedevils the adoption by science and mathematics educators of authentic qualitative research is not so much a lack of will to countenance an alternative world view but the lack of compelling practical means for understanding how to do so.

Many science and mathematics educators tend to resolve this problem from within a WMSM perspective by conceptualising qualitative research as simply an exercise in collecting qualitative data to supplement the quantitative measures of survey, correlational or quasi-experimental research designs. Frequently, this 'mixed methods' approach not only ascribes a subordinate role to qualitative data but, more importantly, it fails to allow creative space for hallmark practices of qualitative research, such as emergent design arising from the researcher's progressively developing subjectivity. This is not to decry quantitative research or necessarily deride its subordination of qualitative data, nor is it to deny the desirability of an advanced hybrid research design of mixed quantitative and qualitative practices. We may even wish to use research to highlight the common storied nature of both practices (Wallace and Louden, 2000b). Our main point, however, is that there is a pressing need in science and mathematics education for resources that enable prospective qualitative researchers to develop a deep understanding of qualitative research as an alternative world view with unique quality standards. That is the purpose of this book.

In compiling this book we have drawn on 30 years of collective experience supervising graduate research in science and mathematics education to present a set of qualitative inquiries spanning a diverse range of research purposes, methodologies, and contexts. Because of the inherent sensitivity of qualitative research design to the context in which it is conducted these exemplars are by no means exhaustive. We have selected them to illustrate possibilities afforded by purposeful immersion within a growing field of research that yields much to those who dare to think and act creatively and imaginatively outside the WMSM 'square'. Our own evolving conceptualisation of qualitative research and its affordances, especially the fascinating shifts in ontology, epistemology, and political purpose, owes much to the work of Norman Denzin and Yvonna Lincoln whose evolving *Handbook of Qualitative Research* (1994, 2000, 2005) has provided a wealth of inspiration.

In this book we focus on contemporary forms of qualitative research shaped by constructivist theory, critical theory, literary theory, and postmodern theory.[2] These theoretical perspectives have transformed qualitative research in interesting ways. The traditional interpretative-ethnographic goal of documenting meaning has

been extended by contemporary concerns with representing meaning more meaningfully and with generating meaningful action amongst research participants.

In contemporary qualitative research a post-epistemological perspective[3] has displaced the WMSM metaphor of *knowledge as justified true belief* (von Glasersfeld, 1995; Noddings, 1990) and made available an array of alternative forms of knowledge whose legitimacy is judged in terms of its fruitfulness for achieving diverse research purposes. These include: generating trustworthy and authentic insights into educational processes, improving research participants' professional environments, empowering the researcher to transform his/her own professional practice, and engaging the reader of a research report in a compelling educative experience. A post-epistemological perspective opens creative design space for qualitative researchers to pursue alternative forms of knowledge that, to varying degrees, are partial, contingent, perspectival, dialogical, ambiguous, unfolding, imaginative, dialectical, and contextual in nature, thus providing rich accounts of the complex and dynamic social world that mathematics and science education should be serving. The chapter authors of this book explain how they developed contemporary qualitative research methodologies, including appropriate quality standards, for inquiries based on many of the following alternative knowledge metaphors:

- *personal practical knowledge*, *professional knowledge landscapes*, *practical reasoning* (Clandinin and Connelly, 1995; Connelly and Clandinin, 1985; Fenstermacher, 1994)
- *knowledge as propositions or assertions* (Erickson, 1998)
- *metaphorical knowledge, embodied knowledge, knowledge as myth* (Lakoff and Johnson, 1980; Campbell, 1973)
- *critical reflective thinking, knowledge as praxis*, *knowing as transformation* (Brookfield, 1995; Grundy, 1987; Mezirow, 1991)
- *knowing as philosophising, knowing as fictive imagining* (Bridges, 2003; Clough, 2002)
- *knowledge as conversation* (Kvale, 1996)
- *narrative knowing, realist, impressionistic, and confessional knowing* (Barone, 2001; Bruner, 1986; Van Maanen, 1988)
- *poetic, phronetic, contemplative, and dialogical ways of knowing* (Henderson and Kesson, 2004)
- *knowledge as connoisseurship, knowing as love, holistic knowledge, sacred or spiritual knowledge, wisdom knowledge, integral consciousness* (Eisner, 1991; Palmer, 1993; Smith, 2001; Wilber, 1999)

Contemporary qualitative research recognises that knowledge is constituted in large part by the manner in which it is communicated (e.g., speech, writing, dance, gestures, silence) and that alternative forms of knowledge require appropriate modes of representation. But first a word of warning! Deeply embedded in the interpretative-ethnographic process of representing others are several important issues that are not readily resolvable but need to be addressed by qualitative researchers. There is a political question of whose (social, economic, cultural, political) interests are being served by the way in which representations of others are

rendered and used. There is a hermeneutic question of how to take account of one's habituated interpretative perspective whilst making (inevitably partial) sense of the other's meaning perspective. There is an ethical question of how to generate representations that are fair, beneficial to all, and harmful to none (Wallace and Louden, 2000a). Bearing in mind the potentially fraught nature of the process of knowledge production, especially when it comprises representations of others, qualitative researchers would do well to maintain a heightened state of critical self-awareness and heed Michelle Fine's (1994) advice to 'work the self-other hyphen'. Now back to the issue of appropriate modes of representation.

Arts-based genres (or writing styles) provide engaging literary settings for displaying the lustrous jewels of qualitative researchers' subjective knowledge (Barone, 2001; Barone and Eisner, 1997). The standard academic genre of the WMSM world view, with its objective, dispassionate, third-person, passive voice, has given way to a limitless array of exciting possibilities. Researchers in science and mathematics education are demonstrating their authorial voices in diverse ways: the first-person narrative voice of the storyteller; confessional tales that disclose unanticipated exigencies of fieldwork and authentic shifts in research focus and design (Wallace and Wildy, 2004); impressionistic and fictive tales highlighting lived experience in colourful, dramatic, and sensory tones (Geelan and Taylor, 2001; Taylor, 2002); poetically soulful renditions of teacher–student relationships (Song and Taylor, 2005); fictive plays portraying autobiographical experiences of impoverished pedagogy (Luitel and Taylor, 2005) – to name a few. Arts-based modes of expression provide unique opportunities for contemporary qualitative researchers to portray the process of coming to know in thoughtful, emotional, and spiritual terms, enabling them to express heartfelt moral concerns about the need to transform the sometimes parlous state of science and mathematics education.

This literary turn in contemporary qualitative practices has raised some new and interesting questions about the complex relationship between truthfulness (issues of legitimation) and artistic or aesthetic merit (issues of representation) in research writing (Louden and Wallace, 2001). The new genres also pose a major challenge to the standard WMSM-based dissertation/thesis structure of literature review, methodology, results, and conclusions (Polkinghorne, 1997). Given the emergent nature of qualitative inquiries (including emergent questions, methods, and literature reviewing) and the requirement to make transparent the progressive development of the researcher's subjectivity, dissertations/theses in diachronic and electronic form are beginning to make use of hyperlinking to provide the artful reader with non-linear reading pathways (Stapleton and Taylor, 2004).

Another hallmark of contemporary qualitative research is the emphasis on generating meaningful action for the purpose of transforming professional practice (termed 'research as praxis' by Lather, 1991). For some time, 'fourth generation evaluation' (Guba and Lincoln, 1989) set the pace with its democratic and inclusive problem-posing-and-solving ethos for enabling participants to transform their own communities of practice. This practitioner research is judged more for its practical outcomes and less for its methodological rigour (Schaller and Tobin, 1998), a balance that would be regarded as heretical within a WMSM world view. Recently the spotlight of transformative research has thrown into sharp relief the cultural

embeddedness of the individual practitioner-researcher's professional practice. The researcher's life world has become a major source of experiential data for narrative portrayal and critical self-reflective analysis as life writing, autobiography, and autoethnography harness research as/for professional praxis (Ellis and Bochner, 2000; Pereira, Settelmaier, and Taylor, 2005; Roth, 2005; Taylor and Settelmaier, 2003). Ethical and methodological problems associated with generating credible representations of the researcher's colleagues and subjecting them to critical appraisal can be obviated by use of fictive imagining and philosophical thinking (Bridges, 2003; Clough, 2002; Wallace and Louden, 2000b).

We are heartened to witness some of our graduate students transforming their professional philosophies through critical autoethnographic research, portraying vividly and reflecting critically on their experiences as teachers and students in Third World schools where modern material resources for living and learning are lacking, where sanctions are mandated for not adhering scrupulously to alien instructional languages, and where mathematics and science curricula are irrelevant to most students' daily life worlds – lingering legacies of former colonial rule (Afonso and Taylor, 2003; Luitel and Taylor, 2006). The act of writing as inquiry (Richardson, 2000), of excavating one's deeply sedimented memories, enables cross-cultural researchers to reattribute the cause of tragic educational outcomes to, for example, the disenchanting effect of culturally decontextualised learning. Through writing critical personal narratives qualitative researchers can recover and legitimise their suppressed cultural capital, an important step in the process of becoming a transformative professional educator. To develop one's authority as a producer of cultural knowledge is a step towards decolonising both one's research and one's professional practice (Mutua and Swadener, 2004). Some chapter authors in this book have used autobiographical forms of inquiry to interrogate imaginatively and critically their cultural embeddedness in educational institutions, resulting in deep personal insights and enhanced moral agency for transforming their professional practice.

The term 'contemporary' in the title of the book situates this work within recent developments in qualitative research in science and mathematics education. We have adapted Denzin and Lincoln's (2005) scheme of nine unfolding and overlapping historical 'moments'[4] of qualitative research development (in North America), a scheme that spans the twentieth century and provides a vision of our near future. We have coalesced these nine 'moments' into a three-part structure, with each section reflecting a major shift in the nature and possibilities of qualitative inquiry in science and mathematics education. There is a clearly discernible shift through the book towards more creatively complex experimental methodologies; however, we do not wish to imply a hierarchical development. Qualitative inquiry should be shaped not by a fixation with methodological dilettantism (or by 'methodolatry' – an idolatry of method – as described by Valerie Janesick, 2000), but by pragmatic considerations of purpose, context, and feasibility.

The first section – *Moving From The Golden Age of Research* – deals with fundamental issues likely to confront the novice qualitative researcher at various stages of an inquiry, from research design, to fieldwork, to analysis, to report writing. The theme of this section reflects the concerns of Denzin and Lincoln's

(2005) Blurred Genres moment of qualitative inquiry in which researchers move from postpositivism towards constructivist and arts-based perspectives, become more ethically and politically astute, and strive to represent equitably the voices of those who participate in their inquiries. The six chapters focus on qualitative researchers in varying roles, including practitioner-researcher (Patricia Forster – Chapter 2; David Lloyd – Chapter 6), historian (Robyn White – Chapter 4), participant-observer (Adrienne Gibson – Chapter 3; Judith Mulholland – Chapter 5) and semiotician (Catherine Milne – Chapter 7). These researchers are concerned to varying degrees with establishing quality standards for their empirical representations of the participants in their inquiries, for representing their own subjectivities, and for connecting meaningfully with their readers.

The second section – *Meeting The Research Crises* – exemplifies increasingly artful ways in which the qualitative researcher can represent meaning more meaningfully and generate meaningful action amongst the participants of his research, especially the reader of the research report. The theme of this section reflects the move into the fourth and fifth 'moments' of qualitative inquiry (Crisis of Representation, Postmodern Experimental Ethnographic Writing) where researchers become more reflexively aware, blur the boundaries of fieldwork and writing by adopting writing as a method of inquiry, and conduct research for the purpose of producing context-based practical knowledge. Four chapters (Vaille Dawson – Chapter 8; Bob Fitzpatrick – Chapter 10; Russel Montgomery – Chapter 11; David Geelan – Chapter 13) illustrate how practitioner-researchers use narrative modes of inquiry, including various literary genres, to explore their own professional practices and to represent their inquiries in ways that engage their readers in acts of pedagogical thoughtfulness. In the remaining chapters, qualitative researchers use narrative methods and literary genres (amongst other methods) in the role of cultural researcher (Jill Slay – Chapter 9) and participant observer (John Willison – Chapter 12) to produce distinctly differing forms of educational theory.

The third section – *A New Era of Research* – moves us into the most recent and unfolding 'moments' of Denzin and Lincoln's (2005) scheme of qualitative research (Postexperimental Inquiry, Methodologically Contested Present, The Immediate and Fractured Futures). Since the mid-1990s, contemporary qualitative researchers have been adopting complex experimental modes of inquiry with which to pursue socially transformative agendas despite the conservative political climate of higher education worldwide. Critical theorists and postmodernists alike continue to urge academics to resist the economic rationalist imperatives that press us to optimise our productivity by situating our research entirely within the WMSM worldview. The alternative worldview of contemporary qualitative research provides a powerful means for academics to engage in political praxis within their own institutions for the immediate purpose of decolonising their own professional lifeworlds; and thus contribute to the process of transforming the social and cultural ethos of their institutions. The chapter authors in this section have agendas for social transformation underpinned, to varying degrees, by an ethical urge to create professional practices that are culturally and socially inclusive. They strive to generate new ethics and epistemologies for the professional practices of both themselves and their colleagues, including health care workers (Georgina Hawley –

Chapter 14), mathematics teachers (Kwena Masha and Bal Chandra Luitel – Chapters 15 and 19), science teachers (Elisabeth Settelmaier – Chapter 16), school leaders and educational researchers (Les Pereira – Chapter 17), and engineering teachers (Tanya Vernon – Chapter 18). A hallmark of these contemporary forms of qualitative inquiry is the important role played by higher-level thinking processes such as autobiographical excavation of the researcher's life world, fictive imagining, moral contemplation, critical analysis of one's methods of inquiry, and envisioning future possibilities for a brighter world.

NOTES

[1] The Western Modern Science and Mathematics (WMSM) world view comprises the interlocking world views of Western Modern Science (WMS) and Western Modern Mathematics (WMM). The strong form of the WMS world view (labelled as 'scientism' by Huston Smith, 2001) comprises an ontology of *naive realism* purporting an external reality that is fully apprehendable by means of: a dualist (mind/body, subject/object) rationality employing a logic which abhors contradiction; a positivist epistemology of research practice involving quantitative experimental design seeking generalisable natural laws; a disinterested researcher posture; a fixation with materialism and indifference to metaphysics, especially spirituality; research quality standards of objectivity, reliability, and validity (Guba and Lincoln, 2005); a discourse couched in Standard Average European languages (Kawasaki, in press); and production of propositional knowledge independent of culture. A weaker form of the WMS world view comprises a *critical realist* ontology that recognises the impossibility of fully apprehending reality, settling for closer and closer approximations; and a postpositivist epistemology of research practice validated in terms of the concept of triangulation. The Western Modern Mathematics (WMM) world view comprises an ontology of either *Platonism*, in which number and shape exist in pure form and are accessible only through the disciplined rational mind, or *Formalism*, in which mathematics is nothing other than the mechanical manipulation of symbols using formal logic. In both cases, mathematics is regarded as having secure foundations and as being transcendent of human experience, and thus of culture (Lakoff and Nunez, 2000). The WMSM world view is being criticised by educational researchers for accelerating the globalisation of Western cultural knowledge, particularly via the West's education export industry, resulting in displacement of local knowledge systems and the diminishing of cultural diversity (Taylor, 2006; Luitel and Taylor, 2006).

[2] Postmodernism is understood generally as an important countervailing standpoint that reminds us to contest the authority of 'grand narratives', especially those produced by the WMSM world view, to challenge with enduring scepticism the implied certainty of its universal knowledge claims (Lyotard, 1993). However, critics of the strong form of postmodernism argue that its deconstructive imperative leads to dystopic visions and nihilism. Moving beyond postmodernism

(into post-postmodernism or a critical self-aware modernism?) we are witnessing the emergence of hybrid world views that seek unity in diversity by integrating premodern, modern, and postmodern world views in search of higher levels of consciousness (see especially: Ken Wilber, 1999; and Huston Smith, 1989).

[3] Epistemology is a classical branch of philosophy concerned with the age-old problem of establishing foundational grounds for claims to justified true belief. The postepistemological standpoint of von Glasersfeld's radical constructivism (1995), which is consistent with Rorty's (1982) pragmatism and Lakoff and Johnson's (1980) experientialism, rejects the correspondence theory of truth (i.e., empirical knowledge can serve as a mirror of Nature) and argues that our conceptual knowledge can be judged only in terms of its viability or fit with personal experience and its consensual fit with social convention. Thus, we cannot peek around our conceptual systems to see Nature 'as it really is'; we are forever captives of our conceptual systems no matter what their development. Of course this argument does not apply to faith based knowledge which claims to reveal God, absolute truth (or Truth), the Oneness of the Universe, etc.

[4] Denzin and Lincoln's (2005) scheme of nine 'moments' of qualitative research.

1. *Traditional Period* (1900–1950) – in which the heroic, lone field-worker romanticises his subject in accordance with social realism, positivism, and objectivism.
2. *Modernist Phase* (or Golden Age of the Social Sciences) (1950–1970) – researchers as cultural romantics with emancipatory ideals valorise tragic subjects and critique social structures using the language of positivism and postpositivism.
3. *Blurred Genres* (1970–1986) – naturalism, postpositivism and constructivism prevail, qualitative researchers become sensitive to the politics and ethics of their work, stop privileging their own interpretative voices, and produce multi-perspectival 'thick descriptions' using Arts-based based genres.
4. *Crisis of Representation* (1986–1990) – research and writing become more reflexively aware, a new politics of textuality contests the authority of the empirical sciences to represent the world of lived experience, fieldwork and writing blur, writing as a method of inquiry emerges.
5. *Postmodern Experimental Ethnographic Writing* (1990–1995) – researchers responding to the ongoing triple crises of representation, legitimation, and praxis experiment with different ways of representing the 'other'; a major focus on participatory research and generating theory from small-scale problem-solving research in local contexts.
6. *Postexperimental Inquiry* (1995–2000) – researchers focus on novel ways of portraying and politicising lived experience via fictional ethnographies, ethnographic poetry, multimedia texts, visual form, and co-constructed, multi-voiced representations, etc.

7. *Methodologically Contested Present* (2000–2004) – a time of debate and struggle born of massive deregulation within qualitative research and of political contestation with conservative regimes (that make claims regarding Truth) over what counts as 'valid' research.
8. *The Immediate Future* (2005–) – social science emphasises a social justice purpose, the rise of indigenous social science(s); decolonisation of the academy via graduate research and culturally diverse faculty; social scientists transforming their own institutions via 'liberation methodology'.
9. *The Fractured Future* – academic work as political praxis; generation of new ethics, aesthetics, and teleologies for a globalised world.

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PATRICIA FORSTER

WORKING WITH CRITICAL FEEDBACK TO IMPROVE RESEARCH WRITING

INTRODUCTION

Is it that you come to know how to write, or is it that the writer, writing and knowing emerge together? I can say that since starting on research my writing has developed in style and, as a process of inquiry (Richardson, 1998), writing helps me work out what to say. The process includes reflection and searching for language to define the situations under interrogation. So, through writing, I have come to understand my teaching and my existence in this world in new ways. However, I still do not find the act of writing easy. I rely on the advice of others to help me revise my drafts. A friend who reads my work gets so irritated by my frequent use of participles and by commas that she says I scatter like confetti. So after I complete a paper, I do an electronic search on 'ing' and ',' to rectify the problems. Other advice I have been given is to write in the present tense for crispness and impact, and to aim for consistency in the position of references within a paragraph – so that they are all at the beginning of a sentence, such as "van Manen (1990) said…", or all at the end. This makes for smoother reading.

Besides these details, there are bigger structural issues, and these are the principal topic of this chapter. Mainly they concern depth of analysis or going beyond mere description, and the linkage of various parts of a paper to each other. I gained insight into what was involved when Peter Taylor, my research supervisor, gave me an early draft of one of his research papers. Later, I read the final version. Comparison of the two versions allowed me to see the process of elaborating the description – through the addition of new insights and alternative interpretations, and the insertion of apposite references to the literature. Therefore, my approach below is to provide two versions of my analysis of an excerpt of classroom conversation for you to compare. The first version is taken from a paper that I submitted to a journal and the second version was in the paper that was resubmitted after revisions (Forster and Taylor, 2004). There were several iterations in between, and these were informed by the recommendations of a journal reviewer and by critique from Peter.

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 15–22.

I am willing to put my early analysis on display and point to the revisions so that others who are beginning research might have a shorter journey to achieving a tolerable research text than I did. To provide further background on the style of my analysis, I finish by discussing the hermeneutic-phenomenological methodology (van Manen, 1990) which underpinned my writing.

THE WRITING JOURNEY

Background to the Excerpt of Classroom Conversation

The excerpt of conversation comes from my third lesson with a Year 11 Geometry and Trigonometry class. It was fourth term of a four-term school year in a private college for day and boarding girls. I had returned to the college after a period of study leave to take the classes of a colleague going on leave. The students were studying vectors. I knew most of the students from having taught them in junior high school, although prior to taking the class, I did not know Sonya, the main character in the episode. For the term's teaching, I adopted the goal of 'inclusiveness', alongside a problem-centred approach to instruction (Wheatley, 1993). I also critically monitored the outcomes where my purposes were to improve my teaching and to document the evolving classroom practice as part of a formal research study.

Viewing a video recording of my *first* lesson with the class revealed that my actions towards Sonya (or lack of them) were entirely inconsistent with my intended inclusiveness. She did not contribute to whole classwork, I did not ask her to contribute and I did not talk to her one-to-one. Consequently, at the beginning of the *second* lesson I asked her to come forward and demonstrate to the class how to locate a point in three-dimensional space. She did so competently. Later, I checked her work and, near the end of the lesson, she offered an answer during whole classwork. Yet, that night I recorded in my journal: 'I couldn't seem to get through to them today [Sonya and Debbie who sat next to her]. Their body language was negative. Particularly Sonya.' (Journal, 14 October).

The excerpt below is taken from the beginning of the *third* lesson. Some sentences are numbered as I refer to them later in describing the revisions. The issue being explored is how inclusive the curriculum was – with regard to interpersonal relations and accessibility of the mathematics task.

The Excerpt and Early Analysis: Pleasing the Teacher (16 October)

We started by revising the vector form of a circle, then, as an application of the concept, I distributed a problem (Figure 1) set in the context of 'Stealth Station' technology at a local hospital. A copy of a newspaper article on use of the technology for detecting brain tumours (*West Australian*, 6 October 1998) accompanied the problem.

Detecting a Tumour: The Stealth Station Platform

To understand the basis of the technology, work through the following problem which is a 2-D simplification of pinpointing a tumour in 3-D space. It is known that a tumour is located somewhere within the circle. Transmitters at A and B emit waves pulses travelling at 299, 000 km per second, where the pulses radiate out from the centre of each transmitter. The times between emission, and receiving back the pulses reflected from the tumour are 1.6019 x 10^{-10} seconds (for A) and 2.0940 x 10^{-10} seconds (for B).

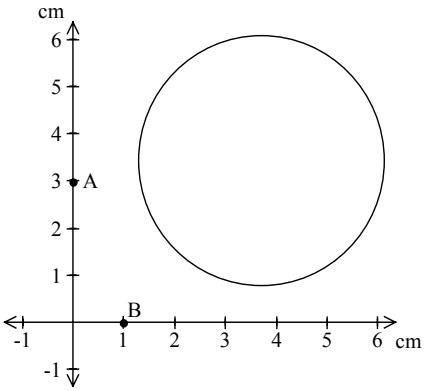

Figure 1. The 'Stealth Station' Problem.

The class quickly became absorbed in reading the newspaper article and then started to work on the problem. I moved among the students and, quite soon, I reached Sonya and the student she sat with, Debbie. I noticed that although students generally put their books on the floor, Sonya's were stacked on the desk. (1) I took this as demonstrating unwillingness to be in class. (2) However, 'Sonya and her friend Debbie seemed to provide moral support for each other. Their code of solidarity is typical of boarders who to some extent keep aloof from daygirls, although this barrier often breaks down by Year 11. Demarcation can negatively impact on learning if the boarders, in their minority, feel alienated from the rest of the class. Perhaps this is what Sonya and Debbie feel.' (Journal, 16 October). Pointing to the diagram on Sonya's worksheet I asked her:

Me: So, what's going on here?

Sonya: Well the rays come from here [pointing to point A].

Me: Yes.

Sonya: And from over here [pointing to B]?

Me: Yes.

Sonya: And this is his head [pointing to the circle on the graph]?

Me: Well, it's the circle the brain tumour is in. It's a piece of his head. So somewhere in there you have got a tumour.

Sonya: So this is the time [pointing to the information in the question] and the wave is moving at this speed up here?

Me: Yes, that's right. So see if you can work it out from there.

(3) 'Some students have a formidable faculty for guessing what the teacher is getting at and an elegant way of appropriating his or her thoughts. That does not mean however that any learning is going on' (cited in AlrØ and Skovsmose, 1998, p. 45). However, maybe Sonya's question, 'And this is his head?' indicated that the abstractness of the diagram was a barrier (Roth and Tobin, 2001) to her making progress with the question.

Advice on the Text

Recommendations that I received from the reviewer, relevant to this excerpt and others, were to choose and clearly define some categories for analysis, to advance the analysis from being mainly descriptive and to include wider theoretical validation. (He/she also complimented some aspects of the piece!) The categories (sites of inclusiveness) that I chose were 'teacher-student interaction', 'student-student interaction', 'the nature of the mathematics tasks' – including level of difficulty and the relevance to students of contexts used, and 'students' responses to the tasks'.

In assisting me with the revisions, Peter advised me not to leave non-interpreted data, for example, the journal entry about the code of solidarity (see 2 above). If data had significance within the inquiry, then I should state explicitly what it was. Other recommendations were to link all lines of analysis with preceding or following text, not to leave literature to speak for itself (see 3), and to clearly identify the temporality of my comments. For example, *when* did I take the books stacked on the desk to demonstrate reluctance to be in class (see 1).

Identification of the timing of my 'coming to know' was crucial to an underlying theme of the paper, which was the value of undertaking analysis of one's own teaching, near the time of it, but more-so in retrospect (i.e., looking back after a period of time). It was important to the argument that my initial spontaneous responses to classroom events were distinguishable from my later understandings of them. I had developed a scheme that allowed identification of the chronological order of my evolving conceptions and this was to include:

- *journal entries,* which represented my impressions and reflections *during the term* on classroom activities;
- *written feedback* from students, which represented their responses to the in-class mathematics problem – solving, *close in time to it,* and which led me to view my teaching in new ways and to modify it (as recorded in the journal);
- *interpretation informed by the literature,* which in the main was enacted as part of a retrospective inquiry, *after the teaching term had finished*.

The first and third of these elements are evident in the version above, but Peter's recommendation was aimed at making the timing more explicit. Also as part of the revisions I created a fourth category:

- *narrative commentary*, which weaves together the transcribed excerpts of classroom conversation. It is indented below. Previously it was not distinguished (in regard to the visual appearance of the text) from the interpretation.

The Final Version

Following Figure 1:

> The class became absorbed in reading the newspaper article and after a while I said 'It is one application that actually might be relevant in the future if you are thinking of becoming doctors or dentists. Technology is being used more and more often in medicine these days'. I suggested to the class that they might like to talk to their neighbours to sort out a method. Gradually students started to write on the handout and some talked with each other, and I moved amongst them. Quite quickly, I reached Sonya and the student she sat with, Debbie, and I noticed that although students generally put their books on the floor, Sonya's were stacked on the desk, leaving little space in which to work.

(4) That evening, I recorded in my journal: 'Students use a lot of signals like this to tell the world that they don't want to be there' (Journal, 16 October). (5) So, together with my not having 'got through' to Sonya and Debbie the previous lesson, the evidence is that I was gaining the impression that something was awry in the classroom for Sonya, but I didn't know what the cause was yet. (6) In situ, it was a matter of only fleetingly observing the situation with the books and then asking the two students:

> Me: What do you think? Have you got any ideas?

Sonya responded with describing the question set-up as stated in the question. Then, pointing to the diagram on her worksheet I asked her:

> Me: So, what's going on here?
>
> Sonya: Well the rays come from here [pointing to point A].
>
> Me: Yes.
>
> Sonya: And from over here [pointing to B]?
>
> Me: Yes.
>
> Sonya: And this is his head [pointing to the circle on the graph]?
>
> Me: Well, it's the circle the brain tumour is in. It's a piece of his head. So somewhere in there you have got a tumour.
>
> Sonya: So this is the time [pointing to the information in the question] and the wave is moving at this speed up here?
>
> Me: Yes, that's right. So see if you can work it out from there.

(7) I notice now, in interpreting the action, that it was Sonya and not Debbie who answered me – even though I knew Debbie slightly from before, and in spite of what I had assumed was Sonya's greater reluctance to be in class. (8) Further, while transcribing the video recording of the lesson in the evening after it, I wrote in my journal that Sonya 'described the question, pleasantly enough' (Journal, 16 October). As well, the text of the transcript shows that Sonya was open to discussing the mathematics with me, to the extent that she identified the features needed to start a solution. Thus, apparently she had a more positive attitude than I had assumed.

(9) But, in fact, after this lesson and the next one had unfolded, I returned to this conversation and asked if Sonya had 'played the game of being engaged until I moved away' (Journal, 19 October). (10) In other words, I asked myself if it was a case of a student coping with a classroom situation by 'pleasing the teacher superficially' (Voigt, 1994, p. 177). That I *was* pleased or satisfied with Sonya's responses in the conversation is indicated by my closing the conversation sequence, but a central issue is whether she was motivated to 'work it out from there', or was ambivalent about it. There are a number of intersecting factors relevant to the situation and these emerge below.

(11) First is the possible interest/apathy engendered by the context of the question. I learnt the next week that the context did not appeal to Debbie: 'I didn't like it because the topic just doesn't interest me' (Written feedback, 20 October), which possibly explains why Debbie did not answer me when I approached them. However, Sonya did not write negatively about the context, and, in conversation with her near the middle of term, she mentioned that her father had a GPS (Global Positioning System) on his harvester (for detecting the ripest part of the crop). This was mentioned in the newspaper article as the technology that the Stealth Station System was modelled on, so her personal experience of a related context may have contributed to her wanting to work out the problem. (12) But the notion of personal relevance in regard to classroom problem solving is complex (Nyabanyaba, 1999), so it is simplistic to infer effect or motivation on the basis of only one characteristic of a problem.

(13) Second is the level of difficulty of the problem, which was brought into sharp relief for me as I interacted with students in class. The text of the transcript shows that one impasse for Sonya was interpretation of the diagram, in particular, what the circle represented ('And this is his head?'). (14) Other sources of difficulty for her and the class are identified below.

(15) Challenge or difficulty can be a deterrent to students' attempting a problem but, as I read after the term had finished, for others it sustains their interest (Lucock, cited in Middleton and Spanias, 1999). However, the situation in this lesson was that I gave a problem to the class, which I expected students would be able to do, and I was not concerned with what students' differential responses might be. So, I assumed that everyone would go about working the problem out. I will mention also that reading the literature sometimes brought to mind what I already implicitly knew, as was the case here. In other instances I encountered new ideas.

The Revisions

The two versions are remarkably different, but one aspect of the revisions was reorganisation of the paper, which included introducing the Voigt (1994) reference about 'pleasing the teacher' (see 10). Originally, I included the reference in the description of a later part of the episode. This applies also to Debbie's response to the 'Stealth' context (see 11).

In regard to responding to the feedback from the reviewer and Peter, the category 'student-teacher interaction' gave rise to the paragraphs starting at (7) and (9). The 'nature of the task' and 'students' responses to the task' are discussed in the paragraphs starting at (11) and (13). In fact, I found a key to advancing the analysis was systematic interrogation of each line of classroom conversation in terms of the categories. This approach meant also that the analysis was tightly focused on the conversation and, so, less fragmented. Data relevant to the interaction were introduced (e.g., 4, 8, 9), while data of peripheral relevance were deleted (see 2).

Wider theoretical validation comprised describing more extensively the epistemology of my inquiry in terms of theory (see next section) and including more references to the literature throughout the analysis, where these mainly related to student motivation and interest (see 15). The reviewer suggested that I extend my inquiry in that direction and this significantly enriched the piece. Also, instead of leaving the literature to speak for itself (e.g., 3), I used it sometimes to support my perceptions of the action (see 10) and, at other times, to bring my perceptions into question (see 12 and 15).

In regard to the temporal status of my thinking, 'that evening' (4), 'in situ' (6), and 'I notice now' (7), etc., made the changes in my thinking over time more apparent. Links to previous parts of the paper (e.g., 'So, not having got through to Sonya the previous lesson', see 5) and forward to later parts of the paper (e.g., 'after this lesson and the next one had unfolded', see 6) were included.

Now, having discussed the technical aspects of the revisions, I proceed in the conclusion to outline the role theory played in the analysis, and other related aspects of the research-writing process. But first, in case you were wondering, the end of the classroom story was that Sonya and Debbie made no more than a token effort with the Stealth problem. For Sonya, evidence is that the difficulty of the problem was a barrier to her engaging with the mathematics of it, which again, for her, constituted a non-inclusive curriculum, rather than the inclusiveness that I intended.

CONCLUSION

In conducting the research into my teaching, I turned initially for guidance to van Manen's (1990) hermeneutic-phenomenology, which is essentially a writing methodology for investigating lived experience. Phenomenological understanding, as such, is existential and non-reflective; it relates to impressions of how phenomena are experienced. My journal entries made daily during the term provided evidence of such impressions. Hermeneutics is interpretation of the text of a situation (or experience), where text can be spoken or written; and can be taken to include

gesture and other actions (Ricoeur, 1991). Sources of text that I relied on were my journal, video recordings of classroom conversation that I transcribed, and students' written feedback on the mathematics problem solving.

The research process involved moving back and forth between writing and interpretation of the collected data. The method included reviewing the video recordings, rethinking events, and modifying the analysis, which is to be expected (van Manen, 1990). The call for revisions by the journal reviewer caused me to repeat these activities. Besides the changes described above, I established the epistemology of my inquiry by (a) elaborating how the assumptions of hermeneutic phenomenology related to it and (b) questioning what it was in my experience that led me to perceive the classroom events in the ways I described. Questioning which returns to lived experience is in accordance with a phenomenological orientation (van Manen, 1990; Young, 1992). The issue is not to establish the 'truth' of an analysis but to embrace ambiguity and complexity (van Manen, 1990).

Overall this was a process through which my understanding of theory and method evolved as I applied them. Writing 'places consciousness in the position of the possibility of confronting itself, in a self-reflective relation' (van Manen, 1990, p. 129). In the confrontation there is redefinition and so I came to deeper understandings of the teaching and became more discerning of the meaning of it.

In conclusion, starting to move away from objective reporting and towards being able to write richer research text was one of the rewarding outcomes of my study. I valued the critique and explicit advice that I was given in that regard, including the instances which was subject to discussion above.

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ADRIENNE T. GIBSON

UNDERSTANDING TEACHER UNDERSTANDING: AN ETHICAL CHALLENGE

INTRODUCTION

As I entered the classroom for the first day of my research, I was eager for the opportunity to observe and dialogue with science teachers about the many issues surrounding student assessment. I looked forward to rich discussions and an increase in understanding, on my part, of what teachers were thinking about the assessment of student achievement. My research was to be descriptive and exploratory. In the beginning I did not have a clear idea of where my exploration into teachers' thoughts would lead. I knew, however, I was entering a situation replete with ethical challenges. I did not realise that ten minutes into the observation, I would be uncomfortable with what I saw and so encounter my first ethical decision.

The constant need to explore ethical issues would underlie many decisions that I made over the next several months. In the first section of this chapter I describe the particular circumstances that resulted in my struggles with ethical issues from the moment I initiated the data collection phase of my research until I completed writing the final draft of my dissertation. I then discuss three specific ethical issues I encountered as I conducted my research and the manner in which I resolved them.

RESEARCH BACKGROUND

When I began my research, very different factors appeared to influence science teachers as they made decisions regarding the assessment of student achievement. There was strong national, state, and local pressure on teachers to increase the standardised test scores of their students. National, state, and local standardised tests were mandated within the district that was the location of my study as well as within many districts across the nation. These tests consisted primarily of multiple-choice, true/false, and matching questions. They generally assessed student achievement at the lower and middle levels of Bloom's Taxonomy of Critical Thinking Skills

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 23–32.

(Bloom, 1971). At the same time, strategies suggested by advocates of teaching for understanding, constructivist learning theory and the National Science Education Standards (NSES) encouraged teachers to assess higher level thinking skills and major conceptual themes rather than factual information (National Research Council, 1996). In addition, NSES, which had been used in the development of the science curriculum of the district where I did my research, provided guidelines for instructional and assessment practices. These guidelines discourage the use of multiple-choice tests as effective assessment tools. The need for teachers to balance these competing demands while trying to teach for understanding set the context for my research. I was interested in how teachers developed their own understanding of student achievement and why they used the assessment strategies that they did.

Initially I believed that the ethical dilemmas I confronted were primarily self-imposed by the location of my research and the teacher-participants with whom I chose to work. I had worked for more than 25 years in a small, but rapidly growing district. While our district administration had provided support for the development of a district-wide science programme based on the NSES, there was also a great deal of concern that our students achieve and maintain high scores on national and state standardised tests. I had made the choice to do my research in my own school district in spite of the potential pitfalls of working with friends and colleagues during that process. In addition to the personal relationships that I enjoyed with many of the district teachers, my situation was further complicated by the fact that I was asked to assume an administrative position just prior to my beginning to collect data. I would be moving into a position involving teacher evaluation and staff development at the same time as I was asking teachers to allow me into their classrooms for extended periods. While I was not familiar with the teacher-participant whose classroom I first entered, I counted two friends among the other teachers who would be working with me. My hope was that the relationship that I had built with my colleagues would produce more thoughtful and honest conversations than might have been generated among strangers. I counted on a personal quality of ‘connoisseurship’ (Eisner, 1991), accrued through my growth in the field of science education, to balance the difficulties that might occur as I continued my data collection and analysis.

ETHICAL CHALLENGES

In a discussion of some of the methodological issues related to strictly observational research, Adler and Adler (1994) point out that observers are likely to employ all their faculties in data gathering and are likely to draw on their broad cultural or commonsense knowledge. This use of commonsense knowledge is similar to Eisner’s concept of connoisseurship or the ability to make fine-grained discriminations among complex and subtle qualities (Eisner, 1991). It was Eisner’s explanation of connoisseurship and my recognition of that quality within myself that allowed me to make the decision to conduct my data collection in my own home district and with colleagues and friends. I relied heavily on my accumulated commonsense knowledge of teaching, the teacher-participants, the school district, and the community as a whole. I thought that this knowledge would enable me to

identify and focus on the observations that provided information important to the question and insight into the reasons behind teacher decisions about instruction and assessment practices. In several instances that knowledge and experience helped me find ways to resolve what might otherwise have been uncomfortable situations for the teacher-participants and for myself. Daily contact with the teacher-participants allowed me to meet with them on a casual basis and to be available for discussions of issues outside the realm of my research.

Tobin (1992) describes circumstances in which an ethical dilemma might occur as one in which a "researcher encounters a situation in which he or she is not sure how to act to protect and promote the interests of all participants in the study" (p. 113). The ethical dilemmas I faced during my research were centred on three specific types of situations. The first was the need to balance my desire to retain the personal relationship I had with the teacher-participants and my need to maintain a sense of fairness and validity in the data collection and analysis process. A second dilemma, one I was unable to resolve completely, concerned my original intent to provide anonymity for the teacher-participants. Pseudonyms for participants and the district as a whole might serve to disguise the participants from identification by readers of my study outside the district. However, any district employee would find such devices relatively transparent if they were to read the product. The third dilemma I faced was one that I had not anticipated when I began the research. I had expected some disagreement with the district mandate and discussion of alternative methods of assessing student achievement. However, during early conversations with the teacher-participants, I became very aware of the degree of conflict between what the teacher-participants were telling me they believed and the mandates they were given by the district that employed them. I was very concerned that I express their thoughts in a way that would not only serve my own study but also initiate constructive dialogue between all district stakeholders in the mandated assessment processes. At the same time I would need to be careful not to place the teacher-participants in a position that would compromise their reputations in the district. My challenge, as Tobin (1992) described it, was to protect the participants in my research while promoting my own interest in pursuing my research question. The following examples illustrate the ethical dilemmas that I was confronted with and resolutions I was able to achieve.

RESOLVING DILEMMAS

Qualitative researchers are guests in the private spaces of the subjects of their research. Stake (2000) cautions that their manners should be good and their ethics strict as the value of the best research is not likely to outweigh injury to a person exposed. In order to reduce risks to participants, it is suggested that issues of observation and reporting should be discussed in advance. This seemed to be good advice at the time as I had initial open discussions with the teacher-participants. However it was not possible to anticipate all that would be observed nor which observations might be appropriate for reporting. Shortly after I entered the classroom on that first day I witnessed a situation that would help me set criteria for future decisions as to which data I would report in the writing of my research.

A Dilemma of Personal Relationships

The teacher (Teacher A) being observed was new to the profession and had not clearly established her classroom rules. In order to get the attention of her very energetic and excited fifth grade students she 'thanked' over half of them for sitting down, getting their books out and being quiet. No sooner did she thank an individual than that student proceeded to turn to his or her neighbour and strike up another conversation. It was several minutes before the class had settled down enough for the teacher to begin the science lesson. As I was scripting the words and actions of teacher and students I knew that I would ignore the many 'thank yous' in the final writing of the data. They really had nothing to do with the purpose of my study. However, could I ignore them as an experienced teacher observing a new teacher? One of my commitments to the teacher-participants had been to provide them with support in developing effective science lessons and an opportunity to reflect on their own thoughts regarding instruction and assessment. I was concerned about intruding uninvited into Teacher A's reflections on the effectiveness of her classroom management practices. If this teacher felt that I would be evaluating her teaching ability she might not welcome me to her classroom. I chose to delay addressing the difficulty she was having until an appropriate opportunity presented itself.

That opportunity came a few days later. In a follow-up conversation after my observation I asked Teacher A if she had taught her students her expectations when they heard her 'thank' someone for being ready to learn. We talked only briefly about how that might be done and went on to the subject of my research. However, it was clear the next time I entered her classroom that things were different. While I was very pleased to see the progression of skill that this new teacher showed as the year went on, it was not the focus of my research. The opening of the case study story was very indicative of her classroom demeanour for the rest of the year.

> Teacher A's class was excited and noisy when they entered the room after their lunch break. Typical high-spirited fifth graders, they were especially enthusiastic today because they were about to start a unit on airplanes. They were looking forward to the final activity in this unit, which would be a model airplane-flying contest. It was a few minutes before they started to settle down and Teacher A was able to get their attention. 'Thank you, Riley for sitting so quietly,' she said to one student, to another, 'I appreciate the way you are waiting for me to start. I see you have your notebook out and you are ready to learn.' Gradually the students began to get their materials out of their desks and Teacher A started the lesson. (Gibson, 2001)

I had entered this teacher's world to gain understanding of how she assessed student achievement. I was happy to share a little knowledge gained from my own experience in return. In addition I had established personal guidelines for dealing with such situations during future observations. In all of the case studies I needed to make decisions as to what to report and what to leave out. Clandinin and Connelly (1994) caution that as personal experience researchers we owe our care and our responsibility to the participants and how our research text shapes their lives. The reporting of an ineffective action on the part of a teacher by way of illustrating a point to be made in my study would not only jeopardise the relationship that I had

established with the teacher participants. It would also be a betrayal of their trust and a breach of ethics on my part.

Another example of an observation that I chose not to report was one that involved a series of activities more closely related to the focus of my study. One lesson I observed was scheduled to last approximately two hours and the teacher had planned ten different activities related to the subject. Students were to rotate through the activities every ten minutes and record their observations during each ten-minute period. Teacher B had not attempted any of the activities himself prior to the lesson and, as might have been expected, things did not go as planned. The students had not been taught to rotate through activities. They did not allow time to record any observations of the activities but simply played with the equipment. They generally did not understand the relevance of what they were doing to the objective of the lesson and, in many cases, the equipment provided did not work. My observation showed that there was little student interaction related to the lesson, no group discussion, and follow-up journal writing consisted of a few drawings but little indication of even knowledge level learning.

While I saw great potential for student understanding of the lesson objective in the activities that were chosen, I felt the implementation of the lesson was ineffective in terms of learning achieved. I knew that Teacher B had been particularly eager for me to observe this lesson because of the activities that he had planned and I was very uncomfortable with the situation. I was not sure if I should even broach the subject of my concern directly with the teacher afterwards. However, when reflecting on the lesson in his journal, the teacher wrote, 'I'm not sure if my students learned anything today.' We talked about the journal entry several days later and I asked the teacher if he would have done the same lesson again? His reply was 'No', that children need to do things to learn but they also need to talk about the learning. He would know what they had learned from listening to the discussion. I was much relieved that I did not have to struggle with the question of how I might tactfully make suggestions to this teacher about his strategies. The process of journalling had been the only tool Teacher B needed to reflect on his practice and decide on changes that might be made. His journal entry was included in the narrative on his reflections. The lesson was not included in the teacher chapter but served as 'food for thought' when I discussed some of the challenges faced by science teachers when teaching for understanding.

I was not always successful in resolving ethical dilemmas. The incident with Teacher A was not related to my research focus and I could have ignored it completely without affecting anything that I wrote. I felt that a hint from an experienced teacher would help her become more skilful in classroom management techniques without seeming critical of her abilities. Teacher B raised the question about the effectiveness of his multiple-activity lesson in his own journal. The discussion we had of his journal entry led naturally to the generation of ideas on how to make adjustments in his lesson. It also gave me insight into the dilemmas faced by elementary teachers as they planned for science instruction. My observation of a simple strategy for assessment used by Teacher C created a situation that I, in the end, chose not to discuss in detail with her. Typically this teacher opened

and/or closed a lesson with a series of questions such as those described in her case study story.

> "Michael, can you name three types of storms?"
>
> Michael answered with "a thunderstorm and..."
>
> Teacher C quickly added, "a hurricane and a tornado. Good Michael!" Then, to another student, "Tell me the cause of a thunderstorm."
>
> The student responded with "ions".
>
> Again Teacher C helped him with his answer. "They are caused by positive and negative ions. And what does that cause?"

When the next student answered with the word 'electricity', Teacher C expanded on that by explaining that the electrical discharge caused lightning and continued with an additional explanation that thunder was caused by air expanding. She continued with a few more questions and then ended with 'Good job, I am surprised that you remembered all of that.'

The case study story does not indicate the many times, during these questioning sessions, that Teacher C accepted group responses. Nor does it reflect her habit of answering her own questions, if the students did not respond. I read her the script of one particular set of questions during a follow-up conversation and asked her if she felt the students understood the underlying concepts of the lesson. She was proud of her questioning skills and, although her questions were mainly at the knowledge level (Bloom, 1971), she was certain that her students understood and would be able to apply what they had learned. Since my interest was in how teachers gain an understanding of what their students are learning, I decided to pursue this topic again after another observation. However, Teacher C was a bit cautious and seemed uncomfortable discussing her questioning strategies with me, so I chose not to continue. I used what I had observed to gain understanding of the dilemmas that teachers were facing in assessing student achievement but chose not to jeopardise my relationship with this teacher and possibly lose her cooperation in my research because of continued prodding on this subject. My research concern did not require that I address this instructional practice in any further detail.

The Dilemma of Maintaining Anonymity

The three previous examples related to ethical concerns involving my personal relationships with the teacher-participants as well as the need to protect their privacy. When I began to report on the data I had collected, I was confronted with the reality that anonymity or, in the case of these teachers, the virtual impossibility of it, would become an important factor to address as I discussed the results of my endeavours.

The use of pseudonyms and other ways of 'fictionalising' research texts are often standard procedures for addressing issues of anonymity and visibility. Guba and Lincoln (1989) advocate a contract between researcher and client that protects

both the client from misrepresentation and the evaluator from client misunderstanding or false expectation. Such a contract should include a statement regarding the evaluator's intent to guarantee confidentiality and anonymity. The evaluator needs to make sure that these issues will be given high priority.

Prior to beginning my research, participating teachers signed a release form allowing me to use the data I collected and giving them the right to remove themselves from the project if they chose. They were told that I would be using pseudonyms in the final report in an attempt to disguise their identity. I would also change the name of the school district. We discussed the fact that, in spite of my efforts to maintain some anonymity for them, it would not be possible to guarantee a high degree of confidentiality about the identity of the participants or the information gathered in my research. While each teacher is discussed in the final report using a pseudonym and the district name has been changed, a belief that anonymity has been achieved would be founded on a very meagre hope.

The teacher-participants were very open about my working with them in their classrooms and we all shared ideas in a discussion about the NSES (NRC, 1996) along with several other colleagues. The assistant superintendent supported my research by offering a small stipend to each teacher-participant for the time they would be working with me. Our district is a small one and, were the district to be correctly identified, the teachers would be easy to locate by a very simple description of their roles. If someone should have a specific interest in discovering who the teacher-participants were, it would be an easy mystery to solve. In fact, in a few cases the teachers themselves shared the review copy of their own case study with co-workers. Although anonymity was discussed with each teacher prior to the beginning of this research, it was not considered a priority in what we were trying to accomplish.

My decision to write this chapter presented its own ethical dilemma because I have used examples of observations that I chose to ignore in the process of writing the results of my original study. I did not include them in the final writing both because they were somewhat tangential to the focus of my study and because I thought they would make the teacher-participants uncomfortable if they read them. The examples used in this chapter were not necessary to my study as I had many other examples to use. In order to provide a higher degree of anonymity in this chapter I have changed the pseudonyms used for the teachers in my original study to the letters A through C. This provides at least one more layer of disguise (albeit penetrable) to protect the privacy of the teachers involved.

The Dilemma of Representing Teacher Beliefs

Guba and Lincoln (1989) explain that at the outset of a qualitative study the researcher knows what the problem is but he does not know what will be discovered, what to concentrate on, and what the final analysis will be like. That certainly described my position as I began the process of analysis of my data classroom observations, teacher journal entries, examples of student work, notes on informal conversations with the teacher-participants, and transcripts of two semi-structured interviews held with each teacher-participant. As I examined the data and began to

seek patterns, I became very aware of issues that kept recurring as concerns of teacher-participants. These issues had not been expressed previously in a common forum in our district. Each teacher-participant discussed the importance of performance assessment strategies for the understanding of student achievement, several were concerned about consistency within the science curriculum, and I was struck by the lack of curriculum alignment between grade levels.

Discussions of these issues raised possibilities of future staff development opportunities and the teachers agreed that they should be engaging in dialogue with the district administration. There was an additional issue that I had anticipated would be raised but I had not predicted the intensity of the teachers' feelings. Our district governing board had recently adopted the goal of becoming the number one school district in the nation based on standardised test scores, along with other criteria. Each teacher-participant disagreed strongly with the district emphasis on standardised testing as a meaningful measure of student achievement. Although the younger and less experienced teachers tacitly accepted the district mandate to concentrate on raising test scores, one of the more experienced teachers, highly respected and considered to be a leader in the district, rejected standardised testing as an effective tool for instruction and had no interest in even reviewing her students' scores.

Wallace and Louden (2000, p. 142) identify two ethical implications in narrative forms of inquiry. The first concerns 'the nature of knowledge, understanding and truth' which has implications for the telling of a story. The second issue 'involves the rights of the human subjects in the research process' and the fundamental relationships between all individuals involved in the research. Both of these ethical implications were involved as I struggled with ways of reporting the teachers' thoughts about the effectiveness of using standardised tests to assess student achievement. I was concerned with representing their viewpoints accurately and in such a way that the representation would provide the impetus for continued dialogue between the district administration and the district teachers. I was also very concerned that I did not represent the teacher-participants' viewpoints in a manner that might jeopardise their reputations among their colleagues or the district administration.

During interviews with the study teachers, they expressed opinions regarding the use of standardised tests to assess student achievement that placed them in opposition to the district-mandated goal. Teacher A felt that she did not need an outside measure to determine what her students understood. 'I know by experience, by what other people tell me and, most of all, by what my students are telling me. I question the need for either criterion-referenced measures, the Stanford 9 achievement tests or the state tests.' Teacher B expressed concern about the correlation between the district criterion-referenced measures (standardised multiple-choice tests) and his own perception of what students understand. Teacher C stated:

> The district criterion-referenced measures will not correlate with the level at which I believe my students are understanding. The tests themselves are too picky, too specific in the nature of the questions. If I had a choice I would change the tests completely to

> authentic assessment. I don't really think there is a place for multiple-choice tests, at least not at the fifth grade level.

Another teacher explained her concern with the standardised tests in terms of her own style of instruction and assessment.

> I don't teach that way. I don't write a single test all year long that is a multiple-choice test. I prefer performance assessments, I think they take kids to a higher level of thinking that you can't get out of multiple-choice. If I had to rely on one outside measure of whether my students are performing I'd go with a performance test. But then I have to trust that that test will actually test the objectives I am supposed to teach. I don't think we have that level of trust with any outside test.

The teacher-participants were facing a dilemma in choosing means of assessing student achievement that they felt were appropriate and, at the same time, abiding by the mandate of the district they were contracted to serve. I was faced with the dilemma described by Wallace and Louden (2000). How was I to respect the rights of the participants to confidentiality and prepare an 'accurate' account of the information I had gathered?

When constructing a narrative configuration not all data elements are needed nor, as discussed in a previous section of this chapter, did I use them. 'The final story must fit the data while at the same time bringing an order and meaningfulness that is not apparent in the data itself' (Polkinghorne, 1995, p. 16). To achieve this outcome, I needed to decide which data to include as meaningful indicators of teachers' thoughts and which to eliminate as extraneous to my original purpose. I developed concept maps from recurring themes that emerged during the teacher interviews. I then used my own observations to substantiate what the teachers were saying and support the organisation of the maps. Once constructed, I used the maps as guides for developing case study stories and narrative reflections for each teacher.

I chose to be very open about my findings with the teacher participants. They each received a copy of their case study story and an accompanying narrative describing their reflections. I gave each a copy of the concept map that I used to guide the construction of the narrative pieces. After discussion and review of any concerns expressed by the teachers, I constructed the final versions of the case studies incorporating, in most cases, the teacher's previous editing and suggested changes. I also asked each teacher if they were comfortable with the fact that I would be formally writing their statements regarding their disagreement with the district about the importance of standardised tests. Not one asked me to change their words. In fact they seemed eager for their opinions to be heard.

CONCLUSION

One of the goals of my research was to initiate constructive dialogue between all district stakeholders in the mandated assessment processes. I do not take credit for doing so. However, I do recognise that the conversations generated by my research questions provided the participants with opportunities to develop their ideas and share them with colleagues. In addition, the district practice of administering its own

criterion-referenced tests has since been discontinued until those tests can be rewritten to address the concerns that teachers and administrators have expressed.

The ethical implications raised by Wallace and Louden (2000) are ones that I had to address in a context where anonymity was pretence at best. When I began the research process I anticipated that working within my home district among friends would create some unique ethical dilemmas. As I reflect now on the dilemmas that I had to resolve, I no longer think they were peculiar to my circumstances. Perhaps the fact that I was working with my colleagues made me more aware of the pitfalls I needed to avoid, but I suspect that all researchers need to address similar issues. Brickhouse (1992) suggests that in case study research the ethical decisions that are made are closely tied to the particulars of the situation at hand. The context of the research situation and the individuals involved provide a mechanism for understanding dilemmas that arise. I feel the advantage I gained from being able to participate in extended dialogue with my colleagues in an environment of trust certainly outweighed the constraints of working in my home district and the resulting ethical dilemmas. Part of my success in working my way through what might have been a more challenging adventure needs to be attributed to the participants themselves. Their capacity for reflection certainly aided the process. It should be noted that the outcome might have been quite different had I chosen a topic that had been more threatening to them, more critical of their practices, or more fraught with controversy.

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ROBYN WHITE

HISTORICITY, NARRATIVE, AND METAPHOR: MY JOURNEY THROUGH HISTORICAL RESEARCH

PROLOGUE

My field of interest chose itself. As a long-time participant in my State education system, initially as the child of teachers and later as a teacher myself, I became fascinated by the culture of my teaching community. I was especially enticed by the intersection of this culture with the complex processes of curriculum change. Over the years, my own conversations with colleagues and friends about schools and learning, increasingly mirrored those overheard in my youth between my parents and their friends. Despite multiple differences in context across the years and generations, these conversations created a recurring *déjà vu*. In research I have tried to link my cross-generation local cultural knowledge and understandings with my own interest in teasing out a coherent pattern to this reiterative process of change.

I focused my study on the impact of the beliefs and understandings of two 'heroic' science curriculum leaders (identified metaphorically as Perseus and Theseus) in creating and leading State-wide curriculum change in the 1950s and 1970s. Early in this exploration, struggling to identify similar research, I wondered at the suitability of my chosen interest. However, when considered as a reflection situated within the broader scope of the culture of school education, I am convinced of its value.

My initial perceptions of how such an inquiry might be accomplished, and what it might look like once written, reinvented itself many times over. The final product was quite unlike anything I had imagined in terms of scholarly investigation. Yet it arose from an extensive collection of data, thorough analysis, and careful interpretation. In this chapter I will outline the circuitous path taken in order to locate appropriate data for this study – in itself a journey for the novice researcher. I try to clarify the qualitative processes employed in this disciplined inquiry and explicate my reasons for presenting the study in the form in which it is written.

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 33–43.

HISTORICITY

In the naivety of my inexperience and my attempt to establish historical 'authenticity', I began this study expecting to spend hours poring over documents in the quiet alcoves of our State education department archives. I imagined that my research report would be a tightly ordered document with frequent references to my private (photocopied) collection of historical paraphernalia; letters, draft programmes, texts and so on – a 'historicity' of the period. I visualised an historical research study such as those undertaken by Cremin (1961), Kliebard (1988, 1992), and Mossenson (1972). However, this was not the reality of my study.

Initially, I spent hours during weekends and school holidays with archives. I looked fruitlessly amongst the collection of the State education department library. I found that older records had been moved into the State archives. I obtained researcher status from the State library and my world opened! Files and files of documents relating to all aspects of schooling became available to me – student enrolment information, immunisation records, requests for the opening of new schools, school requisitions, and so on. With infinite support from the ever-patient librarians, I learned to focus down my area of interest. Categories such as *curriculum* and *science* and *teacher training* became the foci of my delving.

This kind of data collection is most absorbing. I read a lot of detail about issues of particular interest to individual teachers as evidenced in the many letters from head teachers in small rural schools. As the size of the education department grew, documentation became focused into reports and proceedings. Some of these were pertinent. Personal letters and outlines became scarce. Memos were non-existent. Throughout the many files, curriculum documentation and specifically science curriculum materials were relatively few. Some draft curriculum proposals and occasional letters reflecting the views of an association or individual provided the bulk. After the 1950s there was little of interest except letters between senior State educators regarding senior level courses and high school exit certification. I was immensely disappointed.

In my full-time role at school and meeting with colleagues, I expressed my frustration at the lack of information and especially the lack of individual and group responses to the curriculum reports and statements. As happens so often, a shared problem tends to uncover solutions, or at least partial solutions.

Firstly, a close colleague working with the State curriculum-accrediting agency spoke about some old books he had discovered in the agency library. Amongst the collection of national and international books describing numerous senior level courses and accreditation processes, were some books inherited from pre-existing agencies. In his wisdom, the chief executive officer of the agency had determined that these books could provide a historical reference point for the organisation and retained them in the library collection. They did exactly that for my study. These books were the publications of the public examinations board of my State, outlining the compulsory external Year 10 and Year 12 examination courses from 1914 until 1974. Thus I was able to track science subject content and process statements over the years from 1914 until the final State-wide Year 10 examination

in 1972. The similarity of content over the years and the gradual expansion to include new scientific understandings was clear.

The second important input came from one of my older superordinates. He reminded me of the way we work today. In the 1920s, letter writing to the central office of the education department was an effective means of communication, when road and rail transport was paramount and telephone connections expensive and unreliable. However, times have changed. Telephones do not leave a paper trail. At his suggestion I interviewed two recently retired science curriculum consultants who had worked in the central office. They provided further reasons for the absence of paper evidence.

> In the 1970s our minister of education gave instructions that we were not to communicate with any federal officers, or anyone from another state. That was just impossible! So we used the telephone all the time. You won't find any archival records – they were 'lost' for excellent reasons. (Proteus, Superintendent of mathematics in the 1970s interviewed in 1992)

> When the 1987 restructure came, I packed the science curriculum materials I'd collected and labelled them with 'Not to be destroyed' and 'Refer to Jason before removal'. Two years later when I arrived back in the city, I went to collect them. One of the clerks reckoned that the boxes had all been opened and texts sent off to a library and the papers and documents shredded. What an enormous loss! You won't find much for your study. The philistines have beaten us all. (Jason, Superintendent of science through 1980s until 1987, interviewed in 1994)

Following these discussions, I realised that I had to rethink the form of my data collection. Rather than physically remove myself to analyse papers written years previously by people I knew only by reputation, I now had to get close to my subjects in order to obtain any viable data. If I was to access the understandings and knowledge associated with these events, I needed to sit down and talk with the long-term participants of my science education community. Many of the individuals associated with events of interest from the 1950s were already advancing in years and memories were fading.

Consequently, over the following years I became very close to my tape recorder and computer as I recorded and painstakingly transcribed interviews averaging about an hour in length. Initially, I used a reasonably loose interview protocol. I asked individuals to talk about their own understandings of science, school science, school science curriculum as a student and as a teacher, the teaching and learning of science over this time, and the names of others to whom I should talk. I am indebted to each of my informants for giving of their time so freely, particularly the two main characters in my research, whom I have called Theseus and Perseus. Theseus participated in two lengthy interviews, as well as critiquing two of my earlier papers (White, 1993, 1995). I was able to spend some time with Perseus only a short time before his death. He was eager to tell his own story but also that of his beloved teachers and the education department. His loyalty towards, and trust in, the science teaching community remained untainted.

Over the years of interviewing I learned to listen more and interrupt less often. Inevitably many interlinked issues became part of our conversations. I am immensely grateful for the trust given to me by those who became involved in the

process. My own commitment on requesting an interview was that each informant would retain anonymity when the study was documented. As well as Perseus and Theseus, who were science superintendents later promoted to become chief executive officers of the education department, my interviewees included a director in the central head office during the 1950s until 1969, six superintendents (from the 1950s until 1987), five heads of department (1960s until present), five science and education university professionals (1950s until present) and four science teachers (1950s until 1980s), representing well over two hundred pages of transcript. Each discussion flowed freely, embroidered with anecdotes about individuals, groups, and the organisation. Like Perseus and Theseus, each wanted to tell their own story and more. The advantage for myself as colleague, sometimes friend and researcher, was that inevitably one story reinforced many parts of another and I was able to recognise repeated sequences in time, negotiation, and decision-making – wonderful triangulation! It was a totally absorbing task to listen to the unhesitating interest, open-mindedness and enthusiasm of these people.

In meeting and talking with participants in the culture with which I identify, I learned far more than can ever be described in this study. I was reminded repeatedly of the resilience of beliefs about learning and teaching and science, as those expressed in interviews resonated with my own. The nature of the issues which emerged during the interviews became a repetitive cycle. I learned more about the understandings of the people involved in policy making and curriculum implementation. In seeking to document this qualitative study, I cast around for some time. My embryonic papers were written more or less as traditional historical studies (White, 1993, 1995). Written in the expository language of the objectified and non-emotive researcher, these scribblings included time-lines, dates, sequences of events, and a naive researcher's conclusions. Such papers gave information and some interpretation. However, they did not resonate with me as a reader. In my hands the traditional historical framework seemed to be inadequate to the task of providing the complex context inherent in this study.

NARRATIVE

At the same time as I was piecing together these early accounts of events, I continued to interview members of my community. Our conversations consisted of anecdotes and stories. My data consisted of a wealth of descriptions and tales about schools and science curriculum and teachers in schools, in the form of narrative as prosaic text as defined by Polkinghorne (1995), where 'narrative has been employed to signify that qualitative inquiries are concerned essentially with everyday or natural linguistic expressions, not with decontextualised short phrases or with abstracted counts designed for use in computational analysis' (p. 6). I found myself relating not dates and events but whole stories. Increasingly I looked at my study with a different lens. Like so many scholars before me (Carter, 1993), I too began to make story a central element in my own analysis. As so cogently expressed by Witherell and Noddings (1991):

> We learn from stories. Stories are powerful research tools. They provide us with a picture of real people in real situations, struggling with real problems. They banish the

> indifference often generated by samples, treatments and faceless subjects. Most important, they invite us to remember that we are in the business of teaching, learning and researching to improve the human condition. Telling and listening to stories can be a powerful sign of regard – of caring – for one another. (p. 280)

This recognition of stories and narrative as not only providing a form in which human experience as lived can be expressed (Ricoeur, 1984,1991), but also as a legitimate tool for research, is reiterated by Connelly and Clandinin (1990).

> Perhaps because it focuses on human experiences, perhaps because it is a fundamental structure of human experience and perhaps because it has a holistic quality, narrative has an important place in other disciplines. (p. 2)

Arguments such as these gave additional credibility to my emerging focus and understanding of the possible worlds of research. My experience had already broadened my understandings to include inquiry quite different from the traditional, positivistic horizons nurtured throughout my science degree. I had read, debated, and accepted Bruner's (1986) argument about two legitimate forms of knowing, the paradigmatic and narrative. In particular, Bruner articulated the distinctive features of each mode of cognition.

> Each of the ways of knowing moreover, has operating principles of its own and its own criteria of well-formedness. They differ radically in their procedures for verification. (p. 11)

As a researcher undertaking disciplined inquiry, I needed reassurance that my primary data were as authentic as possible. During my time spent in archives, libraries, and sorting through the forgotten staff bookshelves of several established schools, I was able to verify many of the sequences of events during the interviews. In addition the accuracy of much of my interview material as primary data was reinforced as different informants reported on the same activities. While interviewees provided recollections mediated by their own position in the organisational hierarchy and tempered by their own retrospective understanding of significance and meaning, the combination of perspectives gave me confidence in the authenticity of my data.

Having consolidated my decision to employ narrative as a primary methodology and being satisfied that my data were authentic, I needed to clarify my process of analysis. In presenting my data I made use of both of Polkinghorne's (1995) primary forms of narrative enquiry – narrative analysis, as well as analysis of narratives. Polkinghorne recognises these approaches as complimentary but different.

> Narrative analysis relates events and actions to one another by configuring them as contributors to the advancement of a plot. The story constituted by narrative integration allows for the incorporation of the notions of human purpose and choice as well as chance happenings, dispositions and environmental processes. The result of a narrative analysis is an explanation that is retrospective, having linked past events together to account for how a final outcome might have come about. (p. 16)

In my final research report (White, 1998), I presented accounts of the activities of my two 'heroic' figures, Perseus and Theseus, as stories representative of the data obtained from different informants as well as documents. Interspersed with the

accounts of events and actions, I endeavoured to answer questions about how science curriculum change proceeded over time and in context.

> The paradigmatic analysis of narrative seeks to locate common themes or conceptual manifestations among the stories collected as data. The researcher inspects the different stories to discover which notions appear across them. (Polkinghorne, 1995, p. 13)

Based on the stories of Perseus and Theseus, I constructed several assertions about my perceptions of the common elements in the process of curriculum change. In the tradition of Polkinghorne (1995), they were derived through a continual inductive process of defining and modifying categories or assertions to attain a 'best fit' with the data.

I was cognisant that my study included only two narratives – those of Perseus and Theseus. Was this sufficient evidence from which to draw generalised assertions? I wondered if the patterns emerging in my stories would be recognisable in other settings. I found guidance in the position of Guba and Lincoln (1989), who made a case for 'transferability' as an alternative for generalisability. I believe that my assertions reflect my understandings of curriculum leadership and change in my own culture and hope that readers of my research will recognise the transferability of these assertions to their own culture.

METAPHOR

Metaphor permeates not only our language but also our culture and our meaning-making. As Lakoff and Johnson (1980) observed when they wrote about how people understand language;

> Metaphor is pervasive in everyday life, not just in language but in thought and action. Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature. (p. 3)

I identified my reconstructed stories as metaphors well before any link to Greek mythology had been imagined. In using my data to create my stories of the hero figures, Perseus and Theseus, I designed a vehicle whereby I hoped the reader might more easily understand the actions of two men trying to progress towards particular outcomes. As Vanhoozer (1991) states, 'Other things exist in time, but only humans possess the capacity to perceive the connectedness of life and to seek its coherence' (p. 43). In explicating these human activities as stories, my reconstruction is itself a metaphor.

In recognising this reconception as metaphor, I was then drawn to the Aristotelian concepts of *mythos* and *mimesis* in devising stories (Ricoeur, 1984) opening a different understanding of the Greek philosopher. This newfound knowledge was extended by Aristotle's discussion quoted in Lakoff and Johnson (1980, p. 190):

> It is a great thing indeed to make proper use of the poetic forms. But the greatest thing by far is to be a master of metaphor (Poetics 1459a); ordinary words convey only what we know already; it is from metaphor that we can best get hold of something fresh (Rhetoric 1410b).

As one educated primarily in the empiricist Western culture, articulated by the ancient Greeks of whom Aristotle was a crucial figure, I had failed to connect my education in the sciences with that in the field of literature. I investigated further. Through Diane Wood (1992), I was introduced to Martha Nussbaum (1986). Nussbaum identifies two strands of thought amongst the early Greeks, one pertaining to truth and the other to art. In the first, logical and rational argument, objective and unemotive reason, ultimately define moral order and valued knowledge. However, Greek theatre and art described their tragic heroes as unable to avoid fate.

> Greek tragedians portrayed the detached, rational character as guilty of hubris, a tragic and fatal flaw. They made the case that the truly virtuous must recognise and consciously live with human vulnerability, with the essential fragility of mortal existence. (Wood, 1992, p. 539)

Although both schools of thought coexisted in early Greek culture, the increasing power of the sciences and technology over art led to the modern Western tradition. Throughout recent centuries, knowledge based upon rational, logical, reasoned argument, and formal, objectified discourse has been recognised as valuable. It seems that in recent decades there may now be a return to a more equitable balance between the power of each school of thought.

While my stories themselves may be viewed as metaphors, the identification of my two lead characters as heroes was a different use of metaphor. Early on in my conversations with colleagues, one made the remark that '[Theseus] was one of my heroes'. In the course of the discussion this was an appropriate metaphor, and passed without further comment. Later on, in moulding my narratives through listening to anecdotes, the power of underpinning referents became increasingly significant to my understanding. My analysis moved further and further into a cultural framework. It was then that I began to refer to these two men as 'Heroes'. For me, the metaphor worked and helped me to comprehend their role within my community. Of course, for those of us raised within the Western European culture, heroes also invoked thoughts of Greek and Roman mythology. It took very little imagination on my part to extend the metaphor to Perseus and Theseus. Greek rather than Roman, because so much of our Western philosophy has emanated from this heritage. Perseus and Theseus because their particular Hellenic myths so effectively mirror the life histories of the modern Perseus and Theseus. In my final report, I also provide further evidence of why these men could be so closely identified with the Hellenic heroes. I am convinced that the use of these metaphors would resonate with both of my modern Heroes.

RESEARCH ISSUES

My Role

A critical decision early in my study was to determine my own role. Initially, when I saw myself analysing text materials only, I expected to write in the expository formal style of discourse. When I began to interview people from my own culture, the way in which I represented my data was radically altered. I also found that my understanding of my role as researcher had changed.

In particular, I found that I could no longer feel comfortable writing as a supposedly unbiased, objective arbiter of *truth* as is so often perceived in the simplistic recounting of past events which sometimes passes as history. For me, this history needed to be more complete, 'in the ordering of the experience of others, in tracing connections between cause and consequences, continuity and change' (Makler, 1991, p. 46). However, in meeting and talking and knowing my informants and the subjects of my stories, my study could become weighed down by too much evidence. As researcher my role included determining which evidence was to be selected as part of my constructed representation of reality. This became more difficult once I had met and interacted with my subjects. For instance, although he may have been a stickler for rules, boring and conservative to his colleagues, the Perseus whom I met was a delightful, gentle man whose carpentry skills were superb and who remained immensely proud of 'his' department and 'his' teachers. It would have been much easier to select evidence from written reports and documents than it was to weigh up the contributions from people I had grown to respect and had no wish to hurt. Consequently, in constructing the stories of Perseus and Theseus I have endeavoured to be fair in my representation. However, I could not appropriate the language of objectivity for my account.

As a student, teacher, head of department, deputy principal, and principal of schools in my State, I was a participant in the culture upon which I was reporting. Thus, I realised that in the very act of writing I was presenting my personal meaning of events and activities. Unlike the writers of the modern, scientific culture from which my initial academic education began, in this study I needed to explicate my own position. I am not the modern author suggested by Bauman (1987).

> The modern author in society is a 'legislator', defined as a specialist, a manager, a professional, an intellectual or an educator ... they 'know' and 'decide things' by weighing up the positive and negative and determining what is 'true'. What they select becomes 'correct and binding'. (p. 27)

Rather than trying to be politically neutral I provided a perspective mediated by my own knowledge of my community and its history, understandings, and culture. I attempted to clarify my predicament and my position for the reader early in the study. I tell my own story, or at least my construction of life events which may have influenced my approach and my analysis. I consistently referred to my own relationship with the narrative so that the reader could recognise the effect of my role and views in shaping the stories.

Truthfulness?

I hesitate to use the word 'truthfulness', and yet when one evaluates paradigmatic research it is the rational discourse revealing true knowledge which is communicated. However, in making sense of human endeavour, such a unique outcome does not do justice to the complex context of our lives as lived. Peshkin (1985) explained:

> When I disclose what I have seen, my results invite other researchers to look where I did and see what I saw. My ideas are candidates for others to entertain, not necessarily as truth, let alone Truth, but as positions about the nature and meaning of a phenomenon that may fit their sensibility and shape their thinking about their own inquiries. (p. 280)

Researchers who have presented their studies as narratives have provided explanations for different ways to evaluate the quality of narrative. Bruner (1986) looked for 'verisimilitude', whereas Van Maanen (1988) added 'apparency' as an underrated alternative to validity and reliability. Other constructions include 'trustworthiness' and 'authenticity' (Lincoln and Guba, 1986), 'adequacy' and 'plausibility' (Connelly and Clandinin, 1990), and 'fidelity' and 'believability' (Blumenfeld-Jones, 1995). Hatch and Wisniewski (1995) suggested that the issue of clarifying criteria for judging quality in narrative and life history is a continuing and unresolved issue for researchers.

In writing up the study, I hoped that the reader would find 'believability' in how the stories might resonate with their own life experiences. I was aware of the range of documentary evidence and of the many individual accounts upon which this study has been based. Throughout the writing process I endeavoured to include as many voices as possible, although my own remained the one consistent throughout. I was particularly aware of the warning articulated by Catherine Emihovich (1995) as she tried to account for quality in narrative research:

> But who decides that it rings true; even more importantly, in the world of meaning and perception where there are no tangible physical referents to guide us, can the truth ever be established? My contention is that while truth cannot be definitively established, social scientists must act as if the world is real, or more importantly, as if 'the world is more than a text' (Hawkesworth, 1989, p. 555). This position suggests that we need to reflect self-critically on our actions, to examine whether they are consistent with the meaning of theories we have constructed. (p. 44)

Throughout the years of this study, my world in education has remained very real, to continually remind me of my responsibility to produce a trustworthy representation. I have remained acutely aware of the multiplicity of contexts in which these human negotiations took place and have confronted the difficulty in presenting these fairly. While I accept that truth cannot be established, my wish is that this portrayal 'rings true' to my readers, that it is understandable to those from within the culture I describe as well as to those from without.

CONCLUSION

Qualitative inquiry provides a vehicle within which researchers may study the human experience in a holistic way. It opens a new field of possibilities in science and mathematics education research and new tools with which to recognise the importance of relationships in education. However in working in this paradigm each participant is confronted by the perceived need to justify his or her methods. This represents one's identification with that nebulous quality – scholarly standards. As Wallace and Louden (2000) explain

> [N]o method can guarantee the truth in a postmodern world. Whatever emerges from a program of disciplined inquiry must be constructed within a web of intersubjective agreement, reflecting the preconceptions of the authors and the power structures within which the knowledge is constructed. (Wallace and Louden, 2000, p. 6)

For the novice researcher like myself, it is important not to close our minds to different ways of thinking and doing. The trick is to do this while also maintaining rigour in decision-making and analysis. One way of underlining the authenticity, credibility, and believability of research is to explicate the elements of the method. This involves not only simply describing the steps but also being transparent about the decision-making process. In this way, we can affirm to our readers the rigour underpinning our work.

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JUDITH MULHOLLAND

UNDERSTANDING THE SELF AS INSTRUMENT

INTRODUCTION

I have been asked to write this chapter about the processes of qualitative research so that my experiences as a beginning researcher can be of assistance to others who are also beginners. In writing, I have drawn on the text of my thesis and on my memory of carrying out the research. In the first section of the chapter I attempt to locate my research in the ever-expanding and changing field of qualitative theory. I then describe the data-gathering techniques used and the methods of data analysis I employed. In each case I have attempted to recall my difficulties and dilemmas. In the final section of the chapter I return to the qualitative theme of "self as instrument" in the research process.

RESEARCH ORIENTATION

The purpose of my study was to investigate how beginning primary school teachers learn about science and teaching science. The study commenced at the preservice level and documented the progress and learning needs of three participating teachers enrolled in science education subjects at university. After graduation I followed the teachers into the school setting to obtain information about the transition from preservice student to practicing science teacher.

I chose to use qualitative research methods because I wanted to make sense of the complex world of teaching and teacher education. Qualitative researchers have been described by Glesne and Peshkin (1992) as meaning-makers who draw on their own experiences, knowledge, and theoretical outlooks, to collect data and to present their understanding to the world. The particular paradigm I adopted in this study was constructivist-interpretative which 'assumes a relativist ontogony (there are multiple realities), a subjectivist epistemology (knower and subject create understandings), and a naturalistic (in the natural world) set of methodological procedures' (Denzin and Lincoln, 2000, p. 21). The term interpretative research refers to a set of approaches where the central research interest is the meaning that

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 45–57.

humans give to their experiences and social interactions. Interpretative research involves long-term participation in a field setting and careful recording and collecting of data. This is followed by reflection and writing using rich description, narrative vignettes, and direct quotations (Erickson, 1986).

Eisner (1991) described the constructivist view by saying that human knowledge is made, not simply discovered, that what we know is a product of our minds as well as of what may exist outside the mind. Thus, I entered the research project as a learner, and did not claim to know beforehand what would be important (Guba and Lincoln, 1989). Research then became a process of meaning-making with the assistance of participants rather than reporting objective reality (Abell and Roth, 1992). Knowledge was made in an inductive process by interaction between my reading, the carrying out of research, and reflection (Glesne and Peshkin, 1992).

The interpretative-constructivist orientation to research was particularly apt for my study as the approach allowed for the complexity and uniqueness of the participants' worlds to be honoured as I sought, with their assistance, to construct a better understanding of primary school science. I believed that better understanding was central to my own professional development and the facilitation of science teaching in primary schools where beginning teachers work. I hoped that my study would assist to improve teaching by helping teachers better understand the nature of their work and the meaning they gave to it, rather than by giving them new tools and techniques so that they could do a better job (Gallagher, 1991). In order to facilitate the development of such understanding I used two broad questions, 'What is happening here?' and 'Why is it happening as it is?' (Tobin, 1991) as guides to my learning about primary science teaching.

DATA GATHERING

My data were obtained from unstructured and semi-structured interviews, participant observation, journals, and field notes. Fontana and Frey (2000) describe the unstructured interview as an attempt to understand the complex behaviour of people without imposing categories that may limit the scope of inquiry. Mishler (1986) explains that we are more likely to find stories reported in studies using relatively unstructured interviews where respondents are invited to speak in their own voices, allowed to control the flow of ideas, and encouraged to elaborate upon their responses. Unstructured interview was the preferred interview technique used in this study. Semi-structured interviews were used on a few occasions when emerging themes or ideas were checked with the participants. However, structure was kept to a minimum and participants were encouraged to respond in ways meaningful to them. I did not attempt to channel their thinking so that their discussions of themes or ideas were not necessarily similar to those of other participants. I attempted during both types of interview to engage in real conversation (Daniels, 1983) in order to facilitate empathic understanding of participants' views.

In both stages of the study the preservice teachers and I kept journals. Clandinin and Connelly (1994) describe journals as powerful ways for individuals to give account of their experience. Journals can also be a way of creating field texts so that an ongoing record of practice and reflection on practice is kept (Connelly and

Clandinin, 1988). Journals kept by the participants allowed me to understand their perspective on events that I could not observe directly. The comments in journals were often used as a starting point for interviews. My own journals were more like field notes in which I wrote impressions of classes in a science education subject I taught during the participants' preservice course, and of the classroom events I observed once they were inservice teachers. I wrote descriptions of classrooms while I waited to begin observations. During observations I taped verbal interaction and made notes of events that could be used to interpret the tapes. I also made note of my own impressions of events and of emerging themes during analysis.

DATA ANALYSIS

Erickson (1986) explains that field notes, documents, interview transcripts, and other materials collected, are not data but data sources from which data must be derived through analysis. During the process Erickson terms *analytic induction*, a researcher studies data sources for important links which connect items of data as comparable instances of the same phenomenon. The researcher also makes assertions, interpretations that are valid if they can account for patterns found across numerous events. A researcher using this process cannot offer proof of the truth of such assertions, but should be able to demonstrate their plausibility (Erickson, 1986).

CODING

My study involved the collection and organisation of a number of data sources. Initially I borrowed some techniques from grounded theory methods to assist me with analytic induction. As I read interview and observational transcripts and journals I assigned concept codes to blocks of text using constant comparative analysis (Strauss and Corbin, 1990). In real terms I used names for blocks of text in an attempt to describe the essential nature of each block. I found that most blocks of text needed several names or terms to fully describe their content. Frequently, a hierarchy was derived involving a general name and several more specific names. For example, the dialogue below was coded *Management* as a whole and individual sentences were highlighted and coded as *group size*(1), *management of materials*(2), *management of children's behaviour*(3), etc.

JUDITH Now what your year six, the time before. What did you do then?

KATIE Solubility. That was groups again, but their desks were in rows. Every science lesson we had to go to groups which took about ten minutes to change around. I had roles. So I had a roster. (1)There was four in a group except there was one group of five. And each kid had a role and in the groups of five there were two coaches so that everyone got a chance and they rotated every week, every lesson(1). (2)With the solubility, we didn't use much equipment, it was mainly just cups and liquids and things from home. It was an easy one to get equipment for because they didn't have much equipment there(2). (3)I found it was all boys so they were mixing everything by the end of the lesson. It was all one, even though I had the rules on the wall, no mixing, no you know, only mix what you're asked to

mix. At the end of the lesson, everything was in the one container and they were having fun stirring it around which is very frustrating, but...[(3)]

JUDITH You've got to be careful because it could also be dangerous. You'd have to know what you were handing out.

KATIE [(3)]That's what I said. Because they said to me, 'Why can't we taste the sugar?' I said, 'No, you can't taste the sugar. If you get into older science classes and you have another substance that you don't know you can't go tasting that.' It's just a habit. Because they had lots of things like sugar and salt that they could taste. But I made the point of saying, 'No you can't because it's a good habit. And you can't mix what you shouldn't because it's a good habit to get into. If you mix the wrong things in a house you could blow-up, you know'[(3)]. So I tried to get those habits, but it was very hard with all the boys. Every group had it all mixed by the end of the lesson. It was terrible. They had everything all in the one container, the oil and everything and all the different things like sugar and salt. They enjoyed it, they really loved the science. They said that it was great. And it worked because that class was just rows the whole time. They never went out of their rows.

I tended to code each observation and interview as soon as the transcript was typed so I could share my ideas with the participating teachers. This technique was recommended in the research literature as a way of improving *structural corroboration* (Eisner, 1991), *trustworthiness* (Glesne and Peshkin, 1992) *adequacy* (Connelly and Clandinin, 1990) and *credibility* (Guba and Lincoln, 1989; Kincheloe, 1991) or what my supervisor, John Wallace, and I later referred to as the *strength* of the study (Mulholland and Wallace, 2003).

THE PROBLEM OF VOICE

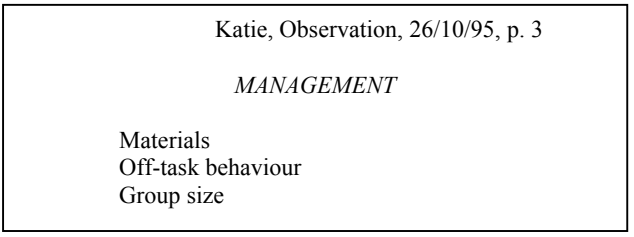
As the sharing and coding of ideas progressed, I came to believe that although I had a good rapport with all teacher-participants, I was unable to escape the lecturer-student context. This was most obvious when I asked for comment on my early interpretations of interview and observation transcripts. The teachers seemed to agree too readily with what I suggested. I concluded that they were very busy and did not really spend much time looking at the transcripts. I stopped hoping for them to volunteer opinions on coding and began asking specific questions in order to clarify what I did not understand. I also refrained from showing them any critical comment that I had made in my own notes as I thought that in circumstances where they did not seem to see their own opinions as equally valid as mine, these comments would simply be damaging. At first I was disappointed about not being able to get participating teachers to directly validate my interpretations, but I gradually came to view my own interpretations differently, particularly those that were critical of the participants. What use were criticisms to the participating teachers or to me for that matter? What good could come of them? Did they throw any more light on the complex issues relevant to teaching primary science? In fact my experiences in coding the interviews and seeking explanation from the respondents helped me to better see my position as 'outside' the world of the

primary science teacher and not as an insider with better knowledge than the respondents.

Further evidence of my outsider role was provided by a story one of the participants told me on the day of my first school-based observation in 1995. I was to some extent recast in my role as field experience supervisor. The participant said that she was teased by other members of staff that morning. The teachers laughed in a friendly fashion and suggested that the participant was still being checked on and assessed by a university lecturer, while they were past that stage. Thus, I believe I was seen by participating teachers as a legitimate person in the settings of the study but with a specific role, more powerful than theirs and always as 'outside' the world of the preservice or inservice teacher.

MANAGING DATA

The task of coding was time consuming and the large number of concept codes I was using became confusing. This was especially so when a time interval such as a week elapsed between coding sessions. There seemed to be an overwhelming amount of data, so much data I had the sensation of 'drowning in data'. I felt that it might be impossible to organise all of it or to ever make sense of it. At this stage, I decided to use a card system and to literally cut pieces of coded text and paste them onto one side of a large index card. On the other side of the card I wrote the source of the text chunk (e.g., 'Katie, Observation, 26/10/95 page 3'). In addition I wrote the major category heading and any subheadings. The text sample above would have had the following information on the blank side of the index card.



Cards were filed according to the major category heading. When I was coding a text chunk I compared it to one card file at a time. It became much easier to handle the data and also to compare chunks of text with others to decide on the correct category heading to file them under, or whether or not to invent a new category heading. In other words the process of constant comparative analysis (Strauss and Corbin, 1990) became easier to manage. After a time I started to learn the data and could code new text chunks easily. I also became aware of the range of different chunks in each category. In other words, major categories contained a number of subcategories.

CONSTRUCTING THE NARRATIVE

The next phase of data analysis according to Erickson (1986), is the amalgamation of similar concepts into themes that can be used to organise a narrative. Although I

used an interpretative case study approach I came to understand the particular analytic method adopted in this study as narrative method. That is, the telling and retelling of stories was an important aspect of data analysis and a basis of the research method. Clandinin and Connelly (1994) say that people live stories, and in the telling of them reaffirm them, modify them, and create new ones. These researchers see reflection involving storying and restorying, as a fundamental method of personal growth and thus a fundamental quality of education. Other writers see narrative similarly. Mattingly (1991) says that stories can extract meaning from experiences by offering one way of making sense of what has happened. She claims that in a story we may catch a level of meaning that we only partially grasped while living through the happening.

In order to begin this narrative phase of analysis, I spent some time playing with themes such as science classroom management and the expectations held by beginning teachers. However, the prior experiences of the participants and their teaching contexts during the first in-service year were so different that I began the narrative phase of analysis by writing three separate, chronologically organised, case studies. In this way, the range of experiences of each participant could be appreciated and the uniqueness and diversity of each case could be developed (Stake, 2000). Another advantage of case study is that specific cases are thought to be more persuasive than the impersonal presentation of empirical data. Shulman (1986) writes:

> Most individuals find specific cases more powerful on their decisions than impersonally presented empirical findings, even though the latter constitute 'better' evidence. Although principles are powerful, cases are memorable, and lodge in memory as the basis for later judgments. (p. 32)

I felt that I could justify the time spent on coding and sorting in that these exercises allowed me to get to know the data well enough to be able to see that separate case studies were a good first step. The coding had also alerted me to text chunks that were the most representative of the experiences of individual participants and which chunks were rich in that they were good examples of several category codes. Using rich chunks obviously saved the case studies from becoming too long. Even so, I struggled to rid myself of excess data once I started to write. Some quotes seemed so telling that it was hard to discard them even though the case study contained other examples of the same phenomenon. It seems that the price of knowing data well is to form a strong attachment to it and to be reluctant to part with any.

When I completed drafts of the case studies and sent them to John, his feedback indicated that, in addition to using only a selection of the data for each case study, direct quotes sometimes could be altered or smoothed so that a person not involved in the study could read them easily with understanding. I was concerned that the smoothed quote was not authentic in that speech hesitations and repetitions were removed. However, I gradually understood that there was a difference between a field text, the transcription of an interview for example, and what Clandinin and Connelly (1994) term a research text or a reconstruction of field texts (journals, interviews, observations, etc.) created to represent experiences of the field. Although the case studies represented the narrative that was closest to the field they were

nevertheless research texts and contained slightly altered dialogue. The case study version of the field text used above is shown below:

> Katie tried group work again in a unit on *Solubility* taught at a boy's school the following year. This time she used a more structured approach. Each group had four members who were assigned roles as manager, director, speaker or coach. The boys enjoyed working together as they spent the rest of their time seated in single rows. It seemed to me that Katie was encouraged by the boys' enthusiasm for science but frustrated by the 'extra-curricular' activities.
>
> They said to me, 'Why can't we taste the sugar?' I said, 'No, you can't taste the sugar. If you get into older science classes and you have another substance that you don't know you can't go tasting that. If you mix the wrong things in a house you could blow-up, you know'. So I tried to get those habits, but it was very hard with all the boys. Every group had it all mixed by the end of the lesson. It was terrible. They had everything all in the one container, the oil and everything and all the different things sugar and salt. They enjoyed it, they really loved the science. They said that it was great. And it worked because that class was just rows the whole time. They never went out of their rows. (Interview, 1. 12. 94)

A further advantage of developing separate case studies was that each participant could read and comment on her own without seeing data and interpretation relevant to other participants. I think this is an important issue as participants in the same study can relatively easily identify one another despite using pseudonyms. Again, I was disappointed in the relatively sparse feedback provided by the participants. The few comments seemed to indicate that the case studies were interesting but, as the events had occurred 2 years before, were not of current importance.

In later stages of analysis, writing, rewriting, and the consequent self-reflection were the major analytic methods used. Stake (2000) claims that content may evolve in the act of writing itself. Denzin and Lincoln (2000), describe this whole analytic process as one of moving from a field text consisting of notes and transcripts directly obtained in the field, to a research text containing annotations and interpretations such as codes and then through initial interpretative documents that attempt to make sense of what has been learned to a final public text produced for the reader. The three separate case studies were thus at the first level of removal from the field. I chose which episodes to describe and I added interpretative comment, but the participants' voices were there in the direct, but slightly polished quotes used to illustrate my text. The next narrative was at a further distance from the field and contained a higher degree of interpretation.

I continued to try to find overarching themes that made sense of the whole study in order to organise the findings at a more theoretical level and to be able to compare individual cases. I decided that change and growth were major themes of my study and employed four sets of overlapping *worlds* as vantage points from which to view the participants' experiences. This decision had two sources. One was a conversation with John during which I lamented that fact that the participants' case studies were 'worlds apart' when it came to trying to find major linking themes. The other was my reading of a paper by Roth et al. (1993) in which primary teachers who took part in professional development were described as finding *entryways* into science. These entryways were starting points based on the previous experience and interests of the teachers concerned. Thus, in my study the teachers are described as

people who need to gain new expertise or to enter new worlds of understanding that contrasted in some way with the world of experience or knowledge that they brought to the teaching-learning process. The task was then for the teachers to find ways, which I called bridges, to assist them to achieve the new understanding or expertise. I chose three sets of worlds to describe the experiences of the participating teachers. These were, the world of the person who is good at science and the world of the person who is not, the world of the student teacher and the world of the novice teacher, and the world of the primary science classroom and the world of the primary classroom during other subjects. A final set of overlapping worlds described my own development during this period. I called it the world of the specialist science teacher and the world of the generalist teacher. The recognition of this world was the result of my growing understanding of myself as the instrument of research and of my changing perspectives as a result of conducting this study.

I retold Katie's experiences with the boys and solubility under the heading 'The world of the science classroom and the world of other classes'. I used the experiences of each of the participants during field experience while at university to make the point that field experience did not prepare the preservice teachers well for coping with science lessons in their own classrooms. I then compared their initial experiences with science after graduation and described the ways in which they learned to manage science lessons from these experiences. An excerpt from this second narrative appears below.

The World of the Science Classroom and the World of Other Classes

Field experience provides only limited entry to the world of the science classroom. Co-operative learning groups and hands-on activities during university-based science classes provided all the participants with entry to the world of science. The participants expected to be able to implement such lessons in primary classrooms. However, field experience was something of a disappointment in this regard. Supervising teachers did not seem able to support the beginners in developing the skills necessary for using co-operative groups and hands-on activity. In fact, each of the participants found it difficult to become the science teacher they had hoped to be.

Katie mentioned difficulties with group work in two of her four field experience classes. On one occasion when she was teaching a Year 3 class about eggs, her groups were too large and she allowed children to work in places where she could not watch them effectively. The children misbehaved and the supervising teacher intervened by stopping group work and putting them into a large circle to watch teacher demonstrations. Katie was disappointed about the lack of real hands-on activity.

> In the conclusion I took the children outside and sat them in a circle. ... This however contradicts an important objective of science in the primary school, 'hands-on'. I found that as soon as the children were in their groups doing 'hands-on' investigating with the egg they were difficult to control and monitor. The noise was exceedingly high and the children were mucking around. (Katie, Journal, 24. 4. 93)

While teaching a solubility unit during field experience at a boys' school in following year, Katie came to realise that group work was a novelty for this class. The boys loved science groups but misbehaviour was again common. The boys did not use the substances provided for investigating solubility correctly but had fun mixing everything together.

> It was very hard with all the boys. Every group had it all mixed by the end of the lesson. It was terrible. They had everything all in the one container, the oil and everything and all the different things like sugar and salt. They enjoyed it, they really loved the science. They said that it was great. And it worked because that class was just rows the whole time. They never went out of their rows. (Katie, Interview, 1. 12. 94)

> All the participants remained determined to teach science in their own classrooms. However, effective entry to the world of the science classroom had been limited by the lack of real support for science teaching during field experience.

In my third and final restorying of lived experiences, the distance between field text and research text was greater. The major task of this retelling was to find meaning in the field texts and to elucidate more fully the significance of the study. Interpretation was dominant in the writing and voices of the teacher participants were muted in comparison with mine. In the previous story I used the image of travellers entering 'different worlds' as a way of describing the changes negotiated by the participants as they became primary science teachers. The use of this metaphor allowed me to tell the story of each participant in a way that honoured the individuality and complexity of each case.

In searching for a further analytic framework I used the same criteria. John suggested I read Aikenhead (1996) and I could see that the application and further development of Aikenhead's ideas of science as a subculture were a natural extension of the metaphor of the traveller. I suggested that another way of thinking about the different worlds the beginning teachers encountered was to conceptualise them as cultural worlds separated by borders. Aikenhead (1996) suggests that students' lived experiences in science classrooms be considered in terms of crossing cultural borders, from the subcultures of their peers and family into the subcultures of science and school science. Thus a theoretical framework of border crossing provides a new vantage point from which to analyse familiar problems in learning science. Science classes can be seen from this anthropological perspective as a cross cultural event for many learners. Those who teach science can likewise be visualised as attempting to enculture students through rites of passage (border crossings) into behaving according to the cultural norms, values, beliefs expectations, and conventional actions of Western science (Cobern and Aikenhead, 1998). I used this anthropological framework to analyse my findings by applying it not only to the learning of science but also to learning to teach science.

In order to more fully understand and describe border crossings I drew on the theoretical frame provided in the works of Bourdieu. This researcher describes areas of human endeavour such as philosophy, politics, or science as *fields* or spaces where *games* are played (Bourdieu, 1993). He says that in order for a field to function there have to be stakes and people prepared to play the game, endowed with the *habitus,* a system of behaviours and beliefs that are in tune with the game. He describes players of the game as having *investment* in the game (Bourdieu, 1990).

I was able to use the theoretical framework outlined to discuss four border crossings, border crossing from the subculture of the non-science person into the science subculture, border crossing from the subculture of the preservice teacher into the inservice teacher subculture, border crossing from the subculture of other subjects into the subculture of school science and border crossing from the specialist teacher subculture into the generalist teacher subculture. The excerpt below describes border crossing from the subculture of other subjects into the subculture of the science classroom.

Border Crossing into the School Science Subculture

The findings of this study indicate that for the primary school teachers teaching science is more difficult than teaching other subjects. Primary teachers, both experienced and inexperienced require new skills and different knowledge in order to teach science. Thus science classes and 'other classes' can be interpreted as different subcultures in the school setting and teachers need to cross borders between these subcultures in order to teach science successfully. When the habitus of skills and knowledge teachers bring to science classes from teaching in other areas is not sufficient for science lessons, teachers experience symbolic violence as they attempt this border crossing.

Some teachers find the crossing impossible and do not attempt science teaching. In their attempts to teach science all participants experienced hazards such as a lack of interest in science and a lack of time to teach it during their field experience teaching while at university. The participants also encountered another hazard, the behaviour of children when engaged in hands-on investigative work.

The beginning teachers in this study found that managing the complexity of a classroom in which children worked with other children in groups while at the same time having access to unusual and interesting materials, presented major difficulties for them during field experience and in their own classrooms. The participants realised that the children had had little previous experience of hands-on or group work and that they would have to teach the children new skills. In anthropological terms the teachers were aware that both they and their pupils would have to adjust their respective habitus if science classes were to be successful. Border crossing was essential for both groups.

Although the participants completed their field experience without a great deal of practice of border crossing into the science classroom, they were keen to attempt such crossings in their own classes. They had all experienced the enthusiasm of the children during science lessons and this seemed to be a major motivation to continue with science teaching. The children had shown themselves to be keen travellers and thus encouraged the teachers to see themselves as potential tour guides or travel agents or to maintain their investment in the game of science. However, in this process the teachers seemed to underestimate the hazards they were likely to encounter when crossing borders into science classrooms in the future.

SELF AS INSTRUMENT

As is apparent from the discussion so far, self as an instrument plays an important role in qualitative research. Eisner (1991) goes so far as to claim that the self of the researcher is the main instrument of research, in both data collection and analysis. Traditionally, readers were presented with the researcher's interpretation of the data, cleaned and streamlined and collapsed into rational and coherent accounts. More recently, researchers have begun to grapple with the reflexive, problematic, and contradictory nature of data and with the considerable, if sometimes hidden, influence of the researcher as writer (Fontana and Frey, 2000). It is now common for researchers to tell 'confessional tales' (Van Maanen, 1988) of the problems they experienced in the field and during the analysis of data sources. Fontana and Frey (2000) claim that if we wish to treat the participants in our studies as human beings, we can no longer remain objective, faceless interviewers, but must disclose ourselves and learn about ourselves in our attempts to learn about others. To some extent, all texts we write are about ourselves (Lincoln and Denzin, 1994).

In conducting this study, I tried to write stories that were rich descriptions of the viewpoints and lived experiences of the participants as they learned science and learned to teach science. I acknowledge however, that any view into the inner world of the participants is filtered through my own perspectives. Eisner (1991) claims that the

self is the instrument that enters the research situation and makes sense of it. He says that researchers do not just note behaviours but must recognise that these behaviours exist and interpret their significance and that the meaning that researchers hold is the source of their perception.

Other writers also acknowledge this 'self' of the researcher (Erickson, 1986; Glesne and Peshkin, 1992). They argue that when we interpret we bring our own frames of reference to the task. Our obligation is then to become more reflectively aware of the frames of reference of those we observe, and the impact of our subjectivity on the process of interpretation. Carter (1993) agrees, saying that what we tell and how we tell it indicate what we believe. We must deal with the problems of interpretation and meaning self-consciously and directly, using whatever tools we can to track their influence on our thinking. This involves what Connelly and Clandinin (1990) call 'moving beyond the story' of the lived experience to also tell the story of the research process. The research story documents the thinking of the researcher, both prior to and during the research process. I attempted to describe the interpretative decisions I made during the process of data gathering and analysis. At the same time, I also used the introductory section of my study report to describe my own background and interest in the research topic. An excerpt is shown below.

A Researcher's Perspective

I am a science graduate who has been involved in primary teacher education since 1982. Prior to this I worked as a biology lecturer and a secondary school teacher. I now teach science content and science curriculum units to preservice primary teachers at an Australian university. My appointment as a lecturer in science education coincided with the growing awareness in teacher education circles that primary teachers needed improved science knowledge. Universities and Colleges of Advanced Education began to appoint lecturers who had science degrees to teach primary science subjects, rather than qualified primary teachers.

Since my introduction to teacher education, I have been aware of the problem primary science teaching poses for many teachers. I see it as my responsibility to improve the confidence of preservice teachers to access science knowledge and to encourage them to teach science in primary schools. I have struggled with the difficulty of making science knowledge accessible to teachers and at the same time ensuring that their science understandings are congruent with those of the scientific community. However, it has been my experience that an approach of focusing on the orthodoxy of information rather than on what the learner understands creates problems of its own. Teachers often fail to see the significance of terminology they are required to use or to understand the reasons for science activities designed to assist concept development.

I have come to believe that a constructivist approach to knowledge, that sees understanding as 'meaning making' (Tobin, Tippins, and Gallard, 1994) and thus begins with the learner's perspective, is a more appropriate approach for primary science education. This approach allows that the learner will not always have a 'truly scientific' view but that the view held makes sense at the time and is capable of being developed and changed in the light of new experiences. Thinking in this way helps me to respect the dignity of the learner and not to concentrate solely on the shortcomings of learners' ideas. It also allows for the valuing of primary school science that takes children's ideas into account and is not just simplified university science.

In the final section of the report, I reflected on the power of the border-crossing framework in assisting me to recognise the validity of the perspectives of others. I realised that the original context in which the term 'border crossing' (Giroux, 1992) was used was in a consideration of the difficulties facing students whose race and

thus culture was different from those of the dominant group in an education system. Given the serious nature of multicultural problems, at first I wondered whether using images derived from this work would be seen as trivialising something of great importance. However, I found the use of the term 'subcultures' during analysis to be a powerful source of new insights into my role as a teacher educator.

The term subculture, when applied to the existing knowledge and way of operating of others, brought with it, for me, a sense of moral obligation to value and to try to understand. It is always difficult to imagine operating outside one's own culture. For example, we are only slowly learning in our multicultural country to value other cultures and acknowledge their legitimacy, rather than seeing our own culture as all sufficient. Initially I had great difficulty thinking of students who disliked science, generalist teachers, and beginning teachers as members of a different subculture, whose habitus should be valued. I had assumed, as have many in dominant cultures, that the science subculture was somehow 'the real' subculture and that others needed to belong to it.

Through these reflections, I came to understand that the process of research had been one of personal border crossing. I had expected to learn by doing this study, but about others and their needs rather than my own. I found that my new concept of the validity of the subcultures of the non-science person, the generalist teacher, and the beginning teacher was a fresh starting point in the redevelopment of my work with preservice primary teachers. Shulman (1986) suggests that the value of qualitative case studies is that readers find them memorable and persuasive. I believe that we should extend this idea by emphasising one of the great strengths and joys of interpretative research, its power as a source of personal growth for the researcher.

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DAVID LLOYD

EXPLORING STUDENTS' FUTURES IMAGES

INTRODUCTION

My doctoral thesis is about to be examined and is a significant punctuation point in my life. My committed starting point was a meeting with my doctoral supervisor, John Wallace, at an Australian Science Teachers Association conference in Darwin in July of 1998. The story I wish to relate in this chapter started, if a starting point can be put on anything, in 1988 when I was a teacher at Casuarina School in the Adelaide hills. My aim is to describe the genesis of a doctoral thesis and the way in which the researcher as person is intimately bound to the research project. In my case, the journey of exploration into the nature and importance of student images of futures in science learning.

My thesis was built around two intertwining themes. The first was about student images of the future developed using a guided fantasy approach and my struggle to develop a story that provided insights into students' expectations for futures. The second was about my journey as a participant-researcher. My own story is sometimes explicitly described in the thesis and at other times implied by what I chose to describe and the way I described it, or what I left out. I will separate out these two themes by describing how I came to my research approach and then how I explored and made sense of student images of futures.

THEME ONE: COMING TO A RESEARCH METHODOLOGY

The research methodology I used as participant-researcher is constructivist in nature and informed primarily by the work of Guba and Lincoln (1989). My research methodology, like the subject of my thesis, was emergent in nature. It was not a matter of simply building an understanding through reading and a little practice. I had to consult with and make changes to my own ontological beliefs that developed primarily through my studies in science. This process of changing a world view is no easy task and I still debate with myself the viability of a radical constructivist

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 59–68.

position. When challenged in public I claim to be a modest realist, which is a bit like sitting on the fence.

Genesis of a Research Programme

Prior to 1988 I was unaware of how students viewed futures and like most of my colleagues I did not think them important. Or more accurately, I did not think about them at all. My first experiences with student images of futures in 1988 by way of demonstration and then in 1989 and 1990 in my own classroom set me on a path of reflective exploration. I wanted to come to a better understanding of the nature and worth of student images of futures and how they connect with the concept of student empowerment; how they might limit, mislead, direct, enrich, degrade, or even destroy student lives. The motivation for this passionate crusade was tied up with an empathetic connection, as a result of my own past experiences, with what students were saying. I too had had utopian dreams and existentialist 'dark nights of the soul'.

My initial flush of enthusiasm was tempered in many ways. Apart from the draining demands of teaching that I too often ignore with damaging personal consequences, there was very limited enthusiasm among my colleagues for the idea that student images of futures were worth exploring. Poor attendance at futures workshop and seminars at conferences were indicators of this lack of enthusiasm. I became reluctant to spend time outside of my own teaching in pursuing my interest in student futures images. Instead I shifted my research interests to the alternative conceptions movement (Lloyd, 1993), constructivist teaching approaches (Paige and Lloyd, 1995; Lloyd and Wallace, 1996), and conceptual exchange research (Lloyd, Wilkinson, and Lyndon, 1995, 1998; Lyndon, Lloyd and Wilkinson, 1995). These areas of science educational research were more or less mainstream interest at the time.

However I could not ignore, even if I wanted to, the profound experiences I had with students' futures imaging episodes. They were always at the back of my mind as being of value and so in 1988 when progress on a doctoral thesis on the evaluation of conceptual exchange (Lyndon, 2000) was jeopardised for reasons outside of my control, I changed with enthusiasm to my futures work.

Another tempering effect was that my enthusiasm was generated from personal experiences and an intuitive understanding of the importance of futures images. I realised I needed to build on my intuitions through consultation with others through the literature. This tempering effect led to personal reading and formal study in the futures field, and later to reading in the fields of history, philosophy, and psychology.

Still another tempering effect was to do with research methodology. My first attempt to explore student images of futures in 1990 naively started with the question, 'Do students futures images affect their schooling?' It sounded like a reasonable question to ask and an important one to answer. It is a closed question, apparently investigable and therefore fits the hypothetico/deductive requirement. It is the type of question a scientist would ask, such as, 'Does rainfall affect the salinity of the water in the Onkaparinga River?' (An aspect of a study programme I was

carrying out with my senior school chemistry class at the time). Looking for causal relationships is what scientists do, and I had been trained as a scientist. However, cause-effect research requires the isolation of aspects of a system and the control of variables except those selected for study. Objectivist research of this kind relied on truth claims that match objective facts. Such an approach is clearly not possible when the data is subjectivist where I was dealing not so much with exterior and observable behaviour but with the interior states of students' minds. The only way I could reveal students' interior thoughts was by dialogue and interpretation. 'Truthfulness' would be revealed through sincerity, integrity, and trustworthiness, not the correspondence of facts with hypotheses. Qualitative research is oriented to seeking truthfulness and is a methodology that gets at truth through dialogical and intersubjective methods. Qualitative research is used when it is not possible to control the environment sufficiently for cause and effect type research. It is also used when the aspects under study are embedded to such an extent that to try and isolate them from the immediate environment would lead to an unmanageable and artificial situation. Qualitative research tends to concentrate on many, if not all, variables in a particular site rather than a few variables over many sites (Merriam, 1988).

Apart from having asked the wrong question and using an inappropriate methodology, it was also well beyond the resources I had available to me. The results I obtained provided very weak and tenuous causal connections but serendipitously did provide a wealth of information on the nature and content of student images which I was later able to appreciate and use. It was out of this material that more appropriate research questions arose.

Research Questions

With qualitative research, the methodology I needed to adopt for my study, a holistic perspective is taken which often begins with no clear research questions or hypotheses. Refined research questions usually develop during the research, rather than a priori. It is during the investigation that they become evident, are clarified, and particular lines of inquiry taken. If necessary, research questions can be modified along the way (Wiersma, 1986).

My preliminary research question, 'Do students futures images affect their schooling?' although not suitable for investigation was a start and formed the catalyst for thinking about the nature of the issue under investigation. In a sense my original question could be used as a last question rather than the first. To answer questions about influence there is a requirement that the phenomenon be first understood. And of course it was not. I had to first ask the question, 'What is the nature of student images of futures?' To answer such a question I needed a better understanding of what students were saying and tools for doing this.

The dismissive nature and lack of interest by other science educators I have mentioned earlier prompted the second research question, 'How important are student images of futures?' I needed to find the basis of my intuitive response and verify its viability. I was able to do this by reading in a number of fields of inquiry that included psychology, the future field, general systems theory, integral

philosophy, the history of the idea of Progress, and the place of utopian literature in Western culture.

As a classroom practitioner I wanted to actively use student images of futures in the learning programme. The data that I collected in the 1990 study suggested student interests and concerns that intersected strongly with science learning. The third and fourth research question appeared: 'What is the significance of student images of futures for science learning?' and 'How can student images of futures be used and valued in science learning?' These last two very practice-oriented questions led to the development and evaluation of a teaching approach that embraced both the futures and science education fields.

In 1999 I added a fifth question, 'How have student images of futures changed over the period 1990 to 1999?' Although a seemingly interesting and useful question, it did not add a lot to the study but has generated the germ of future longitudinal studies.

Getting an Appropriate Research Methodology

My strong reaction to student images of futures and the less than excited reaction by many colleagues suggests that my own experiences and sensitivities had a special place in my work. Again, my training as a scientist, where the researcher places himself or herself outside of the research framework, was limiting my view of educational research. I was oriented towards positivistic approaches and unaware of the importance of the researcher in the research process. Although I had intuited the importance of student images of the future through my own world view, I had placed my own experiences and opinions outside the research boundaries. A second aspect of scientific research is that it looks for generalities that can be transferred to all situations by way of general laws. What I needed was an approach that has as its focus the exploration of the particular, the unique, and the bounded. Qualitative research has those attributes.

The general aim of my futures research was to better understand the nature and importance of student images of futures in a science educational setting where I was both the teacher and the researcher. Such a requirement needed a qualitative research approach that has as its goal the better understanding of human experience (Bogden and Biklin, 1992). With qualitative research, primary data is collected at the setting where the research is being undertaken, analysed inductively, and the findings described rather than objectively stated. The story told is what the researcher decides is important in coming to an understanding of the situation under study and when told as a story, is read and lived vicariously. The approach uses as its main instrument of research the researcher himself or herself and there is as much concern about the process as the outcomes. All events and situations are seen as problematic and the search is for meaning and how people make sense of their world rather than ontological truth (Bogden and Biklin, 1992).

During a master's programme I undertook in 1994–1995 on the evaluation of constructivist practices in classrooms (Lloyd, 1995) I was able to develop an understanding of qualitative research methods and later use the Fourth Generation

Evaluation methodology of Guba and Lincoln (1989) that fits within the qualitative methods genre.

Guba (1990) identifies three groups of research paradigms within the qualitative research area. They are based upon the beliefs of postpositivism, critical theory, and constructivism respectively. The requirements of my study were consistent with a constructivist approach. Guba (1990) points out that constructivism

> intends neither to predict and control the 'real' world nor to transform it but to reconstruct the 'world' at the only point at which it exists: in the minds of constructors. It is the mind that is to be transformed, not the 'real' world. (p. 27)

It would be my task in this study to construct the most convincing case for the relevance and importance of what students believed the world will be like in 20 years time when they are in their mid-thirties and to show how these beliefs might be effectively used in science learning. The Fourth Generation Evaluation of Guba and Lincoln (1989) was eminently suitable for my task and I chose to rely heavily on this approach to inform what I had already done and on what I was about to do. Coming to a research methodology partway through the research event is not the ideal situation. However, my work on constructivist teaching methodology and my development as a constructivist teacher in the early 1990s provided me with insights into the relativist ontology and subjectivist epistemology of constructivism and a natural way into constructivist research approaches. Magoon (1977) states the essence of constructivism:

> Constructivism holds as its chief assumption about complex behaviour that the 'subjects' being studied must, at a minimum be considered knowing beings, and that this knowledge they possess has important consequences for how behaviour and actions are interpreted.... The locus of control over much so called intelligent behaviour resides initially within the subjects themselves. (p. 652)

Constructivist research, which is hermeneutic and dialectical (Guba and Lincoln, 1989; Smith, 1990), requires that the researcher debate back and forth his or her own understandings with those of the stakeholders (students) and the literature to construct the most viable position possible. Evidence and verification through negotiation of outcomes are aspects of the study I particularly needed to focus upon. I needed to ensure that the inquiry was carried out in a way that exposed the constructions of the stakeholders (students), was open to critique in terms of other constructions, and provided the opportunity for revised or entirely new constructions to emerge (Guba and Lincoln, 1989); that is, a hermeneutic methodology. Through the joint construction of meaning of student images of futures, both process and product, all stakeholders are empowered. Stakeholders' ideas and beliefs are valued and shared in an empathetic, safe, and supportive environment (Guba and Lincoln, 1989; Lincoln, 1990).

The Stakeholders

The primary stakeholders in my study were the students with whom I worked and myself as teacher-researcher. A constructivist approach values both of these

stakeholders, and insists that the researcher be cognisant of their place in the process. Guba and Lincoln (1989) point out:

> [T]o suppose that it is possible for a human investigator to step outside his or her own humanness, for example, by disregarding one's own values, experiences, and constructions, is to believe in magic. (p. 67)

A constructivist approach accommodates the two roles of the participant-researcher. I was required to play the roles of researcher and teacher and be aware of their uniqueness and commonalities. As researcher I had the responsibility of understanding my students and their images of futures. As participant (teacher) I had the responsibility of ensuring that valuable science learning occurred. A caveat of constructivist learning and research is that of an environment where participants feel safe to take risks with new ideas. For success as both researcher and teacher I had to develop a supportive and safe classroom environment and students had to respect and have confidence in their teacher-researcher. Similarly I needed to have confidence in and respect for the students I was working with.

Student images of the future as a legitimate and valued source of student prior knowledge had, to my knowledge, not previously been debated or evaluated in science education and therefore had the potential to add further insights into the importance of prior knowledge in science learning. This possibility was for me both motivating and legitimising for the study. However, with a constructivist approach I needed the support of the students and needed to be cognisant of Ellsworth's (1989) warning that

> [b]ecause those voices [student voice] are partial and partisan, they must be made problematic, but not because they have broken the rules of thought of the ideal rational person by grounding their knowledge in immediate emotional, social, and psychic experiences of oppression or are somehow lacking or too narrowly circumscribed. (p. 305)

What is of concern is that as the teacher-researcher I was in a position of authority as curriculum manager and assessor of student progress and that I could influence the confidence and utterances of students in the research situation to the detriment of valid data. In my case it was important for me to have a good relationship with students before the study was undertaken and to evaluate and make adjustments, prior to and during the study, with respect to student opinions about my teaching and their confidence in me. I had to be genuinely open about myself as a person, my expectations, and my assessment and reporting methods. There are many procedural elements to this aspect of teaching that all wise teachers use. But I believe it needs to go beyond procedures. To develop true empathy with students there is a need for a loving relationship and a disposition that includes a genuine caring for their welfare. In any such relationship there is the danger of developing blind spots or skewed interpretations which a constructivist approach works to overcome through the negotiation aspect of meaning. In this respect 'individual constructions are elicited and refined hermeneutically, and compared and contrasted dialectically, with the aim of generating one (or a few) constructions on which there is substantial consensus' (Guba, 1990, p. 27).

The reader of the research is also a constructor of meaning of the research, and so as to alert the reader of any possible blind spots or biases I included in my research report sufficient biographical information to enable the reader to make reasonable judgements and interpretations and to build a picture both factual and visceral in nature.

From intuitive beginnings I have gradually built up a picture of student futures which can be viewed through many conceptual filters and lenses. I have been able to address my research questions based on students' emic constructions rather than solely on my own etic construction (Guba and Lincoln, 1989). Through students' trust and openness to share their views about the future I have been able to search for meaning, relevance, and ways of valuing this particular aspect of student world views.

I do not want to leave this topic giving the impression that qualitative research is in some way superior to quantitative research or vice versa. They are different and each is appropriate in its own area of application. Qualitative research is appropriate for internal, subjective study where the search is for truthfulness. Quantitative research is appropriate for exterior, objective study where the search is for truth. Both areas of research have their strengths and limitations. Clearly it is not possible to record everything or negotiate meaning absolutely. Selections of data to collect and interpretations to settle upon will always have a level of uncertainty limited by the effects analogous to the Heisenberg Uncertainty Principle.

Me as Researcher

It was clear to me that my own concerns and interests had motivated the study and that I need to be mindful of reading into my findings, aspects that cannot be supported by the data, participants' views, and the literature. Provided I was aware of my special interests and conscientiously reflected upon them, this tacit knowledge (Polanyi, 1962) can be valued by the constructivist researcher (Guba and Lincoln, 1989). 'The fact that the investigator selects this particular problem or focus to investigate implies that a great deal is already known or understood, and those constructions can be laid on the table early on' (Guba and Lincoln, 1989, p. 176). However, the failure to acknowledge the theoretical perspective of the researcher is likely to result in the unexamined integration of this perspective with the analysis of the setting, and further, that these perceptions are likely to have already influenced the research planning, negotiations with participants, and 'gatekeepers'. There was clearly a need for me to be reflexive with data collection, selection, and interpretation. Within the research paradigm I was working the mechanism for valuing and validating the researcher's world view is the reflexive thinking and the hermeneutic dialectic described by Guba and Lincoln (1989).

Prior to the beginning of the study (i.e., before 1988), I had taken a number of courses in Jungian psychology and through workshops and a dream diary had kept records of my own reflective thinking. I was very aware that these experiences alerted me to the potential value of student images of futures. I also had to be conscious of the possibility of projecting my own existentialist concerns onto student data.

My own history and personal expectations, which I had never consciously brought into my work as teacher and (science) researcher became recognisably important through my reading in educational research methods but particularly in reading of the futures literature. I used a number of futures techniques to explore my own futures but one in particular was useful for research purposes. I used Boulding's (1989) concept of a 200-year present to provide the reader of my thesis with biographical information that again I suspected influenced my work. Because of the topic of my thesis, I was also able to use my own biography to illustrate the importance of an extended present in our own lives and how my own world view was formed and is still being formed through personal experiences and expectations, my social history, and cultural roots.

THEME TWO: STUDENT IMAGES OF FUTURES

I used a number of techniques for gathering data but the one I want to discuss here, because it is rather novel to the science education research environment, is a guided fantasy approach. The guided fantasy has the purpose of helping students let go of the past and project themselves into the future and become more aware of the underlying mental pictures that are their world view, and which colour their expectations, hopes, and fears.

In the guided fantasy process, I instruct students to close their eyes and then take them through a relaxation exercise in readiness for the mental projection into futures. By means of a story I take students on an imaginary journey 20 years into the future and ask them to examine what life is like, what kinds of houses people live in, how people travel, what kinds of clothing people wear, transport, technologies, and any symbols that seem to reflect the culture. Students are then asked to write about, or draw illustrations to represent their images. I follow this up with a debriefing session in which stories are told and discussed. I have included images from two of my students, Amy and William, to illustrate the nature of these data:

> I came over the hill and the road like was like it was black and harder and it was shiny and solar powered hovercraft like went around the streets. It was like a small kind of city and there were like lots of tall buildings and the people that were walking along the street like wore heavy duty clothing that blocked out the sun and polluted air and stuff. (Amy)

> There seemed to be a giant wood frame, there were people on it. They seemed to be building some thing in the sky. I asked a person selling some kind of organic petrol, what it was. He said they were volunteers from the community. They were restoring the Earth's ozone layer and also putting in a huge panel to save electricity. (William)

The imaging activity was novel for both the students and myself. There was, with me, a palpable level of apprehension and an acute realisation of the risk I was taking. I was using a new teaching methodology in a science learning setting and asking students to undertake an activity that was likely to reveal personal and subconscious material. However, all went well and the results were fascinating.

I interacted with the data in a number of ways. Initially it was from a holistic, undifferentiated, and mainly intuitive perspective. With further thought and the use of the literature I focused on four aspects of the images: holistic nature, utopic and dystopic qualities, common themes, and their congruence with the idea of progress. Each of the analytical tools resulted from reading the literature.

The holistic aspect came from the work of Moos and Brownstein (1977) on utopias in Western culture and helped me to identify the degree to which student images embrace the complexity of their world. I used Kateb's (1963) ideas to interact with students' work in terms of their utopic and dystopic nature. I later used the idea of utopia as a way of connecting student images with Western history, both past and future. As I became more familiar with student views of futures and began the process of categorisation and analysis it became clear that the idea of progress was prominent in their futures stories. I used the work of a number of authors (e.g., Nisbet, 1980) to interact with student images in this third way. I later used the idea of progress to explore how student images, which clearly contained this theme, connected to broader societal and cultural attitudes and dispositions. The fourth way I interacted with student images of futures was by looking for elements or themes that arose in students' work. I did this to identify and quantify the emerging elements of student images.

By using the dimensions of holism, utopianism, progress, and themes I was able to view students' expectations of the future from a number of perspectives. As a result I built a rich understanding of these students' personal views on the future that are generated through their personal experiences within their cultural setting and predominantly Western cultural history.

My early work in 1990 provided a starting point for my exploration of student images. Through that study I was able to develop skills and confidence in eliciting student images of futures. It raised my awareness of an aspect of students' world views previously unthought of by me and led to the research questions I discussed above.

CONCLUDING REMARKS

The research methodology that I have used in my thesis requires that the researcher be integral with the research act and do so in a reflective and inclusive way. To expose this dimension of the study I provided personal biographical data in an early chapter of my thesis to alert the reader to my own history and disposition. I also used my own story to illustrate how past experiences and future expectations identify in part who I am and by so doing added validity to my study. My interpretation of stories of student images of futures can then be explicitly seen as a joint construction by the participants and myself as author.

I have used qualitative research with a relativistic ontology, subjectivist epistemology, and a naturalistic methodology. More precisely, a participatory constructivist research approach has been adopted for this study which lies within the ethnographic research methodology. This approach represents an interpretation of classroom practice and student responses from a personal interpretive and

negotiated position. By using what students say and write about their imaging and verifying interview responses, confidence can be taken in the interpretation given.

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CATHERINE MILNE

SCHOOL SCIENCE STORIES AND A STRATEGY OF ACTION FOR CULTURAL TRANSFORMATION

In developing a methodology to generate and analyse data for a research study that formed part of my doctoral study I was driven by three goals:

1. To develop a methodology for my study that provided a consistent frame for analysis and synthesis of text – spoken, written, and acted.
2. To advance a methodology teachers and students could use to analyse and synthesise texts.
3. To propose a methodology that could be used by agents to transform school science not just reproduce the cultural structures that constitute school science and are, in turn, constituted by it.

BACKGROUND

This methodology is underpinned by the notion of culture as a weave of practice and symbol systems in which users of culture share a semiotic field. You might assume that a shared understanding of symbol systems would result in a thickly coherent culture. Although actors understand the symbol systems that help constitute a culture, they do not use these systems in the same way and what emerges is thin cultural coherence and contested boundaries (Sewell, 1999). 'What are taken as the certainties or truths of texts or discourse are in fact disputable and unstable', (Sewell, 1999, p. 50). Inconsistencies and contradictions must be a factor within the culture when interaction between symbol systems and practices is not causal. Therefore within cultures such as science and school science, different texts can be represented. These texts can serve to constitute resources. Resources frame cultural structures upon which practices are enacted and which enact practices.

Sewell (1999) argues that 'structure is a set of mutually sustaining schemas and resources that empower and constrain social action and tend to be reproduced by that social action' (p. 19). The cultural structures of school science are composed of cultural schemas and resources. Cultural schemas represent rules for group action,

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 69–79.

norms, beliefs, and cultural practices that are enacted through space and time (Sewell, 1992). For example, in school science classrooms, cultural schema can represent expectations about appropriate methods for generating science knowledge and the types of behaviours that are valued. Resources can be human, material, or symbolic and the resources that participants bring determine the forms and quantity of capital to which individuals or groups have access (Bourdieu, 1977). Bourdieu differentiates four categories of capital: economic, social (ability to sustain relationships with significant others), cultural (legitimate knowledge), and symbolic (reputation and distinction). Resources can include the forms of capital that students and teachers bring to the classroom, how those resources are valued in the social systems of schools and the resources that are available in schools and classrooms for use by students and teachers in the reproduction of structures. However, there is an inequitable distribution of these resources that reflects an uneven distribution of power. The more resources that a group or individual have, the greater their power.

According to Sewell (1992), agents have the power to enact and change structures. Agency arises from an ability to apply schemas to different contexts and from an actor's control of resources to transform schemas. Our capacity for agency is culturally and historically determined. My experience as a high school science teacher had made me aware that very often teaching occurred in a resource-poor environment where teachers were dependent on textbooks for information. The accounts in textbooks are usually treated as though they represent the reality of the situation that is being described. After reading Scholes (1981) and Carter (1993), I realised that the notion of narrative as a selection of events for the telling could inform my analysis of accounts in science textbooks. In a narrative, not all the events in a situation are given equal significance and some are left out altogether. When this selected sequence of events has a recognisable narrative structure, and particular cultural and human values are embedded in the content, you have a 'story'. If examined from a sociocultural perspective we could say that there are events that are known about a specific area. When events are selected they constitute a resource. This resource is represented in a particular form because of the cultural schemas that inform the selection and at the same time are constituted by the selection.

Science as a Story: How Can Such a Notion be Supported?

The notion of science as a story can be an anathema to those teaching science because often stories are equated with fiction and science is about facts. Having facts is one way of differentiating between science and other subjects. Some might argue that facts and theories are taught in science, while stories are used to help students talk about their understandings in a different way or used as anecdotes by teachers to make science more interesting for students. Some readers might think that they could possibly accept the importance of 'accounts' as part of school science because accounts are used to link facts together in a time frame. These accounts can be used to explain concepts or processes to children but they are based on facts and therefore could never be described as stories.

However, why not look at the relationship between science and stories differently? Think of all the knowledge available to us about science, even a tiny area. When people represent this understanding do they include all the knowledge that they have about that area? Consider the discussion of life cycles in a primary science class. Life cycles tend to be a component of some, if not all, primary science curricula. Look at 'the life cycle of a mealworm' in Figure 1 (Australian Academy of Science, 1994, p. 163). Is this life cycle an account, a description, or, is it a story?

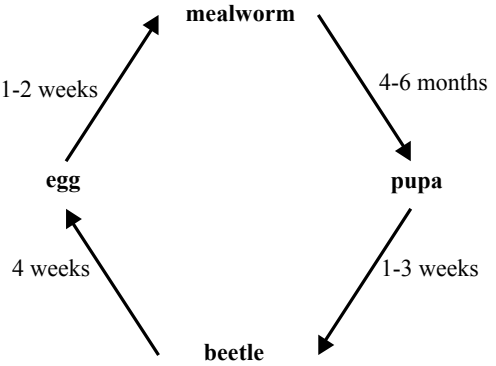

Figure 1. Life Cycle Mealworm (from Australian Academy of Science, 1984, p. 163).

I wonder who decides which mealworm is represented in this account? Is it possible in our account or in a textbook account to include all the facts about a mealworm's life that are available to us? If it is not, who decides which facts to include and which to leave out? What implications do the selection of facts have for the meanings and values that embed the account? I argue that once ideas are presented selectively in science we are no longer telling 'the facts'. We are instead telling a story. Thus, in the example above there exists one possible story about a mealworm and its life cycle. It seems to me that in every account we choose events for the telling and, in the process of that selection, we construct a story.

I wanted to examine the story resources in school science textbooks, analyse the cultural schema such as beliefs and norms that drove the production of those resources and were reinforced by those resources, and demonstrate how these resources could be transformed and in the process transform schemas. I realised that schema and resources were intertwined and that changing one would change the other. My reading of the history and philosophy of science allowed me to develop cultural capital that I could use in this analysis. I brought to this study certain philosophical perspectives – cultural schema – that would assist me to choose different events for the construction of resources in the form of stories than the textbook stories that I selected for analysis.

METHODOLOGY

The methodology that I developed was based on Scholes' (1981) semiotic circle structure of stories (see Figure 2).

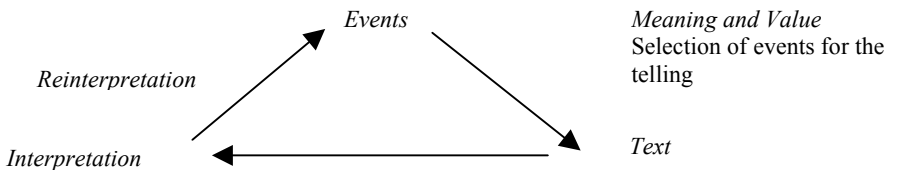

Figure 2. A Semiotic Circle of a Story.

According to Scholes (1981), issues of power are embedded in the selection of events for the telling because the storyteller has access to resources that are not available to those reading the stories. This has always concerned me in school science because I see teachers and students can be held in the power of the textbook that structures their learning experiences (Apple and Christian-Smith, 1991). In the selection of events for the telling, writers of stories determine the events to which teachers and students should have access. If teachers and students accept these stories and act as though the stories are true then they accept the cultural schema that are embedded in these stories and interpret the stories from that perspective. In this process, they are involved in cultural reproduction of cultural structures and the maintenance of schema and resources.

How Does the Construction of Stories Work?

If teachers and students of science understand how stories and narratives are structured; if they understand the relationship between events, text, and interpretation; and if they appreciate that stories are informed by values and meaning; then they can develop an awareness of the possibility of multiple representations of events and cultural transformation. Thus, if we wish to encourage the implementation of constructivist-based teaching and learning practices in science it may be important to understand the influence of narrative structure on the representation of science because stories are an undeniable feature of the human condition. A critical awareness of the interaction between meanings and values and the formation of a story can involve the actors, such as researchers, teachers, and students in creating a text resource that is different from the texts that are represented in other sources. My first goal was to develop a methodology that these theoretical perspectives framed and that I could use to analyse textbook stories as part of my doctoral study. An understanding of cultural schemas and the existence of human creativity indicates that all humans have the capacity for transformative action (Goffman, 1967).

Why are Stories so Common in School Science Textbooks?

Students are novices who are believed to lack knowledge about science, that is, 'situated' knowledge, so textbooks and teachers use stories to help students make sense of the purported grand narrative of science. Thus, stories are used to help students organise their knowledge into explanatory frameworks that serve them as interpretive 'lenses' from which to comprehend their experiences in science and within which they act. Even stories about the natural world reveal the author's values and attitudes (Pagano, 1991). Consequently, narrative structure in school science serves to assist in the construction and transmission of a particular notion of the culture of science. However, I hope that narrative can also assist to transform school science. Because science stories reveal implicitly something about the nature of science, they serve to legitimate particular philosophical frameworks in science that might not be consistent with contemporary developments in philosophy of science or educational practice. I interpreted Scholes (1981) semiotic circle in the following way (Figure 3).

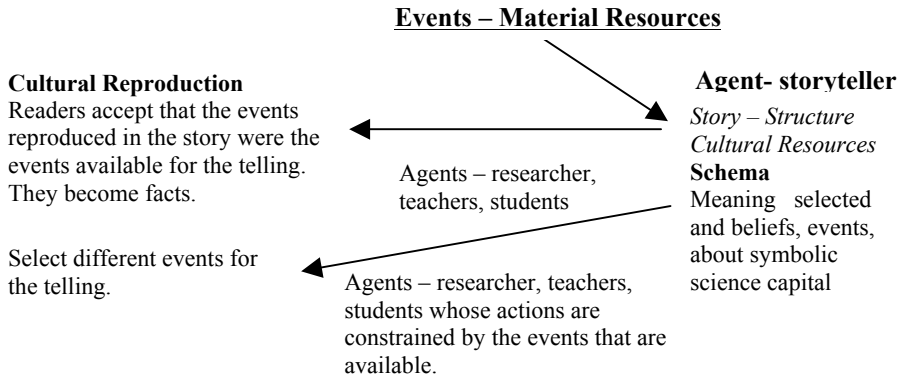

Figure 3. Stories, Cultural Reproduction, and Cultural Transformation.

Events are the things that can be known from which episodes are selected for the telling of a story. These represent material resources. Often teachers and students do not have access to a broad range of events and they accept that the stories found in science textbooks are the only possible way of representing certain ideas. Textbooks possess social capital because of the way they are produced and marketed. They also possess cultural capital in the form of legitimate knowledge but how much cultural capital do they possess? Embedded in the stories are the cultural schemas, the beliefs, values, norms, and group rules that informed the selection of those events in

the first place. In the practice of reading a text its coherence is always at risk as readers interpret the text for themselves and the text is always likely to undergo minor transformation. However, if schema and resources remain substantially unchanged then the education that occurs in that situation will be cultural reproduction. I wanted to develop a methodology that encouraged readers to be critical and transformative, to value the cultural capital that they brought to the construction of stories and to be more critical of the apparent cultural capital embedded in the stories present in textbooks. I wanted to develop a methodology in which efforts to transform stories were conscious and directed. What follows is an account of this methodology and its application to a particular story.

APPLICATION

How can this analysis be applied to a specific science story?

In the course of my research study reading through many high school science textbooks, I identified many different stories. Cultural schemas in the form of beliefs and values about science that informed the creation of these stories were quite varied. In order to write different stories actors need to know more about the events surrounding the story than is available in the text. It also requires a critical approach so that the actor stops and asks, 'What are the values that underlie this text?' and 'Are there other events that I could use to tell this story differently?'

If the selection of specific events for the telling produced a story in which certain cultural schema were embedded then selection of other events for the telling would embed different cultural schema. The cultural schema and resources are woven together so that if the storyteller wanted to emphasise other cultural schema, different events would be selected and a different story would be told. In order to tell different stories I would need to do the following (see Figure 4).

1. Read the story and identify the schemas that inform the story.

   Food Chains and Food Webs

   In a freshwater aquarium, you can see how plants and animals interact. Some animals eat only plants, and other animals eat smaller animals. You can show how plants and animals interact by describing food pathways. These are called *food chains*. . . . In a natural pond you would probably find several food chains linked together. Food chains linked together like this are called *food webs*. (Stannard and Williamson, *Two Exploring Science*, 1986, p. 64, italics in original)

2. I need to ask questions such as, 'What are the meanings and beliefs that are embedded in this story?'

Material Resources Events

The term food chain was proposed as a term to describe feeding relationships between producers and consumers. Since they began hunting and farming people had observed that animals ate plants and other animals but in the early 20th century ecologists began theorising about these relationships. Charles Elton, on an Oxford University Expedition to study Spitzbergen, an area above the Arctic Circle, proposed the term to explain their observations. As he said, 'We refer to these as "food-chains", and all the food-chains in a community as the "food cycle"' (Elton, 1927/1966, p. 56). According to Elton (1933), Shelford who was studying Illinois habitats and constructed a theoretical food cycle diagram first proposed the notion of food chain in 1913.

Alternative Cultural Schema – Meanings and values supporting the selection of events for the telling

Scientific concepts, such as food chain, are human constructions. Scientists construct concepts based on theoretical understandings that they have developed from years of study. People interpret Nature. They do not describe it. Unless you know about food chains, you will not find them in Nature.

Cultural Schema – Meanings and values supporting the selection of events for the telling

Scientific concepts exist in Nature to be discovered by humans. Words like 'food chain' describe Nature as it really is. There exists a direct relationship between object-word-meaning. Anyone can see a scientific concept in Nature.

Alternative Story

Food Chains and Food Webs

In a freshwater aquarium, you can see that plants and animals interact. Some animals eat only plants, and other animals eat smaller animals. In 1921, Charles Elton carried out ecological studies in the Arctic Circle as part of the Oxford University expedition. He was one of the first biologists to study animals in relation to their environment and other animals and plants and coined the term 'food chain' to describe the feeding interactions that he observed. The concept of 'food chain' was based on observations that if you studied communities hard enough you noticed that all feeding relationships began with a plant. As early as the 18th century, and perhaps even earlier but no one wrote about it in science publications, people realised that organisms depended on each other as a source of food for survival. If you look at the animals and plants in the aquarium, you might be able to suggest some food chains. Today we call all the food chains that can be identified in a community a *food web*.

A greater knowledge and awareness of history and philosophy of science supports the development of this text. So although it might have less **symbolic capital** because the writers might not have the same status as textbook authors, it has more **cultural capital**. Alternative stories might also make greater use of the **cultural capital** that students and teachers bring with them from their home cultures.

Story from Textbook

Food Chains and Food Webs

In a freshwater aquarium, you can see how plants and animals interact. Some animals eat only plants, and other animals eat smaller animals. You can show how plants and animals interact by describing food pathways. These are called *food chains*. . . In a natural pond you would probably find several food chains linked together. Food chains linked together like this are called *food webs*.

(Stannard and Williamson, 1986, p. 64)

In its development the text can also become imbued with some **cultural capital** because it is believed to represent knowledge and **symbolic capital** because of the status ascribed to textbook authors and publishers. Because all these resources sustain it, the text has a lot of power in the classroom.

Figure 4. Enacting the Analysis and Synthesizing Different Stories.

In the example in Figure 4, I needed to read the story about *food chains* and *food webs* very carefully and think of the schemas or values and meaning that inform the presentation of that story. I argue that this story imputes that food chains are concrete entities that have an independent existence and that when anyone looks at Nature they see food chains. It implies also, that science is about objects, such as food chains, and that words used in science have fixed meanings that directly relate the object to the word. For example, a food chain is a food pathway which shows the eating interactions between plants and animals. To me a fundamental assumption of this presentation is that the language of the story is describing Nature, not presenting a particular notion of Nature. What is lost or hidden in this story is the notion that the word food chain, and its underlying conceptual framework, are scientific constructs that have been developed to help scientists and others explain and predict. This declarative science story presents a particular rhetoric of science that is underpinned by specific philosophical notions about the nature of science and language. In this story the notion that the word food chain and its underlying conceptual framework are human constructs has been hidden and interpretation is presented as description.

3. Research the events in the story to learn what other events are available and what meanings and beliefs can be presented with a different selection of events for the telling.

In the example in Figure 4, I used other resources such as the *Oxford Dictionary* to learn of possible sources of the term and concept of food chains. According to the *Oxford Dictionary*, the word *food chain* was introduced to the English language by Charles Elton in his book *Animal Ecology* which was first published in 1927. He wrote:

> There are, in fact, chains of animals linked together by food, and all dependent in the long run on plants. We refer to these as 'food-chains,' and to all the food-chains in a community as the 'food cycle.' (Elton, 1927/1966, p. 56)

In his account, Elton emphasises the constructed nature of food cycles. If we accept the schema that scientific knowledge is not static but changes as scientists investigate their world then, perhaps, in school science we also need to emphasise how humans order Nature by developing conceptual frameworks. These frameworks, of course, must 'fit' with the constraints of Nature. I also used resources such as a dictionary of the history of science in which the historical emergence of the concept of food chain is discussed and books published by Charles Elton. I also searched the World Wide Web for references to Charles Elton. When researching events for other stories I used other resources such as original issues of *Philosophical Transactions*, publications by historical figures such as Hooke (1665/1961) and resources such as publications by Conant (1957), Fasto-Sterling (1992), and Alic (1986).

4. Propose another story based around the same events but with the selection of different events for the telling.

Of course, the schemas and resources that I have available underpin the story that I write. I want to tell a story that implies that the notion of food chains is a constructed notion that was proposed by a human, Charles Elton, working with others. He proposed a term that could be used to represent the notion of a feeding relationship between plants and animals and animals and other animals.

Food Chains and Food Webs

> In a freshwater aquarium, you can see that plants and animals interact. Some animals eat only plants, and other animals eat smaller animals. In 1921, Charles Elton carried out ecological studies in the Arctic Circle as part of the Oxford University expedition. He was one of the first biologists to study animals in relation to their environment and other animals and plants and coined the term 'food chain' to describe the feeding interactions that he observed. The concept of 'food chain' was based on observations that if you studied communities hard enough you noticed that all feeding relationships began with a plant. As early as the 18th century, and perhaps even earlier but no one wrote about it in science publications, people realised that organisms depended on each other as a source of food for survival. If you look at the animals and plants in the aquarium, you might be able to suggest some food chains. Today we call all the food chains that can be identified in a community a *food web*.

It is not necessary that teachers and students know the names of all the researchers and scientists who proposed names for relationships, or interactions, or objects. However, it is important that they begin to examine the cultural schema that inform the stories that they read in textbooks and in general science books and magazines. If they do they might accept that concepts do not lie around in Nature waiting to be discovered so that someone exclaims, 'I've found a food chain!' By developing a better understanding of the history and philosophy of science it is possible to develop cultural capital that can be applied to the telling of other stories. A greater knowledge and awareness of history and philosophy of science supports the development of other science stories. So although these stories might have less symbolic capital because the writers might not have the same status as textbook authors, they can have more cultural capital. Alternative stories also can make greater use of the cultural capital students and teachers bring with them from their home cultures.

CONCLUSION

I have found the methodology that I outlined in this chapter to be very useful in other research that I have done and in my own classroom practice. It has become a strategy of action that I use unconsciously as I read the arguments and narratives of others. Swidler (2001, 1986) agrees that culture is not a unified whole and argues that it is a tool kit or repertoire from which participants in the culture can develop strategies of action that they use to achieve their goals. She argues, 'Strategies of action incorporate, and thus depend on, habits, moods, sensibilities and views of the world' (Swidler, 1986, p. 277). The methodology that I propose in this chapter is a strategy of action and is consistent with the notion of school science as being composed of a tool kit from which I have selected the actions that allow me to achieve the goal of writing alternative stories. This methodology is a tool or a

strategy of action that researchers, teachers, and students can also use to transform aspects of school science culture.

The agency that researchers, teachers, and students bring is necessary for cultural transformation through the telling of alternative stories rather than cultural reproduction through the propagation of stories that are told in textbooks and by teachers. Through this strategy of action we can change the structure of stories in the process of using different resources and valuing different schema. The thin coherence that allows us to identify that we are involved in school science also allows us to use the same semiotic systems that are recognised by other users of school science but to tell other stories. Having an active role in the construction of stories helps researchers, teachers, and students to realise their agency in the construction and transformation of the culture of school science. Critical agency encourages us to analyse stories in a search for implicit values and meanings in cultural schema, to recreate these stories from multiple perspectives, and to accept that these reconstructions are as valuable and meaningful for use in school science as the original text construction. The semiotic circle (see Figure 2) provides a framework for the actions of classroom analysis of science stories in order to assist students and teachers to unpack the meaning and values that shape the construction of the text of science stories from selected events. It also provides an approach to re-creating the stories by selecting other events for the construction of a different text about the same subject. After all, it is in the process of the selection of events for the telling that philosophical underpinnings, the meanings and values, the cultural schema are incorporated into each science story. As a result, science can be thought of as constructed by multiple voices rather than one dominant voice.

Science teachers might examine how they use language in their classrooms. They might contemplate whether they use language to imply that scientific concepts exist in nature and emerge fully formed when students look hard enough or if they open the door to consideration of human agency in the construction of these apparently natural frameworks. Students and teachers can examine the apparent cultural capital that a textbook story brings with it. Further, they can examine the semiotic system that presents what is a human interpretation of Nature as a description of the world ‘as it is really’, that is as facts rather than as representations. Teachers might begin to think about the implications of science as storytelling because the science that they and their students read in school science is based on someone’s notion of what needs to be told about a scientific concept. Conceptual frameworks like food chains are powerful, explanatory, and predictive because they allow learners to look for relationships in a variety of situations and to make predictions about those relationships but they are still human constructions. To develop a critical facility learners need to have access to strategies of action such as the methodology proposed in this chapter to develop alternative science stories and in the process culturally transform their school science. Without strategies, such as the strategy I propose in this chapter, we are likely to perpetuate the cycle of cultural reproduction of actions and beliefs about science that are employed by the texts currently in use.

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SECTION II

MEETING THE RESEARCH CRISES

This section exemplifies increasingly artful ways in which the qualitative researcher can represent meaning more meaningfully and generate meaningful action amongst the participants of his/her research, especially the reader of the research report. The theme of this section reflects the move into the fourth and fifth moments of qualitative inquiry (Crisis of Representation, Postmodern Experimental Ethnographic Writing) where researchers become more reflexively aware, blur the boundaries of fieldwork and writing by adopting writing as a method of inquiry, and conduct research for the purpose of producing context-based practical knowledge.

Four chapters illustrate how practitioner-researchers use narrative modes of inquiry, including various literary genres, to explore their own professional practices and to represent their inquiries in ways that engage their readers in acts of pedagogical thoughtfulness.

- **practitioner-researchers:** Vaille Dawson (Ch. 8); Bob Fitzpatrick (Ch. 10); Russel Montgomery (Ch. 11), David Geelan (Ch. 13)

In the remaining chapters, qualitative-researchers use narrative methods and literary genres (amongst other methods) to produce distinctly differing forms of educational theory.

- **cultural-researcher:** Jill Slay (Ch. 9)

- **participant-observer:** John Willison (Ch. 12)

CHAPTER SUMMARIES

Chapter	Context of the research	Focus of the chapter	Methodological referents	Quality standards
Ch. 8: Vaille Dawson	A practitioner-researcher investigates her students' experiences of learning science by means of bioethical dilemmas	The researcher outlines the use of fictive tales to investigate her students' novel learning experiences	▪ *Interpretative case study* (Merriam, 1988; Guba and Lincoln, 1989) ▪ *Narrative tales and commentaries* (Schulman, 1992; van Manen, 1990)	▪ credibility ▪ reader engagement: verisimilitude, coherence, interest
Ch. 9: Jill Slay	A researcher investigates Chinese and Australian students' beliefs about Nature	The researcher illustrates her use of narratives of experience to augment naturalistic inquiry and assertion-making	▪ *Researcher as bricoleur* (Denzin and Lincoln, 2000) ▪ *Narrative inquiry methods* (Clandinin and Connelly, 1996) ▪ *Practical knowledge* (Fenstermacher, 1994)	▪ adequacy and plausibility ▪ objectively reasonable knowledge claims ▪ practical reasoning
Ch. 10: Bob Fitzpatrick	A researcher investigates critically his own leadership practice in facilitating structural change within his school	The researcher illustrates the use of dialectical writing as a means of inquiring into his own professional experience	▪ *Writing as inquiry* (Richardson, 2000) ▪ *Critical incidents* (Tripp, 1993) ▪ *The dialectic* (Giroux, 1981)	▪ multiple voices ▪ critical reflexivity ▪ reader engagement
Ch. 11: Russel Montgo-mery	A researcher explores critically his experience as a mathematics curriculum writer in a non-school setting	The researcher illustrates the use of multiple genres to represent and explore conflicts in his personal and professional values	▪ *Tales of the field* (Van Maanen, 1988) ▪ *Ricoeur's hermeneuti*c of *self-hood* (Boje, 2001)	▪ coherence ▪ multiple interpretations ▪ critical reflexivity ▪ emergence
Ch. 12: John Willison	A researcher investigates classroom factors influencing students' development of scientific literacy	The researcher outlines his use of multiple genres and metaphor to conceptualise the interpretative framework of his research	▪ *Tales of the field* (Van Maanen, 1988) ▪ *Metaphor* (Lakoff and Johnson, 1999) ▪ *Analytic induction* (Erickson, 1998)	▪ interpretative power ▪ coherence ▪ voice ▪ emergence ▪ writer and reader engagement: transferability, verisimilitude ▪ reflexivity ▪ researcher self-growth
Ch. 13: David Geelan	A practitioner-researcher explores his experiences of team teaching in an innovative middle school	The researcher explains the use of impressionistic tales to represent his problematic experience as a teacher-researcher interacting with colleagues and students	▪ *Narrative methodology* (Clandinin and Connelly, 1988) ▪ *Impressionist tales* (Van Maanen, 1988) ▪ *Bricolage* (Denzin and Lincoln, 1994)	▪ reader engagement: verisimilitude and coherence ▪ catalytic validity: pedagogical reflection of researcher and readers

VAILLE DAWSON

EXPLORING STUDENTS' LEARNING EXPERIENCES THROUGH NARRATIVE TALES

CONTEXT

This study examined the experiences of a class of Year 10 students at an independent girls' school in Perth, Western Australia, who were studying a Biotechnology course based on the topic of human organ and tissue transplantation. One of the aims of the course was to help students develop the skills to make ethical personal choices about organ transplantation.

This chapter reports on the use of narrative tales (Connelly and Clandinin, 1988; Taylor and Geelan, 1998; Van Maanen, 1988) as a method of generating data. Briefly, case study field notes were used to construct two narrative tales illustrating the (different) learning experiences of two students. Research participants were asked to comment on the extent to which the tales were a 'realistic' portrayal and to reflect on the learning experiences of the two students. The participants' interpretations provided a further source of data which served to enrich my own understanding of the research environment.

This research formed part of a larger study describing and evaluating the types of learning activities utilised by science teachers who were incorporating bioethics education into their science programmes. The research methodology was based on an interpretative case study approach (Merriam, 1988). Utilising Guba and Lincoln's (1989) credibility criterion for judging the quality of this type of qualitative research, the extent to which the teachers' and students' experiences were honestly portrayed was enhanced through prolonged observations and frequent feedback to the participants at all stages of the data collection. Sources of data included multiple semi-structured interviews with the teacher, Carmel, multiple semi-structured interviews with a group of five students, students' work samples, reflective journal writing (Holly, 1992) recorded after interviews and questionnaires completed by all students at the end of the course. The questionnaires related to students' perceptions of the learning activities, teaching style, course content, and

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 83–91.

learning outcomes. Students also completed a survey containing four bioethical dilemmas. The students' ability to resolve bioethical dilemmas was compared with that of experts and also with a similar group of students who had not completed the course.

My initial analysis of the data suggested that the students demonstrated four main outcomes related to bioethics education. The outcomes were:

- an awareness that bioethical issues associated with biotechnology and transplantation, in particular, do exist;
- an awareness that a group of individuals will hold a wide range of bioethical values;
- an awareness that students need to listen to and respect the bioethical values of others;
- an awareness that bioethical principles and a decision-making process exists.

As the study proceeded, I began to realise that the extent to which these four learning outcomes were achieved varied among students. This led me to ask the following questions. Why did the Biotechnology course enable some students to better evaluate bioethical dilemmas than others? In what ways did students differ in their learning and why? What factors influenced their learning?

After considerable thought I decided to address these questions by writing two narrative tales that would represent the experiences and learning outcomes of two imaginary students. The purpose of the two narrative tales was to present a credible and authentic account of students' learning experiences and associated outcomes. The extent to which the tales are credible and authentic is explored through the use of commentaries from research participants. I hoped that these commentaries would enhance my understanding of factors affecting student learning.

WHAT IS A NARRATIVE?

In answering this question, I call on two accounts of the origins of the term, narrative. The first is from Max van Manen's (1990) book *Researching Lived Experience*, which states that '"Narrative, to narrate", derives from the Latin *gnoscere, noscere*, "to know". To narrate is to tell something in narrative or story form' (p. 120). Diamond (1995) gives a similar derivation when he states that 'The etymology of narrative can be traced to the Latin *narrare*, to relate or to account, which derives from *gnarare* which is related to *gnarus*, knowing or skilled, which in turn is related to "to know"' (p. 82).

Notwithstanding the Latin derivation, meaning 'to know', a narrative is not a set of facts that purports to represent knowledge or 'truth'. Rather, a narrative aims to portray in a rich and compelling way the problematic nature of life (including research). A narrative is an expression of our lived experience. It is concerned, not with facts, but with plausibility.

According to Shulman (1992, p. 21), the characteristics of narratives are that they have a plot and characters, they deal with specific situations rather than generalisations and they occur within a social and cultural context that is made explicit. A narrative should also reveal a sense of human agency and intention. As Bruner (1986) states, 'A narrative deals with the vicissitudes of human intention' (p. 16). A narrative may include, for example, the motives, misconceptions and frustrations of the characters.

FICTIONAL TALES

A narrative genre seemed to be an appropriate, ethical and authentic writing style to represent the research participants. I chose to portray the experiences of two students, Holly and Leanne, each of whom achieved the four learning outcomes to differing degrees. In writing the tales I was mindful that a narrative should affect the reader. It should compel readers, cause them to reflect, involve them personally, and transform them (van Manen, 1990, p. 121). I agree with Diamond (1995) and Richardson (1994) that the criteria by which a narrative may be judged include verisimilitude (does it ring true? is it plausible?), coherence (does it hang together?), and interest (is it compelling?). These criteria need to be satisfied not only for myself, but also the participants who later commented on the tales.

The tales are fictionalised in that Holly and Leanne do not actually 'exist'. Holly's tale represents the experience of a student who achieved the four learning outcomes to a greater extent than did Leanne. The construction of fictional composite characters is not unique in science education research. For example, McRobbie and Tobin (1995) created a composite character, Gayle, to illustrate the experience of a Year 11 chemistry student. They used interview data from several students to portray the voice of the character. The authors used the narrative account of Gayle to demonstrate the interaction between teacher and students in relation to teaching and learning. They felt that this genre allowed the voices of the teacher and the students to be heard in an authentic way. The resulting vignette was given to students (and others) who provided feedback. This process reassured the authors that the vignette was credible and authentic.

A fictional character was also utilised by Tippins, Tobin, and Nichols (1995). In their narrative about a constructivist teacher, the authors developed the composite character of Ms Halfaday to illustrate how a teacher would use constructivism as a referent in their teaching practice. The character was based on the authors' collective experience. They wrote that:

> We were unsure of the extent to which the community of science educators would accept our narrative approach to communicating what we had learned from a program of research. To us, it no longer mattered whether Ms Halfaday was a 'real' person, whether she was a composite character, or whether she was entirely imaginative. Through this narrative account of her teaching and her classroom she was as real to us as any other teacher we had written about. We had decided that, just as in any case study, the significance and meaningfulness of this paper would be gauged by the reader... We do see it as a powerful tool to communicate to practitioners, a tool that has greater application in science education than we perceive at the present time. (Tippins, Tobin, and Nichols, 1995, p. 148)

I concur with the sentiments expressed in this quote. In constructing the characters of Holly and Leanne, I have also drawn on my own experience as a teacher at the school in this study, a past teacher of the biotechnology course and as a researcher in Carmel's classroom.

HOLLY'S TALE

Data pertaining to several students were combined to write Holly's tale. Excerpts from student interviews, written questionnaire comments, and students' work samples were extracted and ordered to construct a narrative that I felt was cohesive and representative of the students I had observed. Extracts from Holly's tale are presented here:

> Holly is a slightly built student with long, dark hair pulled back with a green ribbon. She is a quiet and shy student who, in class, rarely asks questions. Although not an 'A' grade student, Holly works hard in all of her school subjects. If she doesn't understand a concept, she will approach her teachers at recess or lunchtime. Her assignment work is always done meticulously. Even though she studies hard, she doesn't do as well as she wishes. It is written tests that she finds most difficult. Even though she rewrites all of her notes and reads her textbook, when she does the test she can't always understand the questions.

Interview One

> We just had our first lesson with Mrs M. She is a good teacher. She seems to know what she is talking about and can tell us things without looking through notes all the time. This is not how science is usually taught. It is more like social science. She got us involved and expressing our opinion.
>
> She told us about the movie, *Junior*, and Baby Fae, where the baboon's heart is put in the baby. I think it's really cruel. To save a life, an innocent animal has to be sacrificed.
>
> I'm not sure what we're meant to learn. About social issues, about what society accepts. I've never really thought about issues before. I didn't know there were any.
>
> Mrs M also explained about the decision making process. She said we had to weigh up the advantages and disadvantages to get an outcome. Then she told us about using bioethical principles to make a decision. She told us about different types of ethical theories.

Interview Two

> We did a cool activity today where we lay on the floor and traced our bodies. I learnt the names of different organs and where they were. Then we did an activity called 'The Transplant Equation'. We read an article and watched a video about transplantation. Mrs M. told us the meaning of hard words. We talked about who is involved in a transplantation, the donor, recipient, their families and the doctors and their rights, needs and duties. This is complicated for me. I didn't realise how rare organ donors are.

> Last lesson we watched a video called 'Sharing Yourself' Around. It was really good. It made me think about whether to donate my organs when I die. Their ideas were like ours except for one girl. She was really annoying. She was like, we're going to die anyway, so why bother? I guess she had her reasons. If you have a chance you should take it. You may as well save a life. When we discussed the video in class I learnt how others feel. Everyone has different opinions and we should respect their views.
>
> We also did an activity called the 'Liver Transplant Activity'. We had to agree on who would get a transplant. It was difficult. We couldn't agree on who was going to get a transplant. Samantha said that the Vietnamese kid should get a transplant and she wasn't going to bend. It really made me think. I hadn't realised there were so many issues. I got to listen to other people's opinions and they listened to me. You hear people say things and you think, oh yes.
>
> What I like about Biotechnology is it's not too intense. It's easy to learn because of the teacher and the way it's taught. I prefer people teaching me by talking to me and me talking back, not just being told what's what. Before I thought science was hard and irrelevant. This course has changed and informed my views on many topics I hadn't considered before. I am thinking about what my ethical views are.

Interview Three

> I think I have changed since I did this course. I think more before I give my opinion. Before I did Biotechnology, I didn't know anything about transplantation or other issues, so what I thought was my first impression. Now I would talk about an issue and research the problem. I would think it through logically and I have a better understanding of how to do this. I also think I have learnt how to express myself. I didn't know how to before. When teachers asked me what I thought about something, I couldn't answer. Now I can. Last week, in English, we had to write about an issue and I chose transplantation. I gave a talk about it. I said there should be an opting out process where unless you say no it is assumed you will donate.

LEANNE'S TALE

Leanne's tale represents the experience of a student who achieved the outcomes to a lesser degree than Holly. Leanne's tale was far more difficult to write. Her 'voice' was not heard in the interview and questionnaire data. Also, the absence of a learning outcome was difficult to represent. Did this type of student exist? There are a few clues that emerged from my classroom observations and discussions with the teacher. The brevity of some student interviews and questionnaire responses brevity suggested a lack of engagement with the learning activities. It was these constraints and hints and my tacit understanding of different types of students that I fleshed out to develop Leanne's character. Extracts from Leanne's tale are presented here:

> Leanne is a vivacious and spirited girl. She is somewhat disorganised and often has difficulty meeting assessment deadlines. On several occasions this year, Leanne has turned up to class to find there is a quiz or a test for which she has forgotten to study. Although students use a homework diary Leanne prefers to spend her study time decorating the pages with fluorescent pens, and gluing in photos of her friends and favourite rock stars. In class, Leanne is a student who participates actively in

discussions, but she finds note taking boring. She especially likes group work because it means that she can chat with her friends.

Leanne is studying the topic of Biotechnology in science. She likes the way the subject is taught. She doesn't have to take notes and there are plenty of discussions. Leanne also likes the discussions because she can give her opinion. But last lesson, when she called out, Mrs M told the whole class that they needed to listen to each other, rather than just talking. However, Leanne doesn't want to hear other peoples' opinions. She just wants to talk about hers.

Leanne had to give an oral presentation on a newspaper article about a woman who received a kidney transplant from her brother. She also had to talk about some of the issues the article raised and state her opinion. She had forgotten about the presentation until the lesson it was due. While other students gave their talks, Leanne highlighted sections of the article with one of her fluorescent pens. Leanne read directly from the article and concluded by saying transplantation was a good idea because the woman's life was saved. Mrs M asked her if she had thought about what may have happened if the transplant had failed, and should family members be allowed to donate their organs? Leanne wasn't sure. She hadn't thought about it.

Last week, the class did the Liver Transplant Activity. Leanne had a maths assignment to complete, so she worked on that while her friends decided which patients should receive a liver transplant.

Leanne decides that the best thing about the Biotechnology course is it's about giving your opinion. It doesn't matter what your opinion is, as long as you can back it up.

Perhaps because Holly's 'voice' was more obvious in the data than Leanne's, it was easier to write Holly's tale in the more active first person, whereas Leanne's is written in the more passive third person.

WHAT DO THESE TALES TELL US?

I asked the classroom teacher, Carmel, and five of the students who studied the course (Sarah, Katie, Melanie, Gemma, and Amanda) to read the tales and provide written feedback (commentaries) on the extent to which the reality of their learning experiences was portrayed. Shulman (1992) states that 'commentaries "layer" cases by providing additional perspectives or lenses through which to view the events of the case' (p. 12). I asked Carmel and her students, firstly, whether students like Leanne and Holly exist? To what extent do the narrative tales ring true? Are they plausible? To what extent do the tales 'resonate' with their own experience? Secondly, I asked them what they thought Holly and Leanne had learnt in the biotechnology course. Finally, I asked what factors may have constrained Holly's and Leanne's achievement of the learning outcomes.

I also sought feedback from individuals other than the research participants. It was possible that Carmel and her students may have been unable to separate the tales from their own personal experiences. When the students read the tales and wrote about what they thought Holly and Leanne had learned, they may also have been recalling and writing about their own learning experiences. Similarly, Carmel may well have written down what she thought the students should have learned.

The criterion of verisimilitude was uppermost in my mind when I asked two colleagues of Carmel (Alyson and Geraldine) if they would comment on the tales. Both Alyson (a mathematics teacher) and Geraldine (a physics teacher) are familiar with the types of students who attend the school, but are unaware of the nature of the biotechnology course and its goals.

Do Students Like Holly and Leanne Exist?

All of those who wrote comments (three teachers and five students) stated that students like Holly and Leanne do exist. As Gemma wrote, 'to me, Holly was the average student that attended the Biotechnology course'.

All five students were relatively unsympathetic towards Leanne. Melanie stated that 'there are students like Leanne and they usually make it difficult for the rest of the class to function to its full potential'. Amanda was particularly scathing:

> Leanne didn't learn much at all and that's all her fault. If she had given the course a chance, she may have found it rewarding. Leanne didn't learn half the information that Holly did. She didn't ever consider other peoples' opinions. She never thought deeply and involved herself in class activities like the oral presentation. Leanne never gave any thought to the issues or consequences of the issues. Unfortunately, Leanne gained nothing from the course.

What did Holly and Leanne Learn?

In writing the tales, it was my intention to demonstrate that Holly achieved the outcomes related to bioethics education to a greater extent than did Leanne. Carmel felt that the most telling statements that Holly made were that 'I would talk about an issue and research it' and that 'issues are complicated'. Carmel also stated that Holly had a better understanding of how to express herself and more confidence than Leanne. She had developed skills that she could use in other subjects, and had enjoyed the course and linked that enjoyment to science. Alyson wrote that 'Holly learnt about issues related to organ transplantation and also that a resolution of the issues is a personal thing although talking and research are part of forming your opinion. Holly also learnt about her preferred style of learning'.

In contrast, Leanne was intended to represent a student who did not achieve the outcomes to the same extent as Holly. Even though Leanne was present in the classroom she did not participate fully in the learning activities. Carmel felt that whereas Holly had learned to think, Leanne had not. Carmel described Leanne as the type of student for whom school is 'a social event'. Alyson wrote that:

> Leanne appears to be more aware of organ transplantation but not to the same extent as Holly. Leanne is typical of some students but I don't think her experience in the class was necessarily less worthwhile than Holly's experience. Any small step forward (e.g. becoming aware that she has to back up her opinion and that she could help someone by donating organs) is important for the Leannes of this world.

The students' responses to the question about what Holly learned were similar to each other. The quote below is representative of their responses.

> Through the Biotechnology course, Holly has learnt to express her opinion and think more before making a decision. Not only has Biotechnology helped her in decision-making, but has also made her more confident in other subjects and respect other class members' decisions. (Sarah)

When asked what Leanne had learned, students wrote, for example, that:

> Leanne's knowledge was limited compared to Holly's. Leanne learnt the very basics about transplantation taught. (Gemma)

The students identified a range of factors that they felt inhibited Leanne's learning. Some of these factors related to the types of learning activities that students engaged in. For example:

> Many students like classes where there is no note taking and lots of discussion. Unfortunately some students take advantage of this and fail to complete tasks. (Sarah)

However, most of the constraints mentioned by the students related to characteristics of Leanne herself.

> Leanne's poor use of time and concentration inhibited her learning. If Leanne used her time studying, doing homework, assignments and paying attention in class instead of decorating her diary and chatting to her best friends she might find she has learnt more at the end of the course. (Sarah)

Although comments from the teachers and students focus on characteristics of Leanne as a learner to explain her non-achievement of the learning outcomes, it is also possible that Carmel's discussion-based teaching style was more suited to Holly than Leanne.

What Did I Learn?

The use of narrative tales and the resultant commentaries enriched my understanding of the research environment in a way that would not have been otherwise possible. I have used narrative tales to demonstrate the variable experiences and learning outcomes of students who undertook the biotechnology course. My perception is that Holly and Leanne's experiences represent two ends of the learning spectrum. I would also argue, from my classroom observations and student questionnaire and interview data, that Holly's experience was more typical than Leanne's. The comments from the teachers and students indicate that, from their perspective, Holly achieved the four learning outcomes mentioned previously. She developed an awareness that the bioethical values of individuals should be respected and that such dilemmas can be resolved by a decision-making process. In contrast, Leanne learnt about the mechanics of organ transplantation, but little else.

The commentaries, especially those of the students, served not only to make credible the tales, but have enriched my understanding of factors influencing the extent to which students achieved the learning outcomes. In reflecting on the teachers' and students' comments, it appears that a combination of intrinsic factors (e.g., maturity, attitude to school, preferred learning style) and extrinsic factors (e.g., types of learning activities, teaching style) affected the learning outcomes of Holly and Leanne.

CONCLUSION

When I began this research study, I did not contemplate using narrative tales. However, when an initial analysis of the classroom observation, interview, and survey data indicated the variable nature of the individual student's learning experiences, narrative tales seemed to present a plausible technique. Although the students who provided commentaries were interviewed regularly and provided comments on interview transcripts and my interpretations of observations, it was the narrative tales that generated real interest and insight.

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JILL SLAY

NATURALISTIC INQUIRY IN CROSS-CULTURAL RESEARCH: A NARRATIVE TURN

INTRODUCTION

My research passion is the issue of culture. Although the impact of culture on students' learning of science has become increasingly important to science teachers over the past few years, this area was only just beginning to raise widespread interest when I commenced my research in 1995.

My research is based on my experience of living in widely contrasting cultures, including China, Africa, and rural Australia. I am female, originally a professional engineer, born in England, and lived for 10 years in Hong Kong before beginning my teaching career 13 years ago in the Far North of Queensland.

When I began to teach tertiary information technology in Australia, I realised that students from another cultural background, particularly a Chinese one, would not necessarily understand the content or processes, which I was carefully imparting, predominantly to 'natives' of Far North Queensland. This provided me with a problem that ultimately became the subject of this research. I felt intuitively that I was asking 'foreigners' to think and reason in the same way as my Australian students which would be difficult because the concepts I was teaching were embedded in a Western cultural understanding (and, also, usually delivered with a particularly Australian use of the English language). I also realised that many of my students of non-European origin, although Australian by nationality, had grown up in a distinct subculture within Australia. They would probably be having similar difficulties, even though their language problems were not so noticeable.

I thus framed my research around the creation of my own 'living educational theory' (Whitehead, 1989). This was in response to cultural differences and potential inequities for some students caused by my novel or strange use of language and the effect of any 'majority' sociopolitical, faith or spiritual-driven beliefs held by students in my computer science classroom.

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 93–104.

BEGINNING THE RESEARCH

My initial problem was to find a research approach that would enable me to investigate the effect of culture on student learning. In order to begin the study, I felt that I needed to understand more about cross-cultural studies in science education. Therefore, I read widely to understand the field and to situate my research within it.

I commenced by seeking answers to the following questions:

- What is a world view and how can it be defined?
- What is culture?
- What is multiculturalism?

My technical background meant that, internally at least, I was looking for a means by which I could 'measure' the effect of culture. I was fortunate to meet Professor Bill Cobern who taught a short course at Curtin University in 1995. Cobern introduced the Kearney (1984) model of world view, explaining how this model "begins with the idea that a world view is an organised set of fundamental, cognitive presuppositions about reality" (Cobern, 1991, p. 38). The model presumes a logical and structural integration of presuppositions, and therefore is known as a logico-structural model. According to Kearney (1984), there are seven categories contained within a given individual's world view: The Other, Classification, Causality, Relationship, Self, Time, and Space. In order to determine the world view of an individual, his or her understanding of the seven categories needs to be identified and integrated.

Cobern (1995a, b) used this theoretical perspective to carry out an interpretative study of conceptualisations of nature held by a group of ninth graders situated in a rural, desert community in Arizona. He concluded that for students in this case study: (i) various standpoints (religious, artistic, environmentalist) are used to deliberate about the world, (ii) no apparent correlation exists between gender and concepts used to describe the natural world, (iii) a religious standpoint was apparent in many narratives, (iv) the level of integration of science and everyday thinking is low, and (v) a high degree of concern about preservation and protection of the environment was expressed.

Cobern felt that his research raised additional questions and opened further areas of research. In particular, he recommended that future research investigate how students in different communities conceptualise nature and how these conceptualisations may vary with gender, age, urbanisation, and teachers' world views.

Inspired by Cobern's research, I decided to study the effect of traditional Chinese beliefs on Chinese students' understanding of Western science and make a comparison with the beliefs of my Australian students. As a computer science teacher in Hong Kong for many years I had often queried the relationship between my students' culture and their beliefs about the nature of science. One particular memory of my time living in Hong Kong, which inspired this research, was the sight of a highly qualified business man, with bachelor's and master's degrees in a

technical discipline, worshipping at a small shrine, hidden by the roadside in a busy part of Tsim Sha Tsui, Kowloon and the smell of incense wafting around in the atmosphere. I wondered how much this kind of worship really influenced his belief system when he was immersed in his daily engineering work for an international company. Underpinning all my teaching was an unexamined assumption of the 'truth' of scientific method, and I wondered whether this assumption held true for all students from all cultures. I decided to carry out part of my research in the Peoples Republic of China in order to find authentic Chinese world views comparatively untainted by Western thinking (*a huge assumption*!).

My study was thus a partial response to the recommendations raised by Cobern. His desire to examine how students from different communities conceptualise nature paralleled my own and provided a theoretical framework within the field of science education for my research. Thus, in addition to Geertz's (1973, p. 5) understanding of culture as 'webs of significance', I employed the logico-structural model in which world view is defined as the "culturally dependent, generally subconscious, fundamental organisations of the mind" (Cobern, 1991, 1993).

NATURALISTIC INQUIRY

I was interested in closely replicating Cobern's research methodology so that I could make direct comparisons with the results of his studies. I was interested to read that although Cobern (1995a, p. 3) advocated a naturalistic inquiry in which students 'would be observed in a number of settings over a lengthy period of time', he recommended a modified methodology that used 'elicitation devices' to persuade students to talk about 'nature, relationship to nature and causality' (Cobern, 1995a, p. 3), thereby saving time in the field. This methodology had been well received and it appeared that it would transfer easily to studies of other cultures.

The elicitation devices devised by Cobern consist of three tasks. The tasks contain some redundancy and allow some overlap to provide triangulation. The basic method involved is that students sort words and sentences about nature, while 'thinking aloud' over the task. These thoughts are taped for later analysis. The first task is completed in a primary interview of 45–60 minutes, and the second and third tasks are completed in a second follow-up interview. The first task uses pictures of nature to provide images to focus the student on the subject of discussion. The student is then provided with a list of words that are designed to draw out answers and 'are based on studies of western culture and represent aesthetics, religion, order control and knowledge'. (Cobern, 1995a, p. 4). The students sort the words into two groups. The first group describes what 'nature is' and the second describes what 'nature is not'. The interviewer uses the words to provoke conversation and extract meaning.

Task 2 uses sentences about nature rather than words, in a similar way to the first task. Task 3 involves comparing pairs of the sentences used in Task 2, so that a ranking of the statements is obtained.

The analysis of the data involves producing transcripts of the tapes and then coding them by attaching codes to sections of the information within the transcripts. Some of the codes are the words used in Task 1. Software (The Ethnograph) is used to sort and list the codes to prepare concept maps. A narrative is constructed for each concept map and content from the transcript. The student then reads and discusses the final narrative with the researcher.

Thus my intention was to adopt a modified naturalistic inquiry using a semi-structured interview technique. Data would take the form of narratives of my fieldwork experiences, classroom observation notes, and interview recordings. Analysis of the data would involve producing transcripts of interview tapes and coding them. Computer software (The Ethnograph) would be used to sort and list the codes to prepare concept maps. I would then construct a narrative for each concept map, and subsequently construct tentative inferences (called 'interpretative assertions' by Erickson, 1986) during the analysis of each case. These assertions would be combined and condensed to establish a final set of more general assertions about the comparative nature of Chinese and Australian students' conceptions of nature. The interviewees subsequently would read and discuss the final narratives and assertions with me as a means of verifying the validity of my interpretations.

Australian Study

My Australian interviews largely followed the pattern of Cobern's modified naturalistic inquiry. My first problem, having worked out how to use the research methodology, which seemed relatively straightforward, was to find my subjects. I could not interview my own students because, by now, I was teaching older students in TAFE and university, still in Far North Queensland. I was really quite obsessive about finding students who were of the same age as the subjects of one of Bill's studies, about 16–17 years old. Fortunately two of my children fitted into this age range and were enrolled at High School north of Cairns, Far North Queensland, and so I asked their science teachers for help. Seven students volunteered to be interviewed. I informed them that I needed their views to help me with research that would help teachers understand more about what students think about science and thus become better teachers. They were very enthusiastic participants.

I used Tasks 1, 2, and 3 as described above in my interviews. However, I found it very difficult to engage the students in protracted and relevant conversation, and all my transcripts are very short. This may be due to my inexperience or the difference between the Australian and American temperaments. I was not able to obtain The Ethnograph but found similar software, NUD*IST (Non Structured Data, Investigating, Structuring, and Theorising).

However, when it came to coding the interview transcripts I realised that I needed to use a simpler method than Cobern's because his method was too time consuming and labour-intensive. His research had involved a team of three researchers in the analysis process. Taking the transcripts, codes were assigned to pieces of information; some came from the words used in the elicitation task, others were assigned by the researchers. A lexicon was developed from the codes. When complete, computer software was used to sort and print text segments ordered by

codes. This provided the material for creating concept maps which Cobern (1995a, p. 3) described as an 'interpreted overview' of the 'ideas that appear to have the most importance for the informant and how various idea are related'.

I decided to maintain Cobern's emphasis on a concept map as an 'interpreted overview'. But I used a simpler method, which involved coding the data by looking for the use of words and concepts drawn from the first elicitation task, the word and picture sort of 'what nature is'. I chose to include other concepts only if they were very different from these. Next, I produced simple concept maps from the codes in my much smaller lexicon and I constructed narratives from these codes and the raw text of the transcripts. I was able subsequently to check these narratives with the students.

Chinese Study

After completing the Australian part of the study I travelled to China in the role of a student studying the Chinese language. By this time, I had studied Mandarin for about 2 years (after 10 years of understanding a fair amount of Cantonese) and felt relatively confident that I would be able to communicate with Chinese people. However, the lowly official status of a visiting language student severely restrained my ability to make appropriate academic contacts for conducting the research. During that visit I was only able to interview one teacher since no one in authority would let me speak to students. Whilst interviewing the teacher, a language teacher at a Southern Chinese Normal University, I recorded the conversation. I soon realised that interpreting the tapes of Chinese language conversations was quite difficult because any instance of a dialect in the speaker made the tapes almost incomprehensible to me. Therefore, I decided to replace tapes and transcripts with handwritten summaries and field-notes in English. I focused on interpreting subjects' use of words and concepts expressed during the elicitation tasks.

After spending 2 years improving my Chinese language skills, I made my second trip to China, this time as a visiting researcher at a University in Ji Nan in Shandong Province. I had translated my elicitation device with the help of a Chinese graduate student who lived with my family for almost the whole 2 year period in Australia, and she assured me that she could understand the interview questions when I asked them in Chinese.

Although carrying out research in computing in Ji Nan, I was coerced into participating in English conversation classes and thus was provided with contacts for research. I met many delightful students and scores of them very willingly helped me with my research. I included the results of seven interviews in my Ph.D. research and shared the thoughts of Yan and Li Na (female students) and Bao Cai, Sheng Bo, Da Peng, Jie, and Hai Tao (male students). All the students were between 17 and 18 years of age and all were in first year of a college of engineering. In high school they would have been students who received good credit or distinction grades. Their university curriculum included theoretical courses in Physics, Chemistry, English, Mathematics, Computer Studies, and Politics. There was little evidence of any engineering content in their first year studies.

I was unable to analyse my research data, due to time constraints, while in China and I could not discuss with the students the subsequent concept maps and narratives that I constructed.

CONCEPT MAPS AND NARRATIVE PORTRAYAL

I had initially believed that because my research would follow that of Cobern, the only issues of legitimation for me would be those that Cobern (1993, p. 3) had faced, namely the trustworthiness and credibility (Guba and Lincoln, 1985) of the empirical part of the research. However, since I had considerably adapted Cobern's methodology in order to deal with the difficulties of conducting fieldwork alone in different cultural contexts, I did not have the basic safeguards of external validation by peer review and cross-checking or feedback from the students, which Cobern had meticulously developed to legitimate his interpretative research.

It seemed necessary to legitimate my research in another way. My previous experience, some 20 years earlier, had been in quantitative research in Mechanical Engineering. Research in science education had been influenced during that period by forms of representation originating in other disciplines. Science educators (Taylor, 2002) have embraced qualitative and interpretative research approaches, influenced largely by the work of Denzin and Lincoln (1994, 2000, 2005) and especially by those working in the fields of ethnography (Erickson, 1986) and narrative inquiry (Clandinin and Connelly, 1996).

Denzin and Lincoln (1994) have indicated that qualitative research is a 'set of interpretive practices' which vary with the arguments of prevailing epistemologies. Importantly, qualitative researchers 'study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them' (Denzin and Lincoln, 1994, p. 2). A powerful metaphor of the qualitative researcher is the *bricoleur*, who produces a *bricolage*, 'a pieced-together, close-knit set of practices that provide solutions to a problem in a concrete situation'. Although postmodern ethnography may adhere to the oral traditions and field techniques of earlier anthropologists, it also encourages experimentation with alternative (non-scientific) research reporting genres, especially those which emphasise the reflexivity of the observer, resulting in the interweaving of the views of both the researcher and the researched.

Narrative inquiry methods (Clandinin and Connelly, 1996) combine with impressionistic tales (Van Maanen, 1988) to enable researchers in science education to use literary genres for portraying their research experiences, enabling them to create deeper and more emotionally subjective awareness for the reader. I therefore took the perspective that my research is a *bricolage* in which I have pieced together several solutions to my research question.

In discussing what makes a good narrative, Connelly and Clandinin (1990, p. 7) feel that it is 'important not to squeeze the language of narrative criteria into a language created for other forms of research'. They suggest that a narrative can be judged good if it acts as an invitation to the reader, allowing the research to be read and lived vicariously. Concepts of 'adequacy' and 'plausibility' are promoted as criteria against which a narrative may be gauged. This infers that the reader may ask

himself or herself 'is there enough information presented to convince me that this research really took place and that I might return to the original respondent and get the same kind of response to these exploratory questions?'

What follows is a sample of a narrative that I wrote about my experience of being with a Chinese student, Jie. The narrative is indicative of my relationship with Jie and serves as a diary, the demonstration of the 'adequacy' and 'plausibility' required by Connelly and Clandinin (1990). This was accompanied by the concept map that I constructed of Jie's conceptions about Nature after interviewing him with the translated elicitation device.

An Interlude in the Flower Park with Jie

> I got to know Jie because he was at least half of the motivating force behind the Little Red Hat English Corner, the poetic name for our English conversation classes. I found him easy to be with because, of all the students, he appeared the most Westernised. He came to find me on my first day and gave me a written plea from the students explaining why they needed to spend time with me. This was where I first saw the expression 'perfecting ourselves'. It was important for the students to study English with me so that they could 'perfect themselves'. I really did not have a problem with this anyway.
>
> Jie was definitely not native to Shandong province, and I could not work out if it was this fact which made him a loner. He definitely did not spend so much time with the group. His parents lived in a town on the coast, a few hundred kilometres away. His father has relatives in America and, when he graduates, Jie is going to live in California and work for his uncle's business.
>
> Jie and I spent an afternoon in the Flower Park and he took many photos of me (his first Westerner). He insisted on paying for a taxi and buying me drinks, but somehow he managed to get his pocket picked and, on the way home, had no money to pay for the taxi. This time I paid, but he lost a lot of face in this incident and I hardly saw him again. I did not have any technique in my cross-cultural armoury to help alleviate his shame and embarrassment.
>
> Before this incident we did sit under a large tree for an hour or so and talked. He told me about his hopes and dreams and we talked about the West. We managed to draw a large crowd of soldiers, mothers with their children, and old people out enjoying the warm afternoon gathered around us. I was uncomfortable but realised Jie was basking in the warmth of something that was being reflected from me (not exactly glory, but something similar, I think).
>
> I enjoyed Jie's company but his thoughts on nature, while a little different from his classmates, still largely reflected the view of science he had learned in the classroom. This was getting to be a repeat of the same answers each time!

I had already spent many hours with Jie before our interlude in the park and this is why he was ready to open himself to me. I spent hours talking to him and a girl called Yan, going out to parks to have my photo taken and speaking English to people who, although they had a 7,000-word English vocabulary gained over 7 years, had never spoken to a Western person before.

My narrative thus is an example of the broader and deeper relationship I had with Jie, Yan and the other subjects of my research and how I was able to establish the adequacy of my interpretative research relationship with them. It illustrates how I spent quality time with them, immersed in their cultural context, in order to gain their confidence and encourage them to disclose their cultural beliefs about nature.

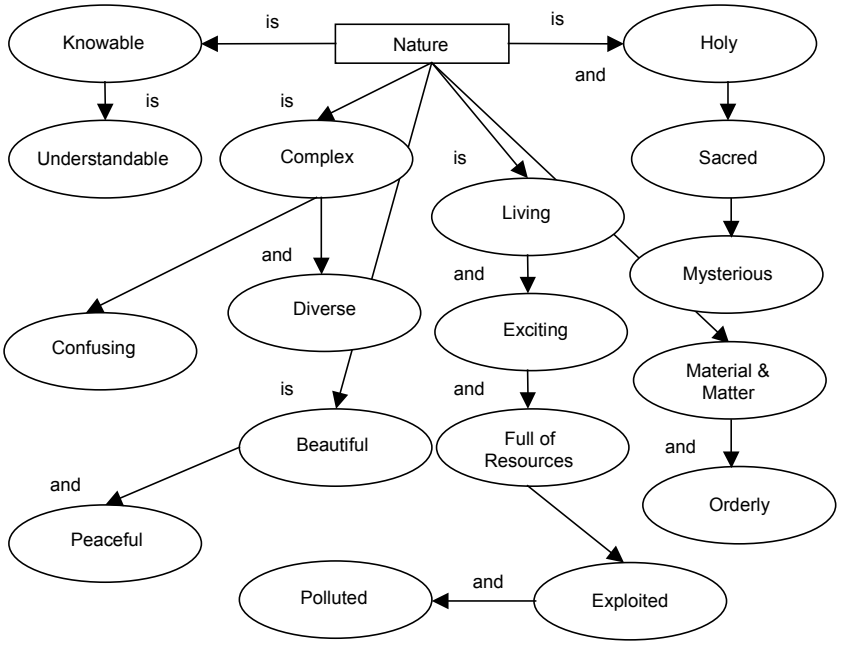

Figure 1. Concept Map of Jie's Thoughts on Nature.

Cobern (1995a, p. 13.) describes the concept map as an 'interpreted overview' of the 'ideas that appear to have the most importance for the informant and how various ideas are related'. I maintained Cobern's emphasis on a concept map as an 'interpreted overview' of the ideas that were most important to my subjects. I interviewed my subjects and coded by looking for the use of words and concepts drawn from the lexicon in Task 1. I chose only to include other concepts if they were very different from these. I then produced simple concept maps from the codes and wrote narratives summarising these codes, checking myself with the raw text of the transcripts. I was also able to check these narratives with the students in Australia but not those in China.

The concept map (Figure 1.) thus provides a graphic overview of the major concepts elicited from the subject and the narrative presents these as a written summary.

CONSTRUCTING ASSERTIONS

In discussing his methodology, Cobern (1995a, b) dealt with the concept of 'assertions', that is, statements made by grouping and correlating concepts found as a result of analysing the data provided in the case studies. He reported that '37 tentative assertions were grouped and reduced to seven semi-final assertions' (Cobern, 1995a, p. 17.), and explained how these were subject to stringent checks from the research team.

Erickson (1986, p. 146) explains that there has to be 'an evidentiary warrant for the assertion that one wishes to make'. Assertions are generally made through induction and may be based on the analysis of field notes, interview notes, tapes, or other site documents. The nature of the assertions may be broad or narrow in scope and high or low in inferential level. He emphasised the need to search the data continually for discrepancies and linkages. Linkages provide the key to identifying patterns of generalisation from which to identify the assertions. Cobern (1995b) fulfilled this requirement in searching and cross-checking for consistencies and differences.

This is illustrated by the three lower level assertions that I constructed about Jie's conception of Nature…

> Nature is beautiful and peaceful. It is living and exciting and full of resources but these have been exploited and so it has become polluted.
>
> Nature is complex, which means it is both diverse, and, sometimes, confusing. Nature is both knowable and understandable by study. It is material and made from matter and it is orderly.
>
> Nature is holy and sacred and mysterious.

I constructed these by inspecting the concept map and grouping similar concepts together to make coherent sentences, illustrating agreement or disagreement with questions asked as part of the elicitation tasks. I reviewed these low level assertions in the light of my interview notes and then rechecked them against the relatively long narratives, documenting the many hours of my own time spent with Jie in Ji Nan.

However, I had a relatively small amount of data due to my inability to communicate well enough in a second language in China. The limited fieldwork time allowed me to interview a small convenience sample of seven Chinese students. Thus the data corpus was small and I was unable to claim the kind of evidentiary warrant for making assertions required by Erickson (1986) and displayed by Cobern. So, I turned to another form of interpretative research for warranting my assertions. In dealing with the knowledge I was claiming about students' understandings of nature, I realised that I was dealing also with issues of my own subjectivity and the knowledge gained through my own long-term

experience within Chinese culture. I turned to Fenstermacher's (1994) call for establishing the epistemic merit of teachers' 'practical knowledge':

> [T]he concept of practical knowledge is a legitimate epistemological category, so long as we attach to it demands for justification or warrant in the same way that demands are attached to formal knowledge. (Fenstermacher, 1994, p. 47)

In this, Fenstermacher is suggesting that knowledge gained through experience is of value, that it has relevance and meaning and can be seen as being true, within interpretative research. Fenstermacher expressed the view that the epistemic merit of practical knowledge can be established in relation to the criterion of 'objectively reasonable', which requires interpretative research to be presented in a way that demonstrates that the claims made are practical and fairly logically justified from experience. He was critical of some in the field of interpretative educational research who have treated the justification of practical knowledge too lightly. An additional standard is that of 'practical reasoning' taken from the field of philosophy, which involves establishing 'good reasons' why the knowledge claimed is valid.

Thus, in making knowledge claims from the narratives in which my case studies are embedded, I have adhered to criteria for establishing the epistemic merit of my practical knowledge, gained from my life in England, Australia, Hong Kong, and China and my work as an engineer and teacher, as well the other knowledge gained through concept maps and narratives.

Here are examples of lower level assertions that I constructed for two other Chinese students who seemed to share similar perspectives.

> I think nature is beautiful, peaceful and pure. It is made of matter and is orderly and material. … I feel unhappy because it has become polluted. We must work very hard to protect nature. (Yan)

> Nature is material and made from matter and is orderly and predictable. … It is also beautiful, peaceful and pure. … Nature is full of resources and these have become polluted and endangered. (Hai To)

As we saw earlier, Jie seemed to have a conception of Nature similar to those of Yan and Hai Tao. Surprisingly, the data gained from the Chinese students was highly convergent, with the same themes being repeated in each one with very little variation.

Based on the assertions generated from the seven Chinese students I constructed the following general assertion about these students' conceptions of Nature.

Assertion 1

> Chinese college students tend to discuss the natural world using the same set of perspectives. The students do not display a diverse range of attitudes. Each seems to provide concepts from the domains of science, aesthetics and conservation in their concept maps.

I also constructed three other assertions from my research data (Slay, 2000).

REFLECTIONS

The process of carrying out this research was far more difficult than I imagined when I began to plan it. Issues in cross-cultural research appear to me to be largely unknown until experienced. Practical issues, such as language learning and the development of important vocabulary, were difficult in themselves, but philosophical issues were more challenging.

As a cross-cultural researcher I was an outsider, living with the tensions of rejecting misinformation, trying to exclude bias in data and refusing to patronise or colonise the subjects under examination. I experienced problems faced by early anthropologists and realised that ethnography is more art than science. The issue of what is essentially ethnography within a scientific discipline still challenges me. Have I created art or science and how will or should this be received by science educators? According to Fenstermacher (1994) and others, this is an issue for the reader.

I have been challenged as I worked in two very different foreign cultures, Australia and China. The possible effects of my own cultural interpretation of the data I collected continually confronted me. I had to face issues of epistemology as I have struggled with the question of 'how do I know this is true?' This is why I have relied very heavily on the work of Fenstermacher (1994). His notion of 'objectively reasonable' has allowed me to attach an academically acceptable degree of tentative certainty to my knowledge claims. In doing this I have illustrated the role of my own subjectivity (my 'practical reasoning' as an ethnographic fieldworker) in generating these claims and I have narrative writing as a suitable form for representing the relationship between them.

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BOB FITZPATRICK

A QUESTION OF BALANCE: CRITICAL INCIDENTS, TENSIONS, AND CURRICULUM CHANGE

Emotional turmoil, self-doubt, anger, frustration, and confusion are the stuff of my personal experiences of change in a school within a period of systemic change. I wanted to make the most of these feelings that acted as flags of 'critical incidents' (Tripp, 1993) in the writing of a paper as part of my master's degree because my ego had been tweaked and I needed to 'vent my spleen' in some way. In this chapter, I look back at my initial writings on the topic, and retrospectively reflect on my experiences at the time. In doing so, I wish to provide the reader with some insight into my methodological processes of writing and reflecting.

In the first version of this paper, I presented narratives of the critical incidents interspersed with my reflections and analyses of the events from the perspective of a 'change agent' (Fullan, 1993). In this current version I used recollections of incidents and their interpretations to produce a field text which I transformed into a research text through a series of processes in trying to make sense of my experiences. I have used this technique to step back and use what Geertz (1983) would call 'experience-distant' techniques so as to reinterpret the experiences using different voices/fonts.

The voices are:

- The voice of my recollection of events portrayed in the original document.
- `The voice of my own reflective thoughts at the time or soon after the event.`
- The voice of my current reflections at the time of writing this final version of the paper. This includes my views as a researcher writing in order to learn (Richardson, 2000) and my analysis of the events in terms of two of the many images of the curriculum put forward by Schubert (1986).

During the process of writing this paper, I am trying not only to understand critical events and incidents (Tripp, 1993) but also to furnish a context for the readers' interpretation of my descriptions (Denzin, 1994)

By working in this way, new questions have emerged about the way I am making sense of both the incidents and my role within these incidents, and about my

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 105–115.

relationship to others as a conscious change agent. To help this process I used two of Schubert's (1986) models for the curriculum to analyse the perspective of the stakeholders within the critical incidents, including myself. Thus, this study has wider implications beyond myself, the school, and the system, reaching into the world of change and change management in the broader sense, as described by Fullan (1993).

THE INCIDENTS

At the time, I was the schools' coordinator of curriculum innovation, working with many groups of teachers, in particular the school's curriculum improvement committee (CIC), and board of management (BOM) as well as the local district office (DO). The school's CIC is made up of teachers, some of whom are heads of learning area departments (groups of related subjects), and aims to implement a new curriculum framework and curriculum improvement programme within the school. I felt good about working with this group of people and viewed the whole work of the committee as being at the 'social reconstruction' (Schubert, 1986) end of the curriculum continuum. That is, I felt we were doing our bit to enable students to build a better society for themselves by providing them with an agenda of knowledge and values. The decisions about what knowledge and which values were placed on the agenda are contained within the new curriculum framework and the living classroom. However, there was a niggling doubt that although we were pushing ahead with the reform agenda and involving change agents from around the school, there was a danger that we were pushing so far ahead that we were moving out of contact with many of the teachers.

Working with the board of management was a different story. As the title suggests, this is the management group of the school where decisions are made, mainly about administrative, day-to-day issues. It is made up of the school administrative team, including department heads, and I felt less enthusiastic about attending these meetings. Curriculum issues were viewed with disdain by some members of this group, as almost irrelevant to the 'important immediate' tasks of running the school. I classed this group as being on the 'cultural reproduction' side of the curriculum divide. From this perspective the curriculum was a device to turn out citizens of tomorrow that would be exactly like citizens of today so that the status quo would be maintained and the teacher's role was to prepare the students in the way that they were. 'If it was good enough for us…' and so forth!

Working with the staff from district office engendered different feelings within me, and a string of incidents that flowed from a meeting at district office serves as a particularly sharp example of the tensions and emotions being aroused within me during this period (and previously, and since).

WORKING WITH DISTRICT OFFICE

Wednesday, 25 August 1999

From the time of my initial appointment to this job I have always seen myself as a link person between the external educational world and the school,

whether it is linking through journals, universities, the district office, the education department, or other schools. Meetings at district office between school curriculum coordinators, district office curriculum officers, and the district curriculum manager are particularly useful in the networking of ideas and information. The group gives the curriculum improvement programme a district-wide perspective, and there is an expectation that the achievement of district-wide targets is part of the work of the group. The main items on the agenda for the day that I remember most clearly were the up-coming whole-district activity for day one, term three, and the curriculum leaders strategy programme.

The curriculum leaders strategy programme immediately produces feelings of guilt within me. I remembered seeing the information amongst the mounds of paper that moved around and off my desk, but it had not been a priority of mine as I thought the school administration had disseminated the information to the heads of department. The problem was that the programme was in danger of imminent collapse due to a lack of response. I left the meeting thinking that I had let the district office team down and that I had better do something right away.

The next day I passed the relevant information to the school's heads of department and asked them to let me know in two days time, so that I could inform district office, if they would be sending anyone to the workshops. The next day, while I was out of the school, each head of department received a memo from one of the deputy principals instructing them that they were not to sign up for the programme until after the next board of management meeting.

Thursday, 26 August 1999

> What is going on! The administration is reversing or cancelling my action.

When I caught up with the principal she told me that the district office programme would cost approximately $4000, and that that kind of money was just not available in the school.

> Oh the old financial constraints thing again!
>
> Am I becoming paranoid? I had the rug pulled out from underneath me! Just what is my job in this school? Do I really have a responsible role or am I just a 'front-man' so that the admin can say that they're doing something about the curriculum improvement programme? Nobody bothered to speak to me about the decisions that were made in my absence. So, how do I look in front of the other staff; rushing around trying to get something going only to have it blocked the very next day? Luckily, I'm reading that "Change Forces" book by Michael Fullan. There's a section about inner learning by the 'flow man' (Csikszentmihalyi, 1990) that says something about the importance of learning to enjoy immediate experience or that 'one can enjoy life even when objective circumstances are brutish and nasty'. So I'd better swallow my anger and do some more talking to

> admin to find out more about what's going on. Peter Taylor (my supervisor) was saying something to me about dialectics theories. Instead of hiding in a corner somewhere with my emotions I'm going to keep the opposites in contact, admin, and myself, so that development can take place from the interaction between opposing points of view. But it's not going to be easy, as deep down inside I'm still hurting.

Monday, 30 August 1999

At the next board of management meeting one of the deputy principals explained that sending 16 teachers off for three days of workshops, targeted at a wide range of teachers from diverse backgrounds, may not be the best way to get value for money from the school's professional development budget. Furthermore, this was not the way that teacher learning had been envisaged within the school. He also mentioned the importance of my role as coordinator of curriculum innovation in providing professional development at the school.

> Wow, was this my job that he was talking about? Why hadn't someone said this before? This admin person and I need to talk about this.

Further discussion revealed that each department would be allocated $100 per person to spend on professional development, and that careful thought would be needed to get the most out of the allowance. Second, the programme of events, put forward by district office for day one, term three was rejected in favour of a programme run at school, to be devised by the school's professional development committee. The emphasis is now on thoughtful departmental or in-school professional development and decision-making.

> This is a huge step forward, in that the reliance on externally planned PD 'on a plate' is going to be diminished in favour of PD arising out of our needs.

This series of events represented a period of some confusion in my mind. The district system had been set up so that the district office could provide support to schools in the development of organisational systems and curriculum to meet the needs of the community. My initial feelings were that I had let district office down and that I had not carried through an important strategy in the curriculum improvement programme, a masthead to which I had well and truly nailed my colours. I was embarrassed and ashamed that I may have been partly to blame for causing the programme to be threatened with cancellation.

But there was more to it than that. My mind was still in the mode of bowing to the greater wisdom of the hierarchy of the centralised education department. The power was at the centre (the education department head office) and the district office was a link in the chain of command. They knew best and I had let them down! And what if the people at school found out about my inefficiency? Would I be responsible for holding back the development of teachers by unconsciously preventing them from attending professional development that was aimed at their needs?

Alternatively, what about the suggestion that teachers at our school could learn and develop in another way? With the benefit of hindsight and from the

viewpoint of Schubert's (1986) curriculum perspectives, it seems to me now that the programme for professional development that I was so concerned about was just as traditional and reinforcing of the status quo. The idea that the only way to learn was through a programme of workshops designed by someone 'in the know', suggested that there is a single best right way of doing curriculum development, and that it had to be 'revealed'. This viewpoint stands in stark contrast to the ideology entailed within the new curriculum framework that we are trying to put into practice. If we want students to become more involved with planning their own courses of study and allow the curriculum to be more flexible to be able to meet individual student's needs, then why shouldn't this apply also to teachers' learning activities? I was being too conservative, reproducing the existing culture.

ANALYSIS

The discussion that I had with the principal following the cancellation of the district office professional development helped to clarify my role, but I still had to sort out my long-term aims. At the back of my mind was the nagging doubt about whether I was just helping to restructure planning and administrative procedures or whether my colleagues were beginning to learn and develop from involvement in the change process. In other words, was I engaged in cultural reproduction by helping to change only the structure of the school, or was I helping to bring about social reconstruction through enabling my colleagues to plan for change and learn from the resulting actions?

> I believe that the answer (to the question of my role in the school) lies in examining my moral purpose and looking to improve my change agent capacities (Fullan, 1993). The conflicts arising within and around me forced me to rethink my moral purpose or to engage in some inner learning (Fullan, 1993). I understand 'inner learning' as being the ability to make sense of what is happening to me as an individual, and learning from that. The tensions between myself, the teachers and department heads in the school, the administration, and the district office brought about internal conflict. I began to think that my purpose was to enable other individuals to learn in this current climate of change. This applied equally to the teachers, the department heads, the administration, and the district office team. The teachers and department heads need to learn about the new ways of working with students and with each other. The administration needs to learn how to apply the 'new paradigm' of the curriculum framework to the whole school and the teachers, and not just say what should be going on in the classroom. The district office team needs to learn how to work with a variety of schools with different needs and attributes. I now see myself in a central position to enable this learning, but in order to do this there is some 'outer-learning' (relating and collaborating with others) that must be done.

I think that I have some of the traits of a change agent, as outlined by Csikszentmihalyi (1990, pp. 209-213):

- setting goals
- becoming immersed in the activity
- paying attention to what is happening
- learning to enjoy immediate experience.

I am able to set goals and become immersed in an activity, but I am not so sure about the other two traits. I will need to pay greater attention to what is happening, but with a more objective viewpoint. The tensions that I felt flow through me during the story told above are quite natural for a person involved in change and are, in fact, only to be expected. Change cannot take place without conflict, and to not feel tension and discomfort would perhaps mean that change is not occurring. Instead, I should immerse myself in those conflicting feelings and emotions, as part of what Csikszentmihalyi (1990) means by 'learning to enjoy immediate experience'. He explains this further by saying, 'the outcome of having an autotelic self – of learning to set goals, to develop skills, to be sensitive to feedback, to know how to concentrate and get involved – is that one can enjoy life even when objective circumstances are brutish and nasty' pp. 212-213). I can look back on my recent 'brutish and nasty' experience and begin to understand that it arose out of the tensions surrounding my position, and that I have unconsciously brought about the situation by my actions.

What is more rewarding is to look at the results from that heightened point of conflict, in that I have a clearer view of my role, in school, in the district 5 and in life. I have used an autocratic style to set deadlines for the department heads to begin their planning process in the knowledge that even getting to the deadline will be a learning process and that unforeseen developments may interrupt this process or disrupt the deadlines. This scenario, however it turns out, will be part of the richness of immediate experience. I now no longer see myself as a passive ideas generator or professional development facilitator, but as part of the dynamic of the change process. I am one of the individuals who is learning, which does not guarantee organisational learning, but without whom no organisational learning can occur. I saw myself as the 'meat in the sandwich', and now I see myself as a 'link in the chain'.

'A link in the chain.' This description now seems too passive to me. I am still having trouble with the top-down, bottom-up tension as well as the cultural reproduction, social reconstruction tension, but then I think that this is good. The link in the chain is elastic, sometimes pulling the two halves and sometimes allowing a bit

of slack. The conflict of proposing (top-down) the need for change or asking hard provocative questions, is needed to initiate discussion and involvement, even though the outcome (bottom-up) may initially appear to be negative. Similarly, proposing a reconstruction of the way that even a microcosm of society operates, or even thinks, cannot be done without conflicting the wishes of the cultural reproducers.

A recurring theme throughout this story is the balancing of two opposing positions against each other and the emotional toll that the tension produced takes on the soul of the individual involved. Through the writing of this story, I have set out to research my own Self (Richardson, 2000). I have learned about myself, and my perception of others, from the standpoint of balancing the opposites: cultural reproduction and social reconstruction.

The cultural reproduction shows itself in many ways, from the 'need to teach them what they need to know for the exams', to the 'we want to work with you but there is so much time taken up just sorting out kids', or 'what professional development are you going to run for us?' These expedient, pragmatic viewpoints serve to frustrate the change agent, but they also are the voice of reality, as the vast majority of teachers understands it. If these issues are not taken care of – disaster looms.

But what about social reconstruction? Does this lie within the pages of the new curriculum framework or the curriculum improvement programme or the school planning guidelines? Without the involvement of a large number (I hesitate to say all) teachers in the discussions, the arguments, and the tensions of the change process, these documents are just empty words and will contribute little to social reconstruction. The ideas are certainly contained within the pages, but if the intellectual involvement is not facilitated then how can teachers learn through their actions except in a haphazard way. Social reconstruction begins with the social reconstructor so that only by living the values and the concepts that are to be the vehicles of social reconstruction can the process be properly understood and begun to be implemented.

DISCUSSION

Following discussions with my supervisor, Peter Taylor, the recurring and emergent question of balance between opposing viewpoints, or the results of the antinomy between two curriculum perspectives, has prompted me to examine the whole story in terms of the dialectic as described by Giroux (1981). In applying this concept, the lessons learned in terms of my role as a change agent should become clearer.

The dialectic is a way of looking for the 'truth' in the story that has unfolded, and will continue to unfold, which demands that I explore the contradictions in reality as being part of that reality as an active participant. As Giroux (1981) says, 'Cognition, in this sense is not simply a contemplation, it is the understanding of reality insofar as humankind shapes it in the process of living it' (p. 115) Also '[the dialectic driving force] must be seen as a form of radical critique and action, each of which act on and interpenetrate the other' (p. 116). Essentially, we cannot understand reality without being part of it and altering it by our actions, which cause us to reflect on and examine the effects of our actions in order to go further. No wonder I was in turmoil over the ideas involved in change and the reactions that it provoked in others and within

myself. In raising, discussing, and writing about issues relating to change I was, through my actions, raising contradictions within myself and others that related to our beliefs and values, not just in terms of education but also in terms of our vision of society. Again, Giroux suggests

> that the notion of the dialectic becomes important only within a commitment to emancipation, one that seeks to liberate … in both subjective and objective terms. (p. 114)

It is no accident that a key section of the curriculum framework, the principles, contains a set of core shared values that are promulgated by the document as a whole. In my opinion, these values are at the social reconstruction end of the curriculum spectrum and are a powerful statement about what underpins what we, as teachers, should be doing. I had decided that the school would begin its exploration of the curriculum framework by examining these values and had naively assumed that there would be general acceptance of them yielding a 'commitment to emancipation'. In a way there was, but it was mainly verbal without my colleagues living the agreement through their actions. Here, the contradiction becomes clear in my work with teachers and heads of learning areas. Some were living the values of the curriculum framework through their attitudes and actions. However, some were in tacit disagreement. Thus, the driving force to attend meetings and move the change process forward was not as strong for the 'agree-ers' as it was for the 'live-ers'. I can now see that my unease and inner tension was the manifestation of the contradictions in the process in which I was engaged.

At the beginning of my story, I had taken the values of the curriculum framework as my new conceptual model, or 'moral purpose' as Fullan (1993) puts it, but I was unable to see the contradictions between intellectual (or verbal) agreement and living and working with these values and the strategies that enact them. This juxtaposition of standpoints was true not only for my colleagues in the curriculum improvement committee and the board of management but also for myself. I now understand this as the concept of 'Praxis', that is, the requirement for ideas of reconstruction to be acted upon in the real world and then reflected upon and further action taken. It is the basis of emancipatory action research. It also means "acting with others, not upon others," (Grundy 1987, pp. 104–105)).

In planning how to manage the change process, I had thought about the backgrounds of my colleagues, or 'where they were coming from', and about the wider contexts of the school, the community, and the education system, in relation to the changes being mooted. In other words, I had thought about the 'totality' (Giroux, 1981) of the situation in terms of its historical and social context. I had also thought about my role in this particular 'corner' of reality, and how my attributes and views were going to influence others. I was aware of my own history of willingness to take up new ideas, my willingness for emancipatory action, and how off-putting that could be for others, particularly those with the view that there is no need for change. I can say that I dealt with what is known as 'mediation' (Giroux, 1981), in that, I was aware of 'the forces that shape our perceptions' (p. 120), but I was unaware of the need to struggle and act on the world around me, rather than only responding to it. I was active, backed up by the moral purpose of both idea(l)s and my life

experiences, but in my story I can read the signs of reaction rather than conscious action. I was certainly willing to 'get stuck in', not always with adequate reasoning, but 'appropriating' (Giroux, 1981) the reality around me. However, with the hindsight of the dialectic, I can see that I had not started from my colleagues' experiences or levels of understanding. I was not aiming to emancipate them by allowing them to develop from their various starting points. This lack of 'transcendence' (Giroux, 1981) from my position to theirs forced me to battle against or act upon them, rather than with them. Hence, my unease and torment was the result of the contradictions not only within the committees and relationships with workmates but also within myself.

In my *Working With District Office* story, another set of contradictions arose which were, with the hindsight of the dialectic, more fundamental to my problems of emotional maelstrom. The moral purpose of the new curriculum framework and my history of innovation throughout my career bring a certain measure of self-confidence in what I believe and what I do, but I also have a traditional respect for (blind faith in?) my superiors and their judgements. This contradiction was to cause me the greatest of problems.

District office had planned professional development in the format of taking teachers out of school, giving them theoretical input, and following this up with reflection on resulting actions, a type of structured action learning programme. I had attended the meetings at district office, listened to the rationale in relation to the new curriculum framework and the curriculum improvement programme, and so I belatedly went ahead assuming the inclusion of my colleagues. But the administration of the school had blocked it! I now see that the administration wanted to start from the experiences of the teachers in the school in taking action for curriculum change (i.e., transcendence).

Ironically, I found myself in the position of supporting the historically legitimate, traditional professional development that had been put forward by the district office. Although it contained an element of action research, it still was based upon taking teachers out of their working environment and contained the danger of turning the professional learning into an academic exercise. So, although I was the change agent, I was supporting a possible backward step because of my own historical influences on my thinking (totality and mediation). At the time, these contradictions were responsible for the hurt, the mild paranoia, and aggressive feelings that affected the way I viewed and reacted to my colleagues.

Another way of learning from my experiences is to view what went on through the lens of the change agent (Fullan, 1993). Fullan describes how effective educational change has 'moral purpose' and 'change agentry' at its core. Moral purpose, as previously stated, can be lifted from the curriculum framework values and superimposed on our own moral baggage. Change agentry, however, contains four core capacities:

- Personal vision-building – links with the totality and mediation parts of the dialectic. As Fullan states, 'creating a personal vision forces us to take a stand for a preferred future. The more one … expresses a personal purpose, the more kindred spirits one will find' (pp. 13–14). I certainly did find many kindred spirits, but I probably missed out on a few by not thinking

carefully about starting from the experiences and level of understandings of my colleagues.

- Inquiry – the questioning of what we do is also part of the process of mediation, and is essential for an internal understanding of the new ideas.
- Mastery – means practicing what we preach by living the life of a continuous learner. In doing so, we are trying out our personal vision by penetrating reality (appropriation). Fullan (1993) makes the point that 'people have to behave their way into new ideas and skills. … The journey is the reward' (p. 15).
- Collaboration – enhances the learning process both for the individual and the community. 'Good ideas converge under conditions of communication and collaboration' (Fullan, 1993, p. 14). Collaboration also equates with taking seriously those cultural [including historical] experiences and meanings that the participants bring to the situation (Giroux, 1981).

The dialectic, then, brings a freshness to Fullan's capacities of change agentry. Although I practised these competencies during the unfolding of the story, the contradictions within the application of each one were not clear to me and raised the tensions described previously. However, Fullan's guiding principles enabled the whole painful process to reach a successful outcome, in that I continued to press ahead with faith in my moral purpose and continued to interact with all parties involved.

CONCLUSION

When I originally thought about the theme for this paper and the research proposal, Tripp's (1993) idea of critical incidents having dramatic and disproportionate effect on my development appealed to me because of the roller-coaster ride my professional life seemed to be taking at the time. I think that it was a wise decision, as I have been able to redirect all the pain, upset, expended energy, and any damage into the writing of this paper, a process that I, at least, have found illuminating and cathartic.

Through the various stages of writing of this paper, I have indeed learned much about my own thinking, personality, history, and abilities. Richardson (2000) was correct when she wrote, 'Writing is also a way of 'knowing' – a method of discovery and analysis. By writing in different ways, we discover new aspects to our topic and our relationship to it' (p. 923). By writing in different voices, representing different viewpoints on the events and critical incidents, I have been able to draw out my inner thoughts, the dark and the light, the yin and the yang, the progressive and the reactionary, the socially reconstructive and the culturally reproductive.

Certainly the dual concepts of moral purpose and change agentry are extremely helpful in the effective management of any change process. Fullan (1993) takes this further in his belief that 'each and every educator must strive to be an effective change agent' (p. 13), and there is no doubt that institutional change cannot take place without a change in the working practices of individuals. However, as a conscious change agent, I found the theoretical back-up of Fullan's thoughts essential for the continuation of my efforts.

The concept of the dialectic has enabled me to delve further into the recesses of myself as a human agent of change, being influenced by and influencing

the world around me, or alternatively, being part of a social version of Heisenberg's Uncertainty Principle. The dialectic has clarified much of the confusion surrounding the emotional turmoil that resulted from my involvement in the change process. However, I have only used the dialectic idea retrospectively, not as a tool to help me intervene consciously in the change process. Without both Fullan's notion of change agentry and the dialectic, can effective change take place? I certainly used Fullan's ideas as my theoretical purpose, backing-up my moral purpose and change agentry competencies, but I would suggest that people good at managing change can acquire these attributes through evolution of their character in the process of lived experience. I would also suggest that taking notice of Fullan's theoretical constructs is a much more efficient way of managing change.

The application of the concept of the dialectic has further enhanced my understanding of the contradictory interrelationship between Schubert's (1986) cultural reproduction and social reconstruction images of curriculum. Our own cultural experiences make it hard for us to completely disregard legitimate traditional ways of doing things, despite our wholehearted acceptance of a paradigm, whatever it may be. We have to live, and commit to the new paradigm, or the values and principles that support it, otherwise the words are just rhetoric without effect on reality. However, a problem with the dialectic through its relationship to praxis, is that it views reality through actions in the material or perceived world. This seems to ignore the thoughts that an individual may have about a situation. The thoughts count for nought if there is no action or the action is ineffectual. Does this mean therefore that they do not exist or at least might as well not exist? There is room for further exploration of this issue, which I am unable to go into here.

My own emergent conclusions from this study are that Fullan's theories of change agentry can govern the actions of a change agent, and enable them to perform adequately. The dialectic adds another dimension to change management in a most potent way, but the question about the role of the mind sounds a warning about the human element in this theory. Finally, as Fullan (1993, p. 18) says, 'without change agentry, moral purpose stagnates'. Or, in terms of the dialectic, without praxis, critical analysis turns into consolidation of the status quo.

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RUSSEL MONTGOMERY

OUT OF THE ASHES: AN AUTOETHNOGRAPHY

> There is the greatest practical benefit in making a few failures early in life. (T.H. Huxley, 1870, *On Medical Education*)

I HAVE BEEN FORTUNATE ENOUGH TO FAIL

At the beginning of 2000, I became engaged in a curriculum development and evaluation project at an environmental education centre that I have called 'The Green Machine'. I was employed at the centre to write mathematics curriculum materials and to evaluate their effectiveness. I did not complete the materials or the evaluation.

Once my part in the project had folded I had my notes, my copy of the draft materials, and not much else. I certainly did not have the expected evaluation report, and it seemed to me that my career as a researcher was in ashes.

While still working at The Green Machine, I had grown quite uneasy as I rubbed up against the culture of the place. I had given a lot of thought to alternative forms of research that might have allowed me to explore this uneasiness. I considered action research but you do that during a project, not after. I began to think about the potential of ethnography. This turned out to be quite serendipitous! I saw that I could think of myself as an ethnographer and that thinking in ethnographic terms would give me a useful set of tools. Ethnographers compile field notes while participating in a community and then use their field notes to write narratives about that community's belief system. The educational setting in which I had been working was a community with a shared belief system. While working on the project, I had been gathering data and compiling material. These became my field notes. I could not have legitimately written narratives about the community's belief system because I could not have gone back to negotiate issues of interpretation (Zevenbergen, 1998). Yet, I could still use my field notes to do some narrative exploration of my own beliefs about teaching within the context of that community. I could have called what I did 'autobiography' but, since I had been unpacking my beliefs about teaching and learning, I chose to call it 'autoethnography'.

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 117–125.

Then I came to the vexed question of theory. I gained the impression that there was still much work to be done in the rigorous development of theories of knowledge and truth in narrative research (Huttunen, 2001). My own thoughts were very much a work in progress (and still are). In spite of this, I still had to put the autoethnography on a sound theoretical basis of some kind. I thought about where to start. First, it was clear to me that I could not adopt the notions of validity and reliability from empirical research. The underlying theory of truth did not match the type of research that I had been doing. Next, I eliminated other possible candidates.

1. I considered Guba and Lincoln's (1989) trustworthiness criteria (pp. 233–243) and their hermeneutic process controls (pp. 244–250). However, I could not adopt anything that relied on a correspondence between the researcher and the researched as separate persons.
2. I was attracted to van Manen's (1990) hermeneutic-phenomenology and Connelly and Clandinin's (1988) narratives of experience. However, my impression of these theorists was that their focus was on teachers engaged in pedagogical and curriculum processes. My autoethnography had not primarily been about pedagogy or curriculum. Therefore, I chose not to adopt these approaches.

Finally, reading Huttunen (2001) gave me the idea of adopting Ricouer's concept of mimesis as a hermeneutic of selfhood. I felt that this adequately described what had happened to me when I worked at The Green Machine, as I came away and wrote about the experience and as I returned to teaching. Central to this hermeneutic and to my experience was the making of a coherent narrative from the jumble of life experience. This notion of coherence tied in directly with an alternative theory of truth that I found important.

TRUTH

During the time of writing the autoethnography, I was at a gathering of student alumni and an acquaintance asked me about my research interests.

> 'What have you been up to?', she asked.
>
> 'Oh, … Maths teaching in education centres.'
>
> 'Can you elaborate?'
>
> I replied that I was doing ethnography. Pressed a little further, I explained that I had been exploring belief systems about teaching.
>
> 'Well, it should have something mathematical about it, since it was in mathematics education, don't you think?', she asked me, with a slightly disapproving frown.
>
> 'Well, there are many in educational research moving away from quantitative methods …', I began.

> She did not allow me to finish. Her question was too urgent … 'But how can you demonstrate correspondence between your study and the facts?'

Her question was an important one. Empirical research relies on validity and reliability. The measures of validity and reliability have at their heart the correspondence theory of truth. Valid findings must correspond to an external reality. Reliable findings must correspond over time for repetitions of the same experiment. In writing autoethnography, I was not seeking correspondence with any external reality and correspondence between consecutive findings made no sense. Clearly, autoethnography required a different theory of truth.

I found the coherence theory of truth more useful. Under this theory of truth, a proposition is true if it is consistent with a set of propositions that are held to be true. Young (2001) explains the finer points of the theory. With this alternative theory of truth I was bound, not to be consistent with some external criteria, but with myself. Was I able to arrive at a coherent account of my belief system?

A HERMENEUTIC OF SELFHOOD

I borrowed from Ricoeur's hermeneutic (Boje, 2001). It is a hermeneutic circle with three stages called mimesis[1], mimesis[2] and mimesis[3], respectively. Mimesis means imitation, but Ricoeur's use of the word refers to more then mere imitation. It refers to the creative reconstruction of life. For the sake of brevity, I will describe the hermeneutic by telling my own story.

Mimesis[1] is pre-understanding. This occurred during my time at The Green Machine. It had been a jumble of expectations, events, conversations, observations, dreams, and other peoples' stories. I responded to an advertisement about the research project. I had initial conversations with other major stakeholders. I had dreams about doing something different in mathematics education. Each of the major stakeholders had his or her dreams. I listened to the dreams. I met other staff at the centre. I watched them at work. I listened to their stories. I watched the interaction between staff members. I learned the layout of the centre. I met teachers coming in with their classes. I watched students going through programmes at the centre. I began to write curriculum materials. I discussed research strategies. I encountered differences in expectations, in belief systems, in previous experiences in mathematics education. I accumulated many experiences over a number of months. I left with a great deal of it recorded in notes. I had a sense that I had a story to tell but the narrative was unformed. It was only when I discovered Van Maanen's (1988) *Tales of the Field* that I found the tools to construct a coherent narrative.

Mimesis[2] is the construction of a coherent narrative, out of the jumble that makes up mimesis[1]. Van Maanen describes three major genres of ethnographic narrative: realist, impressionist, and confessional. I used all three, each with a different result. The first and most difficult narrative to construct was the realist tale. To create a good fit with the realist genre and to be coherent with my field notes I had to construct the image of a busy successful education centre. The realist genre required overall consistency and allowed only the one dominant voice. Certainly, the centre had been successful on its own terms. To be coherent with the dominant

reality I had to portray the centre in this way. Yet in writing this narrative, I felt considerable unease. This may have been the dominant narrative and it may have been coherent with my field notes but I needed to write other narratives. The second narrative was the impressionist tale. In constructing this I was less constrained than in the realist tale and was able to create a collage of multiple voices. I was able to write short narrative panels that I called vignettes. In each panel, I was able to explore a particular aspect of the project that I was interested in and I could allow dissonant voices to speak. Hence, I could allow the tension and dissonance that I had felt to emerge and take form. I started to understand the differences in beliefs about teaching that underlay the tensions. As I struggled with these voices, a coherent understanding of my own beliefs emerged. The third narrative was the confessional tale. Confessional narratives have a dual nature. On the one hand, they are an admission that the research has been less than perfect. On the other hand, they are a claim of heroism, of the researcher struggling against the odds. I certainly took advantage of this dual nature. In constructing the confessional narrative, I both admitted defeat and claimed extenuating circumstances.

Mimesis[3] is application. The narratives that I described above and the many other narratives associated with them are now part of my framework out of which I teach. Since working at The Green Machine, I have returned to teaching in a school. I am now much more alert to relationships. I now think of a school as a community and this is what is important to me. I had held this belief but amongst a confusion of beliefs. Now, it forms the framework from which I think about teaching and learning. This framework, the stories I accumulated and the many new experiences I have had since, will form mimesis[1] of the next hermeneutic circle.

ETHNOGRAPHIC TALES

I have included here a fragment of the realist tale. Constrained by the genre, I wrote the tale as an upbeat presentation of The Green Machine. Unable to conform totally to the genre, I attempted in the text to portray with mild sarcasm and footnotes the tension I felt between this ‘professional’ stance and my own ambivalence towards the project. You might detect a bit of sarcasm but I could not include the footnotes here. Realist tales are distinctive in their overuse of trivial detail. I have used this property here to provide information about the setting and characters from my narratives.

I wrote the impressionist tale as four vignettes. I used snatches of text and conversation from essential moments in order to create an impression of the project. My own rather dark point of view affected my choice of texts. However, I tried to leave it open enough to permit a multitude of interpretations. This approach was consistent with my awareness that my point of view was only one and that, had I been able to check with them, other stakeholders might have held very different views. I have included here the impressionist vignette that, I think, points to a major tension/conflict that developed in the project. Notice the distinct lack of footnotes

and detail in this impressionist fragment. It is merely a conversation. I have deliberately left the text as open as possible. I invite you to make of the text what you will.

In one of the confessional fragments, included here, I give a reason for my part in the project concluding before time. I am saying in effect: 'Yes I failed, but it wasn't really my fault'.

A REALIST FRAGMENT

Another Day at The Green Machine

A typical day would begin much as a school day. Staff arrive early in order to set up and be ready for the students when they arrive. The members of staff include the manager, the education officer, the safety officer, and the programme guides. The more experienced programme guides know the ropes and these are usually the first in. This morning there is a class of Year 5 students coming to participate in the *Planet Protectors* programme. Therefore, Joel and Susan (programme guides) busy themselves getting the teaching spaces and equipment ready. Joel is coordinating the programme. He is one of the old hands and a very competent programme guide.

Another Excellent Programme

The Crampton class has arrived. The programme, *Planet Protectors*, which these students have come to experience, has been on offer for only a few months. The Year 5 class at Lightfield were the first to use this programme. They helped with the trialling. Many of the local schools take advantage of being close to the location of The Green Machine. In fact, Lightfield has regularly been involved in trialling programmes. This arrangement suits both the school and the education officer at The Green Machine. Like all the programmes at The Green Machine, a lot of planning and preparation has gone into the *Planet Protectors* programme to ensure its excellence. Planning and preparing a programme is a complex task. It involves writing the training notes, making sure programme guides know the programme well enough to lead it, coordinating the teachers and students and fitting in with everything else that is happening at the centre. Joel and Susan, being experienced programme guides, are able to assist in the writing and editing of training notes, in the setting up of an interpretive trail and its evaluation and improvement.

Once the students arrive, Joel gathers them into the seminar room. He presents them with an outline of the programme and gives them a 'pep' talk on the positive impact they can have on the environment. He uses a word association activity to help them think about the idea of a 'system' and discusses with them how 'systems' can help them think about the environment. Joel then takes an elastic band (a 'system') and stretches it between fingers until it breaks, pointing out the problem of the pain when it breaks. 'How can we avoid this problem?', he asks. Then he directs their attention to a much bigger system (the environment) and to some of the

problems we humans have created. Then Joel, the other programme guides and the students move out into the car park to begin exploring that system and some solutions.

Once in the car park Joel splits the students into two groups. One group stays in the car park. The other group moves to the children's playground. Joel and Susan guide the students in the car park through a structured role play. This enables them to visualise the biosphere as a simple interactive system. Naomi and Patrick are working with the students in the playground that has been set up as a model of the Swan Valley ecosystem. As the students enter it and interact with it, changes occur. Naomi and Patrick lead the students in a discussion about their actions and the consequences. Mary pops in to check on Patrick (a new programme guide), who is doing fine.

The two groups change places. Then the class is recombined and split into four groups, who then cycle through four activities on energy-efficient appliances, greenhouse gases, wetlands, and endangered species.

Patrick is running the appliance sale. In this activity students purchase appliances. They must choose between more expensive energy-efficient appliances and cheap inefficient appliances. The students who bought the cheap appliances at the beginning of the game, thinking they got a bargain, end up with less money at the end of the game. The cost of running the appliances over the game costs more than they gained by buying the cheap appliance. Students cash in their money tokens at the end of the game for a treat. Mary is very happy with Patrick's progress. He even handled a difficult student well.

AN IMPRESSIONIST VIGNETTE

That's How It Is

'How's it going, Russell?'

'Oh, I'm ok Mary, but I am struggling with the culture here. You see, there already is a discourse, a language, and a way of thinking in place. It works well for what you have been doing up to this point. But there is no mathematics culture. There are only the remnants of what people have brought with them from their school experiences. A lot of that is quite negative. Not only do I have to write the programme but I have to generate a way of thinking among the programme guides as well. It's really hard.'

'Yeah, you've got a big job on your hands.'

'As you know, Mary, I have had trouble adjusting my writing to a different audience. When working with other teachers in schools, I have thought and written about teaching and learning in an environment of equals. In that environment we take our shared discourse for granted. My task at The Green Machine is quite different. I am trying to create the discourse as I write … but, boy, I've still got a lot to learn. I saw that in yesterday's planning meeting very clearly.'

'Yes, Russell, you're still writing like a teacher, for other teachers. Even other teachers would find your writing a bit esoteric. You certainly haven't made the transition to this environment, yet.'

'Hmm, I've given that some thought lately. Mary, you were a classroom teacher. You know what it was like. As a classroom teacher I can try out ideas on the run and drop them if they don't work. I write my programmes and lesson plans for myself and even then I don't rely on what I write. Most of what I teach comes from inside my own head as I teach.'

'You can't do that here, Russell. The programme guides have to know exactly what to expect. They need to know exactly what they have to do in each activity. All the other stuff you had in your training notes about outcomes is irrelevant to them. They weren't interested. You saw their eyes glaze over.'

'I still feel the disappointment and anger now, Mary. As a teacher, sure, I need to be clear about what I want to achieve. I need to have an idea about what might happen and what the kids might do but I always expect to be surprised. Now, writing for non-teachers [see the highlight in the second last paragraph], I have to eliminate the surprise. That's really sad. In fact, when I think about it now, I don't want to do it. I don't want to write scripts for non-teachers who then pretend to be teachers. I actually find the idea rather repulsive.'

'Well, Russell, you might be disappointed, angry and put off, but that's how it is.'

TWO CONFESSIONAL FRAGMENTS

Blakeville Grammar

I was writing mathematics curriculum for Year 7 students at Blakeville Grammar in the year following my time at The Green Machine. This was a new school, and the staff was interested in new ideas. There were three Year 7 classes, all taught by the same teacher. Therefore, the school was easy to involve in my research. However, in time, my interest in the school came to eclipse the research project.

My loyalty to Blakeville Grammar grew as my loyalty to The Green Machine diminished. I had like-minded colleagues at Blakeville whereas I did not at The Green Machine. I understood the culture at Blakeville Grammar because I understood schools. I did not understand the culture at The Green Machine. It was in my interest, in the long term, to cultivate my relationship with the school: even at the expense of the research project.

Parenting

I had been at home caring for children through all of 1998 and 1999. During that time, I had attempted no teaching work at all. However, by the time I began at The Green Machine, in the first half of 2000, I expected to be able to ease my way back into work. I did state in my original agreement that I would have a six-week period

when my youngest child would be easing into pre-primary. After that, I expected to have four days available each week.

Unfortunately, my life as a working parent was not as I had expected. Even during the early part of the project, I needed to stay home with sick children. Then winter set in. I was home most of winter. Once the winter was over, I wrote the following email to The Green Machine.

> A winter of sickness has kept me away from The Green Machine: away from developing the project further. My family has had 4 rounds of colds and flu this winter. My youngest son started at a new school this year. As I should have expected, he has often been ill. He has passed these sicknesses on to the rest of the family. Since it is my role to look after our children when they are sick, I have spent weeks looking after them. Then I have spent weeks nursing myself as I recovered from the illnesses contracted while caring for the children. The last round was particularly severe. I have been careful to stay away from The Green Machine while sick.
>
> This, along with relief teaching, has kept me absent from The Green Machine for the entire winter. This has meant I have been unable to make progress with the project.

By the time I wrote this email, I was feeling rather embarrassed about the lack of progress. Finally, an email arrived from The Green Machine, to put me out of my misery.

> Dear Russell
>
> It has been unfortunate that your illness has prevented you from producing a workable programme for us.
>
> Paul and I have discussed your recent emails and have agreed that it is best if you do not continue at The Green Machine.
>
> We hope that your research works out successfully.

I might have predicted that my youngest son was going to be ill most of the winter. However, I doubt any parent wants to think that way. I have no regret about putting my children first.

EMERGENT KNOWLEDGE

Through this narrative process, a coherent set of my beliefs emerged. In the writing process I came to realise that I believe teaching and learning are primarily relational. I became acutely aware that I think of teachers, students, parents, and other members of a school as a group of people in a web of relationships, sharing a common life. Clearly, my professional actions were contingent upon a view that meaningful, life-enhancing learning happens only in these relationships. Conversely, I have to admit that The Green Machine was a success, judged on its own terms. The realist fragment, included here, portrayed a group of dedicated individuals committed to delivering high quality programmes. I believe that if I had completed the initial research, within the given terms of reference, my findings would have been very positive. Yet, the flip side, also present in the realist fragment, was that the students were in attendance at The Green Machine for only a very short time. The

teaching/learning relationship was, at best, a shallow one. I came to know that it was this that I had found disturbing.

There is more in the impressionist vignette and the confessional tale. I learned that, until then, I had taken the web of relationships among teachers for granted. I had always taught within a network of colleagues. This had not been the case at The Green Machine and I had felt it acutely. I came to understand why I had taken offence at what Mary had been asking me to do. It was because of my beliefs about teaching and learning. I came to see that I believed teaching and learning to be inseparable; that teachers were as much part of the teaching/learning web of relationships as are students. I had been unable to conceive of stepping outside that web and reducing teaching to a programme. The confessional fragment about parenting contained a primal relationship, that of parent and child. This relationship and my relationship with the school had stood, for me, in stark contrast to the lack of relationship I had experienced at The Green Machine. These statements are all about relationship. For me the teaching/learning process is relational and needs to take place in a social network.

IN CLOSING

My beliefs about teaching had disrupted my involvement with a curriculum development project. I was unable to go back and explore the beliefs of the other stakeholders but I was able to research my own beliefs. In searching for a methodology, I found I could link Van Maanen's (1988) ethnographic genres with a theory of truth as coherence and with a hermeneutic of selfhood adapted from Ricoeur (see Boje, 2001). I used the ethnographic genres as I worked through of the hermeneutic circle to arrive at a coherent understanding of my beliefs about teaching and learning. These beliefs, now more clearly understood and articulated, have become both part of the framework from which I teach and part of the pot-pourri from which the next hermeneutic circle will begin.

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JOHN WILLISON

THE IMPACT OF A RESEARCH VIGNETTE ON MY METAPHORICAL UNDERSTANDINGS

A particular classroom incident, and the vignette I used to portray it, had a significant impact on the interpretative framework for my research into scientific literacy. In this chapter, I will trace the salient elements of this vignette including its construction, justification, and effects. I present the vignette, and then track back to the research methodology that I employed, which guided the writing of the vignette. I explain how this writing led to the emergence of a metaphorical framework for scientific literacy and conclude with a discussion of the criteria used to judge these forms of representation.

The study was based on science classroom observations during the course of one school year. I noticed that hands-on investigations occurred in over 40% of all science lessons I observed, and over 90% of these were closed in terms of student freedom to determine the question posed, the methods chosen, or the answer gained. The following vignette serves as an example of a typical science lesson, involving a closed investigation. In the vignette, I have represented the routine in terms of 'closedness', as this suggests the potential paralysing power of normality on student scientific literacy. I wrote the preliminary version of this vignette on the same day as the event it depicts, knowing that my field notes contained salient factors for understanding the scientific literacy of the two main characters, Tara and Shannon. I could not have anticipated the further questions that would arise as I worked on the construction and refinement of the vignette.

RESEARCH VIGNETTE: 'SCIENCE IS STUPID'

By the time I sit on the experimental bench that runs along the rear wall, immediately behind Tara and Shannon, Mrs. Stubalm is already asking the class a recollection question:

> 'What happens to a gas when we heat it?'
>
> 'Expands', exclaims one of the boys.

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 127–137.

Tara calls out, ‘Matures’.

I wonder to myself why Tara uses a word like that.

‘This afternoon we are doing another experiment, and I want you to predict what will happen’, declares Mrs. Stubalm.

The class is obviously pleased, and I smile to myself.

Mrs. Stubalm asks, ‘What do you think will happen if we heat the liquid?’

‘Bubble’, someone calls out.

‘Yes…,’ hesitates Mrs. Stubalm, seeming somewhat disappointed at the answer, ‘…and a solid?’

‘Expand’, says one of the boys near the front.

‘Yes. A very good word’, commends Mrs. Stubalm. The boy throws his chest out.

‘Metal burns and shrinks when you heat it’, adds another boy immediately in front of Tara and Shannon.

Mrs. Stubalm seems to avoid his statement, and immediately asks the students to start writing their predictions in their exercise book.

After a short while, the students are instructed to gather a textbook, and look at a certain page. On it a diagram depicts a metal ring of slightly smaller inside diameter than the outside diameter of an accompanying metal ball.

Mrs. Stubalm explains, ‘What you’re trying to do is put the ball through the hoop. You need to be careful, because you could burn yourself. Decide what to heat, the ball or the ring. You have to push it through the ring.’

Tara collects the equipment and sits down next to Shannon at their lab bench. They soon have the Bunsen lit, and start heating the ring. Soon Tara lowers the ball through the hole in the ring, and says: ‘We did it!’ She looks very satisfied at their success.

Suddenly Mrs. Stubalm calls out, ‘OK everyone, pack your equipment away.’

The girls quickly pack up, sit with the text open and quietly do nothing.

Mrs. Stubalm asks the class, ‘What happens to the solid when it’s heated?’

‘Expands,’ someone calls out.

Mrs. Stubalm nods confirmation.

Shannon whispers to Tara, ‘I *told* you.’

Tara sits quietly, looking annoyed.

I move close to Tara and ask her, 'What was your prediction?'

'Metal would burn and shrink...and that's what happened. It shrinks to let the ball through.' I'm caught by surprise, as this answer seems totally inappropriate.

Shannon rescues me. 'No it doesn't. It expands.'

'No, the ring *shrinks*.'

'It *expands*.'

'It *shrinks*, because the ring becomes thinner and thinner, until the ball gets through', explains Tara, getting extremely frustrated with Shannon's thinking.

Shannon is also annoyed with Tara, and retaliates, 'The hole has to get bigger to let the ball through, so the metal must *expand*.'

Tara continues her explanation, 'I mean it shrinks outwards. Like, the metal inside shrinks towards the outside.'

'You're saying the actual metal bit gets smaller?' I query.

Tara nods.

'What actually happens is the metal expands and moves out?'

'I told you!' triumphs Shannon again.

Tara grows even more frustrated that I, too, do not understand her. She presses on, 'The outside expands to give the inside room to shrink... see. Science is stupid, cause you don't know if you're right.'

METHODOLOGY

The 'science is stupid' incident resonated throughout my research, not so much like a bomb in a great cave, but more like the gentle rustle of snow that initiates an avalanche. At the time of writing the vignette, it was obvious to me that Tara was making personal sense of metallic phenomena, but I didn't realise initially just how sensible her notion was. It slowly dawned on me that, given her background experience, some common-sense knowledge, and the vagaries of classroom-science, her notion of metals shrinking when heated was fully justifiable, and others' arguments, in her ears, were illogical and stupid.

With the developing conviction that her sense-making was logical, I felt saddened that she had been so ostracised in that incident. Eventually (maybe four months after the incident) I realised that this element of Tara's participation was a legitimate form of scientific literacy, one that influenced my notion of what scientific literacy entailed. Ultimately, this led to the emergence of a three-metaphor framework (see later) which provided me with interpretative power to not only

understand Tara's and Shannon's scientific literacy, but to encapsulate the vast majority of definitions of scientific literacy in the literature. Knowing now this event was something of a turning point, I now turn your attention to the direction of the research leading up to the incident portrayed in *Science is Stupid*.

THE COURSE OF THE RESEARCH PRIOR TO THE VIGNETTE

In order to explore the notion of scientific literacy, I adopted the role of participant-observer in two classrooms for one school year. Palonsky (1975) stated that participant observation facilitates the development of understandings by reducing the gap between researcher and subject, and that 'immersion to gain their perspective is the methodology' (p. 89). However, gaining 'their' perspective is a problematic issue, due to the postmodern turn in qualitative research.

An ongoing research 'task is to discover and construct meaning in... [field] texts' (Clandinin and Connelly, 1994, p. 423). So, proceeding by 'analytic induction' (Erickson, 1998, p. 1164), I began to make tentative assertions about my field data. I decided to use metaphor (Tobin and LaMaster, 1995) to develop my understanding of students' scientific literacy. However, my use of metaphor was in a constant state of flux during the research. Its role initially was to encapsulate dominant learning characteristics of individual students, utilising Connelly and Clandinin's (1988) methods to identify personal metaphors. The idea here is to search for rules that seem to direct student actions, conceptualise overriding principles that direct these rules, and then determine a guiding metaphor that unites the principles.

As I began to focus on Tara, in order to understand the rules and principles of her participation in the science classroom, I settled on the metaphor 'learning as fighting'. While I was 'reviewing evidence with my assertion in mind, revising the assertion in the light of evidence, and then reviewing the evidence again' (Erickson, 1998, p. 1164) I was surprised when I began to visit Tara's non-science classrooms, and could find no evidence to support such a metaphor. Moreover, three of her non-science teachers told me she was a quiet and cooperative girl.

The disparity between my observations of Tara in science and non-science classrooms caused me to reconsider the value of a personal metaphor for each student. The limitations of using personal metaphors caused me to look for alternative ways of construing scientific literacy. Better, I decided, to form assertions that explained, at the highest possible level, the greatest number of datum points (Erickson, 1998).

TARA'S SCIENTIFIC LITERACY

Tara's involvement, as depicted in the vignette, suggested that students could at times take on the role of accepting or rejecting classroom-science. Her participation suggested to me an ingredient missing from a two-metaphor framework that I had previously developed during action research on my own classes (Willison, 1999). The two metaphors I had previously utilised were similar to Sfard's (1998)

acquisition and *participation* metaphors. Tara's participation as a kind of judge of what was presented in the classroom alluded to a middle-ground metaphor.

When I interviewed Tara and Shannon two weeks after the event portrayed in the vignette, Tara made some interesting comments about who was right about the metal ring:

> Tara: (To Shannon, indignantly) You were right! What are you complaining about?
>
> John: In what way was she right?
>
> Tara: Well, um, I don't know.
>
> John: Well, when did you decide she was right?
>
> Tara: When everyone else agreed with her.

At first, it would seem as if Tara was saying that the overall consensus persuaded her that the ring *did* expand when heated. However:

> John: Don't you, in reality, agree with Shannon now?
>
> Tara: Not really ... I agreed with her to an extent and then I just, like, agreed with myself.

Here is an evident conflict in Tara's thinking. She agreed with herself, because she felt her position was the only one that made sense. She agreed with Shannon 'to an extent' because Shannon was on the side of the popular vote. During the class discussion that confirmed, rather than challenged, the expansion of heated metals, Tara became quiet and disengaged. Tara, in judging science, found it ostracising, intimidating, and 'stupid'. She continued to hold her own ideas, and felt that science was not an appropriate way of knowing; it did not fit with experience or common sense. This position concurs with Solomon's (1987) suggestion that the explanations that students create not only differ from those of scientists but they widen the divide between everyday and scientific ways of understanding the world. This position would be true for a student who creates alternative understandings to the classroom-science being developed, and is given no recognition for the viability of these understandings (by *classroom-science*, I mean the specific teaching of science content and skills that is particular to one teacher with his or her science class). If such conceptualising is dismissed automatically then there is a subtle inequity for students who have a propensity to evaluate classroom-science.

THE INFLUENCE OF THE VIGNETTE

The ostracising value of the interaction portrayed in the vignette caused me to think about the importance of legitimating such alternative forms of scientific literacy. Tara's participation, as depicted in the vignette, seemed to suggest a middle ground between the two metaphors I had used previously. Students, at the level of the individual making sense of phenomena, could be considered as confirmers or deniers of knowledge. I considered that this way of participating in classrooms

complemented the perspective of scientists as experts dispensing knowledge. This provided the middle metaphor-couplet. If this was the middle ground, then above was the realm of students *acquiring* expert knowledge derived from scientists, a process in some ways similar to protégés acquiring their master's knowledge. Beneath, students' *participation* suggested a realm where scientists' authority is less certain, and so I deemed scientists as explorers, and students to be like them. Therefore, the three metaphor couplets came to be:

1. Scientist as expert – student as (potential) protégé
2. Scientist as expert – student as confirmer/denier
3. Scientist as explorer – student as scientist

I began immediately to consider definitions in the scientific literacy literature, and found there was some 'fit', in that the three metaphor couplets could usefully organise the literature definitions. Moreover, I started to interpret some of the other research vignettes and found an explanatory power when applying the framework. However, during peer debriefing, I was persuaded that the couplets were too cumbersome and incomprehensible, and so dropped the mention of scientists. Ultimately I streamlined the framework until it contained the three metaphors presented below, and so 'working recursively back and forth between hunches and data, one progressively arrives at new insights' (Erickson, 1998, p. 1165).

THE THREE-METAPHOR FRAMEWORK

The revised framework, composed of *student-as-recruit, student-as-judge*, and *student-as-scientists*, emerged, in a messy manner, as a way of making sense of student scientific literacy in general, but heavily influenced by the vignette about Tara and Shannon. Student-as-recruit *accepts* and *appropriates the content* of classroom-science. The metaphor is similar in nature to Sfard's (1998) acquisition metaphor and Scribner's (1986) adaption metaphor, since, from these perspectives, students must acquire the knowledge by adapting to the Science classroom culture. The metaphor implies Science lessons which involve students in taking part in 'ready-made-science' (Latour, 1987, p. 4).

Student-as-judge makes explicit that students making sense of *other* people's knowledge claims, especially of classroom-science, will, ultimately, be *persuaded* one way or the other about the validity of a claim, and display activity that suggests the passing of a judgement based on evidence. For example, in the vignette Tara declares 'I told you science was stupid, 'cause you never know if you are right'. It is the middle ground between Sfard's (1998) two metaphors of acquisition and participation, where students *construct* understandings of phenomena. Student-as-judge conveys the idea of 'science-in-the-making' (Latour, 1987, p. 4) by professional scientists, whose knowledge claims are tentative, and must be evaluated by students of science.

> Students-as-scientists is a metaphor written in the plural form as it is highly suggestive of the salience of social processes as compared to internal cognitive ones. Students-as-scientists ask their own questions, devise their own experiments, and produce their own results and conclusions, utilising imagination as well as logical thinking. They develop

> their *own knowledge claims* about phenomena and attempt to *persuade* others about the validity of these claims (Sutton, 1993, p. 1219). The metaphor is closely aligned with Sfard's (1998) second metaphor of 'participation', and conceives of students themselves conducting 'science-in-the-making'. (Latour, 1987, p. 4)

My changing use and, more importantly, my developing understanding, of metaphor had a profound effect on the research. Whereas I utilised metaphor originally as a tool to provide insight into student actions, I ultimately adopted it as a frame of reference that I envisaged could hold otherwise conflicting viewpoints that influence concepts of scientific literacy, namely objectivism, personal constructivism, and social constructivism. This change began with the limitations of 'personal metaphor' to satisfactorily explain Tara's involvement in classrooms, which led to the rekindling of my interest in a metaphoric framework. I needed to justify the use of such a framework, which ultimately drew me to metaphor itself as a frame of reference. This was influenced by Lakoff and Nunez's (2000) view that 'metaphorical thought is the principal tool that makes philosophical insight possible, and that constrains the forms that philosophy can take' (p. 7). Lakoff and Johnson's (1999) view of metaphor places objectivism, personal constructivism' and social constructivism on equal footing because 'philosophical theories are largely the product of the hidden hand of the cognitive unconscious' (p. 14). Moreover, these authors point out that each philosophical theory typically chooses one metaphor as the true literal meaning of the concept. One reason there is so much argumentation across philosophical theories is that different philosophers have chosen different metaphors as the 'right' one, yet they point out that 'the cognitive reality is that our concepts have multiple metaphorical structurings' (p. 71).

The vignette was pivotal in precipitating the further usage and deepening understanding of metaphor. It was from the point of writing the vignette, onward, that metaphor grew, at least in my mind, in its conceptualising capacity. Having specified the methodology and emerging interpretative framework, I now consider the issue of the quality of the research.

REPRESENTATION OF THE RESEARCH

Qualitative research of the first 40 years of the twentieth century was conducted with a commitment to objectivism, finding out and reporting the perspectives, and even the hidden realities, of those being researched. Denzin and Lincoln (1994) identified this mentality as the first of several 'moments' of qualitative research. The subsequent moments, were, in order of emergence; modernist, blurred genres, crisis of representation, and the double crisis of representation and legitimation. Each of these is still in operation today, so 'there have never been so many paradigms, strategies of inquiry, or methods of analysis to draw upon and utilise' (p. 11). Denzin and Lincoln therefore ask of any qualitative researcher, what are the criteria used to represent your research?

CRITERIA OF REPRESENTATION

> Any representation must legitimate itself in terms of some set of criteria that allows the author (and the reader) to make connections between the text and the world written about. (Denzin and Lincoln, 1994, p. 11)

Representations are written in specific ethnographic genres. Van Maanen (1988, 1995) identified three of these genres as *realist, confessional*, and *dramatic*. I have utilised the latter two to endeavour to make connections between the text and the classroom situations I am attempting to depict. Realist tales are characterised "by the almost complete absence of the author from most segments of the finished text" (Van Maanen, 1988, p. 46), a strategy which is intended to reduce concerns about subjectivity. 'Only what members of the studied culture say and do and, presumably, think are visible in the text' (Van Maanen, 1988, p. 46). Confessional tales, however, move 'the fieldworker to centre stage and display how the writer came to know a given social world' (Van Maanen, 1995, p. 8). Dramatic tales 'reconstruct in dramatic form those periods the author regards as especially notable and hence reportable and tries to keep both subject and object in constant view. The epistemological aim is then to braid the knower with the known' (p. 102).

In departing from the first and second *moments* of qualitative research, mentioned above, I utilised a confessional and, occasionally, a dramatic genre to depict the fieldwork. Fieldwork constructs emerge from a hermeneutic process, meaning fieldwork is more interpretative than observational or descriptive (Van Maanen, 1988, p. 93). Ways in which qualitative research is represented should reflect this interpretative act, that is, by depicting the researcher as an integral part of the research. Therefore, I incorporated the features of *confessional ethnography* in the vignette which: highlight my participation with the students, including my attempts to understand, influence, and help them (sometimes in ways that are, retrospectively, quite unhelpful); and convey cultural information in a personal and historically situated fashion (Van Maanen, 1995, p. 9). In addition, I have utilised some features of dramatic genre, relating particular events 'of obvious significance to the cultural members studied' (p. 9) as an unfolding story, utilising various literary techniques.

Whilst the vignette was written utilising both a confessional genre and a dramatic genre, a more objectivist, propositional language genre is used elsewhere, holding these otherwise incompatible styles in a 'dialectical tension' (Geelan and Taylor, 2001). Whereas the last genre provides a sense of propositional logic and coherent explanation, the first two serve quite a different purpose. The vignettes are more *confessional* than *dramatic*, yet both features are important for transferability and verisimilitude, discussed below.

TRANSFERABILITY AND VERISIMILITUDE

In representing interpretative research, one important measure of usefulness is *transferability,* which involves criteria that determine the extent to which the case

study helps readers to infer applications to their own educational situations. These transferability criteria are somewhat parallel to external validity or generalisability and include the presence of thick description, provision of vicarious experience, metaphoric power, and personal reconstructability (Guba and Lincoln, 1989, p. 206). Confessional and dramatic tales *impress* upon the reader certain ideas from the research and as such can be useful tools to facilitate transferability.

Another criterion to assess the quality of the impressionistic tales is *verisimilitude*, which asks whether the representations in the text are consistent with the real situations that exist in science classrooms (Denzin and Lincoln, 1994). To see if the tales fulfil the criterion of verisimilitude, you, the reader, may ask the questions; 'are the characters in the vignettes believable?' and 'do the experiences depicted ring true from your own experience?' This chapter is written primarily for those involved in educational research with teachers and for teachers themselves who are researching, and so it is important to convey the sense of realistic and relevant research.

Next, I will consider the epistemological status of the vignette and to state how I chose what became research text (Clandinin and Connelly, 1994) out of the corpus of possible data (Erickson, 1998).

THE VIGNETTE REPRESENTING THIS RESEARCH

What is the epistemic status of the vignette? Even though it has elements of dramatic control, I ensured that

> words put in subjects' mouths were in fact spoken by those subjects. The ethics of textual production argue for the meticulous checking of verifiable facts; that one must be certain that statements depicted as quotes were in fact made. But more important, the ethnographer must take care when changing contexts and reordering events for dramatic purposes. (Lincoln and Denzin, 1994, p. 578)

This care ensures that the vignette in this chapter legitimately represents the research as well (or as poorly) as would realist vignettes, given that both are well triangulated with interview data and field notes. Confessional tales convey

> a good deal of the same sort of cultural information and speculation put forth in conventional realist works, but in a more personalised and historically situated fashion. (Van Maanen, 1995, p. 9)

Therefore, 'the work at the coal face of ethnography goes on therefore in much the same way as it did before textuality came into vogue. Evidence must be offered up to support arguments whose pedigree must be established in a way that will convince at least a few readers that the author has something credible to say' (Van Maanen, 1995, p. 23).

Therefore the interpretative act began with myself-in-classroom and continued with recording of field notes, writing of vignettes, interviewing of students and teachers, and rewriting of vignettes. Moreover, a significant part of interpretation was my role as editor, which functioned at three levels: what to record in field notes out of all the possible events; the selection of what comments and actions to focus on when the field notes are utilised in writing a vignette; and the

selection of salient vignettes out of a corpus of dozens, plus dozens more potential, but unwritten, ones.

In the vignette, my voice is not as expressive and dynamic as Van Maanen's (1988), not as reflective and self-revealing as Geelan's (2004) and not as personal as Taylor's (2002). My voice aims, yes, to strongly braid in the strand of my participating, observing presence, yet it seeks to emphasise Tara and her scientific literacy for the effect of paralleling as closely as possible situations encountered everyday in classrooms. The effect of the attempt to quote verbatim is to limit the blurring of the knower with the known, and so to allow some discernment of each braid in the whole plait. In the vignette, I have backgrounded the teacher and most members of the classes in order to highlight Tara, Shannon, and often my interaction with them. This facilitated the main purpose of the research – to deepen understanding about student scientific literacy in the classroom.

In the writing of the vignette, I adopted Van Maanen's (1988) suggestions of literary devices for the writing of dramatic tales. These included: *fragmented knowledge*, where a novelistic style allows events to unfold in a way that shows my own learning process; *characterisation*, meaning that emotions are expressed, rather than objective disinterest portrayed, and that characters have names, motives, and lines to speak; and *dramatic control*, which requires the use of present tense, contextual descriptions, fresh allusions, emotional stimulation, and not giving away endings.

Although the vignette was written for a science education readership, it seems now that its biggest impact may be on its author. In my own writing, reading, and ongoing interaction with the vignette I can see a story as dramatic as the original incident; a story of a researcher being challenged to understand a familiar situation in a fresh way, and responding to that challenge.

CONCLUSION

Significant research incidents may have a sizable impact on the direction of research. This chapter has tracked the impact of one such incident, written up as a vignette, as it challenged the interpretative framework in use at the time, and helped to reshape it. Such critical events that occur during mundane classroom experience may, therefore, lead not only to a different-than-expected outcome of research, but also to a totally revamped theoretical framework.

Tara's participation depicted in the vignette provided an example of what has now become, to me, an obviously necessary part of a metaphoric framework to understand scientific literacy. However, this understanding came, not by a 'flash of insight', but only after a long period of writing, interviewing, rewriting, finding interpretative inadequacies, reading the literature, and so on. Therefore, one may ask: 'Was the most significant factor the actual classroom event, or the ongoing interaction with the vignette that portrayed it?'

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DAVID GEELAN

SONGS OF INNOCENCE AND OF EXPERIENCE: IMPRESSIONIST TALES AND SECRET STORIES OF LIFE IN CLASSROOMS

> Experience takes on dramatic forms more akin to music unfolding diachronically through time than a pictorial description synchronously present. … A melody reverberates and regenerates feeling, mood, atmosphere, nuances of pathos, that no scientific discourse can convey, let alone scientific method begin to study... (Laing, 1982, pp. 10–11)

INTRODUCTION

During 1996, in my role as a science teacher and researcher, I conducted an intensive participant observational study in an innovative Australian middle school. The activity involved team teaching with a group of five teachers attempting to implement curricular innovations such as portfolio assessment, integrated curriculum, and teacher collaborative planning. I chose a narrative methodology, including 'impressionist tales of the field' (Van Maanen, 1988), to both conduct and represent this research into my own and others' teaching practices and values. A 'novel' woven from those narratives, entitled 'School Stories', formed a significant proportion of the research report.

I have chosen to begin this chapter by outlining two theoretical perspectives that influenced my choice of a narrative mode. The processes of collecting the 'empirical materials' (Denzin and Lincoln, 1994) for the research, writing the impressionist tales, and weaving them together with other empirical materials to richly represent my experiences within the school, are described next. I have included an example of an impressionist tale, and considered some of the issues of verisimilitude and validity that confront researchers working within narrative modes.

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 139–148.

THEORETICAL PERSPECTIVES

Michael Connelly and Jean Clandinin: Narratives of Experience

Michael Connelly and Jean Clandinin (1988) champion a 'narrative rationality' as an approach to understanding what happens in education and how teachers think and feel about it. Elliot Eisner notes that teacher narratives are seen as 'soft' data, and that their use requires courage. He suggests that:

> One must be willing to understand by participating sympathetically in the stories and in the lives of those who tell them …. One needs to be able to trust on the basis of coherence, utility, and the often ineffable sense of rightness that true stories display. ... The use of narratives, and the epistemological frameworks through which these narratives embody and convey meaning, not only provides an important way to think about curriculum and teaching, but is also vital to understanding what goes on at school. (Eisner, 1988, p. x)

Connelly and Clandinin suggest that the research literature on teaching has tended to concentrate on the observable behaviours of teachers and students. Such research, they suggest, tells only part of the story, and perhaps not the most important part. A narrative rationality that attempts to understand teachers' classroom practice as the meanings teachers make of classroom events and situations, systemic prescriptions and requirements, their autobiographies as teachers and learners, and the specific, contextual needs of students is more powerful.

> Narrative is the study of how humans make meaning of experience by endlessly telling and retelling stories about themselves that both refigure the past and create purpose in the future .... Constructing a narrative account of oneself, or of someone else, is difficult, rewarding work. It is difficult because so many aspects of life need consideration and because people are so complex that they all have many life stories, not only one. It is rewarding because it is curricular and educational. It as a way of making educational meaning of our lives... (Connelly and Clandinin, 1988, pp. 24–25)

Narratives about teaching are powerful because they take into account not only current practices and situations but the past lives and experiences of teachers, and their future aspirations. Such accounts are intended to provide an occasion for reflection on the part of the writer and the reader – particular dilemmas of education are seen with their full moral and emotional force, and with much of their complexity intact.

Such dilemmas, suggest Clandinin and Connelly in their 1995 book *Teachers' Professional Knowledge Landscapes*, arise out of the richness and complexity of the 'professional landscape' within which teachers work. This goes beyond the classroom context to include other 'professional places' within the school – like staff rooms, playgrounds, and offices – and to include the life experiences and values of teachers. The professional landscape also includes 'the conduit' (Clandinin and Connelly, 1995, p. 9) or 'the pipe' through which flow the apparently unassailable theoretical pronouncements of researchers and the prescriptions of governmental and educational authorities. Such prescriptions have a moral force, because the

descriptive 'is' of research tends to become the prescriptive 'should' of accountability and requirement. Clandinin and Connelly (1996) describe these intrusions from the conduit as 'sacred stories'. Teachers in classrooms are, in a sense, in a secret environment. The stories they enact in this context are their actual classroom practices, and reflect their biographies as teachers and learners and their beliefs and values about teaching (and life). The gap between these 'secret stories' and the 'sacred stories' of the school community is another – although perhaps rather richer – description for the oft lamented 'theory-practice gap'. Teachers tell and share their secret stories when it is safe to do so – sometimes in the staffroom and with other teachers, sometimes (if they are very fortunate) with their partners at home. Secret stories, though, do not play well in the professional landscape outside the classroom, because by necessity they present the teacher as tentative, thoughtful, and uncertain. In the professional landscape it is necessary for teachers to appear confident, competent, certain – so teachers also tell 'cover stories' which deal with classroom events, but present the teachers' role and actions as unproblematic.

The scheme of secret, sacred, and cover stories is one that I have found valuable in considering many of the moral, ethical, and educational dilemmas raised during my year at Arcadia High School. It has value as one more way of teasing out the tangled fibres of my life in the school, spinning them into narrative threads, and weaving these into a useful and aesthetically pleasing narrative net. Another scheme I have found useful, albeit for weaving a different type of net, is that of John Van Maanen.

John Van Maanen: Impressionist Tales

John Van Maanen, in his 1988 book *Tales of the Field: On Writing Ethnography*, describes 'realist, confessional and impressionist tales' that ethnographers have used, and can choose, in representing their research: their lived experience in 'the field'. Space does not permit me to outline the characteristics of realist and confessional tales here, but I found Van Maanen's characterisation of impressionist tales compelling as a description of the type of storytelling I value, and was attempting in my research writing.

The tales are intended to allow the reader to be engaged in an experience of some facets of my year in the school. This is accomplished through tales of 'critical incidents' that occurred during the year, rather than through the realist tale's approach of building up layer upon layer of the ordinary. I was not really interested in the minutia of daily lessons, of classes that went well, and teachers who unexceptionably carried out their duties. Instead, the tales reflect '[their] out of the ordinary or unique character. Impressionist tales are not about what usually happens but about what rarely happens' (Van Maanen, 1988, p. 102).

The four parallel characteristics of impressionist tales, Van Maanen (1988, paraphrased) argues, are:

1. Textual identity – the intention of the impressionist tale is not to objectively describe a culture (like the realist tale), nor to analyse the motivations and theories of the researcher (like the confessional tale), but to engage the reader in the experience, from the perspective of the fieldworker.

2. Fragmented knowledge – life is not simple, resolved, or closed, and the successful impressionist tale represents this complexity in the narrative, with details, juxtapositions, and allusions. Reading becomes a pedagogical occasion.
3. Characterisation – the author of the impressionist tale will use the techniques of the novelist or short story writer to personalise the characters who appear in the tale, especially to personalise himself or herself as a likeable and engaging (though not always right or patient or wise – this portrayal is related to confessional tales) character who will engage the reader.
4. Dramatic control – while the impressionist tale serves an academic purpose, and answers questions of academic interest, it does so through the skills of the storyteller, and the appropriate standards of judgement are different:

> Literary standards are of more interest to the impressionist than scientific ones. ... In telling a tale, narrative rationality is of more concern than an argumentative kind… The standards are largely those of interest… coherence… and fidelity. … Finally, since the standards are not disciplinary but literary ones, the main obligation of the impressionist is to keep the audience alert and interested. (Van Maanen, 1988, pp. 105–106)

In describing impressionist tales, particularly in the above excerpt, Van Maanen probably overstates the reliance on literary standards rather than disciplinary ones, at least for the case of the research writing I am discussing here. While it is *necessary* that the tales presented must engage readers and hold their attention, for the purposes of publication in educational research journals it is not *sufficient*. Such accounts must demonstrate (partly through the tales-in-themselves and partly through the meta-text that surrounds them) that (a) they are grounded in my personal experience within the school; (b) the things they say are in some sense 'about' that experience and about the school; and (c) those assertions and conjectures are significant and valuable within the field of science education. I would suggest, then, that rather than embracing Van Maanen's vision of ethnography wholeheartedly, I have chosen to use the techniques and methods of fieldwork and narrative representation in order to examine questions of pedagogical interest. Essentially I have turned John Van Maanen's (1988) methods into Max van Manen's (1991) project of hermeneutic-phenomenological inquiry into pedagogy.

My avowed intention – to provide, through the text, an occasion for pedagogic reflection on the part of the reader – is essentially rhetorical. 'School Stories' does not argue its case in logical propositions, but in narratives of experience, and, if it is persuasive, that suasion is through an act of the heart as well as of the mind – the appeal of rhetoric, rather than of 'pure' logic. The analogy for the representation of experience offered by R. D. Laing – that of a 'melody [that] reverberates and regenerates feeling, mood, atmosphere, nuances of pathos, that no scientific discourse can convey, let alone scientific method begin to study' (1982, pp. 10–11) – seems apposite for the impressionist tales that make up 'School Stories'.

WRITING THE TALES

Many of the tales that came to make up 'School Stories' originated in the reflective journal where I recorded the 'critical incidents' that occurred while I was teaching at the school. Incidents, whether in classroom lessons, the playground or staff meetings, that struck me as either relevant to the concerns I was attempting to address in the research project, or simply as having some dramatic force, were recorded with a brief sketch of a tale. The incident in the tale included below, where the students skated to the wall to invite me onto the ice, and my reflection on that occurrence and what it meant about our relationship, is one example of this kind of tale. Details of the physical environment – those touches that help the reader to identify with the author and connect the incidents with their own experience – were noted in the original stories, but sometimes augmented or changed, either for dramatic reasons or in the interests of the participants' anonymity.

Other tales arose from ideas with which I was wrestling, or issues that I deemed it important to include. The character of 'Shannon', who later in the book is found by her teacher as being sexually abused by an older step-brother, was not based on a particular incident or person within the school, but was introduced in the knowledge that, in a school of 900 students, there would be many unidentified students in such situations, and as a reminder that students have whole lives about which we know nothing.

In bringing the tales together, a number of possible combinations were explored, such as having the two texts as separate volumes, or interlacing them by alternating chapters of narrative and theory. Finally I decided that the bound book would begin with four chapters of theoretical discussion to background the narratives and inform readers how they were intended to be read, followed by 'School Stories', then another three chapters of interpretation and discussion. The chapter you are reading now mirrors that structure: theoretical discussion first, an example of an impressionist tale then, if not interpretation, at least discussion *about* the interpretation of this narrative research. Personally, however, I much prefer the hypertextual form of the textual *bricolage* on the web, where the reader can take an active role in choosing which portions to read, and in which order.

AN IMPRESSIONIST TALE

This tale forms the first part of 'School Stories', the novel that made up about a third of the written report of this research project. It provides a taste of the approaches to storytelling I adopted and the kinds of issues and ideas that were addressed.

> 'I will be your father figure, put your tiny hand in mine, I will be the one who loves you...' George Michael's croon floats across the ice as the skaters glide in erratic circles. The wisps of steam rising from the ice and the way the skaters smoothly slide lend a touch of glamour to this tatty barn of a building in a suburban shopping centre. It's a forty degree December day outside, but cool and dim here by the ice. I'm standing at the edge of the rink, chatting to Candace and watching our skating, laughing students. 'Did you hear I got that curriculum job?', she asks.

'No, I didn't know – well done. When did you find out?'

'Andrew told me this morning – I'm not really s'posed to tell anyone yet. I really didn't think I'd get it', she says, 'Everyone said James had it in his pocket and no-one else had a chance. But I thought "What have I got to lose?", and put in an application.' I'm excited for her – she's a friend and ally as well as a colleague, and it's great that her talents are being recognised. She'll do a great job for the school.

Every five minutes or so, a group of smiling teenagers slides to the wall to ask, 'Are you coming skating Mr Geelan?'

'I can't guys – my leg's still too weak. It's almost there, but I don't want to risk it....' I broke my left leg roller-blading in February and spent the first half of the year on crutches and then limping in a cast. Although I only have a slight limp now, the kids accept this and skate off, yelling over their shoulders, 'See ya, then'.

I'm pleasantly surprised at how many, and which, students come to invite me onto the ice – it's a nice feeling to discover that I'm more than the policeman I seem to have to be in our school encounters. The realisation that these students see me as a friend takes away some of the tiredness and depression that seem to be getting stronger as the year comes to an end. I really don't know how these students see me. I wonder whether this is because I haven't listened to them, or because they haven't told me – or perhaps because we can never see ourselves clearly in the eyes of others; we look too avidly, and through the distorting lens of how we see ourselves.

Shannon circulates silently, arms around herself in the cold, sleeves pulled down over her hands. Her mother was from Shanghai, her father from Scotland, and she's a striking looking girl, with beautiful Chinese features, in which her grey eyes are a sudden shock when she lifts them to yours. She doesn't meet anyone's eyes very often, but she gives Candace and I a shy smile as she passes, then looks away. Tony asks her to skate with him, and she politely refuses, then quickly leaves the floor and goes to sit with Alyx. They're talking quietly, heads together, and the other teachers deflect students before they reach Alyx, and quietly deal with their questions and requests.

Simon is moving around the ice twice as fast as anyone else, skilled and sure. A rink employee asks him to slow down, and I tense for the explosion, but he just smiles and slows down, a bit. The changes in Simon through this year have been astonishing, and our reflexes still haven't really adjusted: we tend to expect him to behave as he did in Term Two, but he confounds our expectations.

Later, driving home from the skating rink, I remember the people, events and emotions of Arcadia High School, 1996. No, that's not exactly it: the school has nine hundred students and fifty-five teachers, and many of them I don't even know by name. I taught in Cowan Team, and came to know seven teachers and perhaps a hundred and fifty students. What I remember on the drive home is *my* life in the school this year – my own experiences as a teacher, researcher and learner. These are my memories...

THE ROLE OF OTHER FORMS OF EMPIRICAL MATERIALS

While, for me, the narratives of experience that make up 'School Stories' are the most important form of representation that came out of this research project, I saw value in gathering two other forms of 'empirical materials' (or 'data'). These were used in a form of triangulation, but not one that wishes – or is able – to fix precisely the location of a static, observer-independent reality. Denzin and Lincoln note that

> the use of multiple methods, or triangulation, reflects an attempt to secure an in-depth understanding of the phenomenon in question. Objective reality can never be captured. Triangulation is not a tool or a strategy of validation, but an alternative to validation. (1994, p. 2)

I chose to use two survey instruments, the Constructivist Learning Environment Survey (CLES) (Taylor, Fraser, and Fisher, 1997) and the Beliefs About Science and School Science Questionnaire (BASSSQ) (Aldridge and Taylor, 1997), to explore the notions about teaching, learning, and the nature of science held by the teachers and students in the school. The survey results were used to both support and challenge the interpretations I drew from observing the classroom behaviour of the teachers and students, and recording that behaviour in the tales I wrote. Similarly, a series of interviews with my team-teaching colleagues were used to both support and challenge the ways I had constructed the characters based on those teachers in 'School Stories'. In other words, the interpretative chapters in the latter half of the book helped to construct a sense of 'ironic validity' (Lather, 1993) for the work as a whole through 'questioning the answers' found in the tales.

STRATEGIES FOR VERISIMILITUDE AND VALIDITY

The three forms of empirical materials – with Denzin and Lincoln (1994), I prefer this term over 'data' – in this study are used to enrich the understandings developed by the author and the readers, rather than to more tightly pin the truth to a display board. If validity – the search for a perfect match with an observer-independent external reality – is not the appropriate standard for measuring the value of a qualitative research project such as this one, what might be? Certainly one answer is to reclaim the language of validity for richer, less positivistic uses. Lather (1993) has attempted this task, with the description of several forms of poststructurally conceived validity (reflexive, ironic, neopragmatic, rhizomatic, situated). 'Ironic validity', according to Lincoln and Denzin,

> proliferates multiple representations and simulations of the real, showing the strengths and limitations of each, arguing that no single representation is superior to another. (1994, p. 585)

The approach I chose has something in common with this notion of validity, in that I refused to commit to a single discourse and 'truth strategy', but held competing perspectives in a dialectical tension. The use of the interview and survey information can be described as 'postpositivist' in its epistemological foundations, while the impressionist tales are constructivist/postmodernist in intent and approach.

An alternative strategy might be to abandon the pursuit of absolute truth, and judge an account by the standards of verisimilitude – does it *seem* true?

> Verisimilitude can be described as the mask a text assumes as it convinces the reader that it has conformed to the laws of its genre; in so doing, it has reproduced reality in accordance with those rules. (Lincoln and Denzin, 1994, p. 580)

However:

> The truth of a text cannot be established by its verisimilitude. Verisimilitude can always be challenged. Hence a text can be believed to be true even if it lacks verisimilitude. (The opposite case holds as well.) (Lincoln and Denzin, 1994, p. 580)

If my account of my teaching year at Arcadia High School is to have value, it must have verisimilitude. My readers will almost exclusively be teachers, and if the account of what schools and school life is like does not seem true or believable to them, then the account itself will be of very limited usefulness. But, as noted above, verisimilitude does not establish truth – only its semblance. Is that sufficient for my purposes? Perhaps it is.

I believe that this work is open to challenge on the issue that Lincoln and Denzin (1994, pp. 577–578) identify as 'the crisis of representation'. This turns on questions of the ability and right of a researcher-author to represent the experiences, aspirations, and lifeworlds of the other in his or her text. Is it possible to do so meaningfully? If so, is it politically acceptable to take on the role of representing another to the world, an act that can have real consequences in the other's life? Lincoln and Denzin (1994) suggest a variety of strategies that have been employed in attempting to address this 'crisis'. These include collaborative or participatory research, empowering others to engage in their own inquiry into their practices, and the creation of multivoiced texts. Although I have used some of these strategies in constructing this text – many of the direct quotes spoken by characters in the novel are taken from interviews and field notes with teachers in the school – the final product remains my story, told in my words, with my emphases.

The strategy I adopt for addressing this issue is, however, (relatively) simple: this is my story, and makes no claim to be anything else. The 'Alyx' and 'Candace' in all parts of the book, both 'fictionalised' and 'factual', are characters built up from my impressions, my observations. I do not claim to be representing these teachers 'realistically', but to be selecting facets of my own experience with which to tell an educationally significant, experience-based story. Perhaps that is sufficient to free me to some extent from the crisis of representation, but it lands me squarely in the middle of the crisis of legitimation!

> This so-called crisis arose when anthropologists and other social scientists addressed the authority of the text. By the authority of the text we reference the claim any text makes to being accurate, true, and complete. (Lincoln and Denzin, 1994, p. 578)

Lincoln and Denzin go on to suggest that the claims to authority of the text are based in its epistemological validity – the extent to which, within itself, a text claims to have fulfilled certain rules and procedures intended to guarantee validity. There are many such sets of rules (positivist, postpositivist, interpretivist, constructivist), each hotly contested and supported. In the end, however, such arguments must be circular, since a text is supplying the evidence for its own validity: that is a little like having a potential conman identify himself as a trustworthy individual! In the end:

> Every text must be taken on its own terms. Furthermore, the desire to produce an authoritative (valid) text is renounced, for any text can be undone in terms of its internal structural logic. The unmasking of validity-as-authority now exposes the heart of the

> argument. If validity is gone, values and politics, not objective epistemology, govern science. (Lincoln and Denzin, 1994, p. 579)

This teaching/learning/research project is explicitly value-driven: it is the story of my own, and my colleagues', attempts to more fully live our educational values in our practice. From a poststructural perspective, this is all there is: the value ascribed to my work by me and the community with which I wish to identify myself.

The answer to the crisis of legitimation for this text, then, has two parts. The first is to ensure that the text fulfils the rules for 'epistemological validity' within the grounds that I have chosen – a particular subset of the science education community. This is difficult, because this community finds itself in epistemological flux at the moment, with a variety of (possibly incommensurable) rules and epistemologies competing for dominance. For my purposes, however, these requirements can essentially be reduced to those for verisimilitude: does it seem true and plausible? Assuming that I have not faked or doctored the interview transcripts and survey results (since readers have only the evidence of the text available), do they cohere well with the tales? Does the evidence provided address the research questions, and does it provide adequate, relevant grounds for the results reported? Are those results educationally significant?

The second part of the answer, though, lies in the utility of the text. In an earlier paper, Lather (1986) described 'catalytic validity' – the extent to which an account is empowering for a community of learners. This provides an excellent description of one of the purposes of this research project: the use of the impressionist tales as an occasion for reflection – a catalyst – by other science teachers. This criterion fits with Polkinghorne's (1992) 'postmodern epistemology of practice' and its movement 'from metaphors of correctness to those of utility' (p. 162). There are (at least) three potential audiences for whom the text of my research report ought to have been of value if it was to fulfil its purpose – or, more precisely, my purposes for it, since the text itself cannot be said to have purpose or intention.

First, the writing, reading, and rewriting of the text must be valuable for me. It must allow me to experience myself as a 'living contradiction' (Whitehead, 1989), to reflect critically on my practice with the intention of improving it. Second, it must be valuable and useful for my science education colleagues, both in allowing them to reflect on their own teaching and research practices, and in allowing them to evaluate my knowledge claims. Finally, it ought to be valuable to any classroom teacher who receives a copy, and reads either the entire text or 'School Stories'. This is not the only criterion by which this text should be judged and legitimated, but it is an important one.

CONCLUSIONS AND INVITATIONS

One of the conclusions of this research project was that the methodology chosen – a bricolage of impressionist tales blended with surveys and interviews – has value for the kind of inquiry for which I chose it: thoughtful, participant-observational studies of the experiences of classroom teachers. I would argue that the tales have verisimilitude, because they have been read by a number of practicing teachers who have told me so. The research process – teaching in these classrooms, reflecting on

my experiences there and constructing the tales out of those experiences – had utility for me in the ongoing process of attempting to understand how I am, and how I want to be, as a teacher. And finally, the textual product of the research – the research text as a whole and 'School Stories' within it – has been demonstrated to have utility by the fact it has now been posted on the web for some time, and a number of teacher/researchers have contacted me to tell me that it was valuable to them in developing similar inquiry projects into their own and their colleagues' practices. I hope that this account of the work – how I did it and why I chose to – also has utility for you. If it does, I'd like to invite you to begin writing and sharing your own 'narratives of experience', and contributing to a published record of what Polkinghorne (1992) calls 'the aggregate of the professional community's experience of what has been beneficial to [students]' (p. 162).

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SECTION III

A NEW ERA OF RESEARCH

This section moves us into the most recent and unfolding moments of Denzin and Lincoln's (2005) scheme of qualitative research (Postexperimental Inquiry, Methodologically Contested Present, The Immediate and Fractured Futures). Since the mid-1990s, contemporary qualitative researchers have been adopting complex experimental modes of inquiry with which to pursue socially transformative agendas despite the conservative political climate of higher education worldwide. Critical theorists and postmodernists alike continue to urge academics to resist the economic rationalist imperatives that press us to optimise our productivity by situating our research entirely within the modernist world view. Alternative world views of contemporary qualitative research provide powerful means for academics to engage in political praxis within their own institutions for the immediate purpose of decolonising their own professional life worlds, thereby contributing to the process of transforming the social and cultural ethos of their institutions.

The chapter authors in this section have agendas for social transformation underpinned, to varying degrees, by an ethical urge to create professional practices that are culturally and socially inclusive. They strive to generate new ethics and epistemologies for the professional practices of themselves and their colleagues, including health care workers, mathematics teachers, school leaders, engineering lecturers/professors, and educational researchers.

- **interpretative phenomenologist**: Georgie Hawley (Ch. 14)
- **practitioner-researcher**: Kwena Masha (Ch. 15)
- **virtual ethnographer**: Tanya Vernon (Ch. 18)
- **critical auto/ethnographers**: Elisabeth Settelmaier (Ch 16), Les Pereira (Ch. 17), Bal Chandra Luitel (Ch. 19)

A hallmark of these contemporary forms of qualitative inquiry is the important role played by higher-level thinking processes such as autobiographical excavation of the researcher's life world, fictive imagining, moral contemplation, critical analysis of one's methods of inquiry, and envisioning future possibilities for a brighter world.

CHAPTER SUMMARIES

Chapter	Context of the research	Focus of the chapter	Methodological referents	Quality standards
Ch. 14: Georgie Hawley	A researcher investigates health-related spiritual needs of multicultural Western Australians	The researcher reflects critically, via the metaphor of *researcher as punk*, on how she conducted an interpretative phenomenological inquiry	▪ *Interpretative phenomenology* (Heidegger, Bakhtin) ▪ *Textual analysis and data coding* (van Manen, 1990) ▪ *Analytic induction* (Erickson, 1998)	▪ plausibility ▪ member checks ▪ critical self-questioning ▪ self-growth of researcher
Ch. 15: Kwena Masha	A researcher conducts a self-study of the development of a constructivist mathematics classroom environment	The researcher considers the emergent nature and process of constructivist inquiry he undertook as a practitioner-researcher	▪ *Researcher as bricoleur* (Denzin and Lincoln, 2000) ▪ *Constructivist inquiry* (Guba and Lincoln, 1989) ▪ *Reflexive interpretation* (Alvesson and Skoldberg, 2000)	▪ reflexive interpretation ▪ emergent design ▪ fused research strategies ▪ literature as data ▪ interpretative richness
Ch. 16: Elisabeth Settelmaier	A researcher investigates auto-biographically and ethnographically the development and use of ethical dilemma stories in school science to enhance students' moral sensibilities	The researcher outlines the autobiographical writing component of her research which enabled her (and her reader) to engage in transformative learning	▪ *Exploring self-identity* (Palmer, 1998) ▪ *Transformative learning* (Mezirow, 1991) ▪ *Autobiographical research* (Roth, 2005) ▪ *Self-study* (Bullough and Pinnegar, 2001)	▪ textual ambiguity and aesthetics ▪ critical self-reflection ▪ authorial voice ▪ honesty ▪ reader engagement: self-understanding
Ch. 17: Les Pereira	A researcher conducts a critical self-study of his school leadership practice	The researcher discusses the role of multiple modes of inquiry in conceptualising a transformative research methodology of 'no-method'	▪ *Writing as inquiry* (Richardson, 2000) ▪ *Seven modes of inquiry* (Henderson and Kesson, 2004) ▪ *Integral thought* (Wilber, 1998) ▪ *Against method* (Feyerabend, 1978)	▪ crystallisation and multiple perspectives ▪ writer and reader engagement: dialogical writing ▪ researcher self-growth
Ch. 18: Tanya Vernon	A researcher explores expert problem solving amongst students studying electronic engineering in a laboratory setting	The researcher reflects on the future prospects of her 'virtual research' which makes use of hypertext and cyberspace to represent complex and sophisticated discourse and analysis	▪ *Researcher as bricoleur* (Denzin and Lincoln, 2000) ▪ *Writing as inquiry* (Richardson, 2000) ▪ *Virtuality* (Hayles, 2001) ▪ *The digital dialectic* (Lunenfeld, 2001)	▪ truthfulness ▪ believability: verisimilitude, audit trail ▪ service to the reader: reflective conversation
Ch. 19: Bal Chandra Luitel	A researcher inquires via critical autoethnography into the culturally decontextualised nature of mathematics education in Nepal	The researcher discusses the emergent nature of writing as inquiry, particularly the role of research questions and multiple theoretical referents.	▪ *Writing as inquiry* (Richardson, 2000) ▪ *Exploring inner landscapes* (Palmer, 1998) ▪ *Autoethnography* (Ellis and Bochner, 2000)	▪ polyvocality ▪ reader engagement: verisimilitude, pedagogical thoughtfulness ▪ emergence ▪ critical reflexivity ▪ crystallisation

GEORGINA HAWLEY

BEING PUNK HELPS TO PERFORM A PHENOMENOLOGICAL STUDY

INTRODUCTION

I live in a quiet quintessential English village. In the centre of the village are the 'green' and duck pond, the bus stop, one pub, and the village shop. The church is also there with its rising damp and fallen grave stones. One morning I went to collect my newspaper from the shop on the way home from church. On entering the shop I was asked, 'Did you see the punk?' I had to reply in the negative, as I could not recollect seeing a punk. 'He was waiting for the bus, you must have seen him, you couldn't miss him … so glad he got on the bus we don't want the likes of him around here', 'you should have seen him Rev'd Georgie he was dreadful – purple spiky hair, black jeans and shirt, and a black leather jacket … he had rings in his ears and even one in his eyebrow… I was scared he might come in the shop'.

On the way home I reflected on the word and name of 'punk' (and qualities that characterised the punk person of the 1970's when the name was fashionable). To me, a punk is a person trying to make an alternative statement – quite often this entails looking different from others (hence the young man's purple hair), but more importantly it is to think differently, and in particular to question what is traditional or conservative in society at that time. No wonder the village people were a little taken aback by such a person. But to me, I rather liked the sound of the unique qualities or characteristics of being a punk. For here was someone that was prepared to think differently and make a statement! These same qualities are important when undertaking research for there is the need to question the accepted practice and to propose alternative ways of thinking.

The purpose of this chapter is for me to give an explanatory account of undertaking an interpretative phenomenology study when living in Australia. I will also discuss with you the 'punk' qualities that I found useful when doing the research. This will enable you to have some insight into the research process and hopefully clarify some of the questions you have about interpretative phenomenology. The first section is concerned with the qualities of being a punk,

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 151–161.

the characteristic of questioning. This includes my research topic and why I chose to use an interpretative phenomenological approach. The second is concerned with the punk characteristic of proposing alternative ways of questioning and thinking. This includes an explanatory account of my methodology. Finally, the punk attribute of alternative ways of thinking and how this attribute facilitated the findings. To help you gain glimpses of punk characteristics I use the font '*Lucida Handwriting*' to raise the questions and think of alternative ways.

QUALITIES OF BEING A PUNK

Although this chapter is written in a style that I hope is easy to read, I found the process of undertaking the research quite the opposite. That is, I found the experience mentally taxing as I had to deal not only with my subjectivity, but also with the experiences of cognitive dissonance (in which I questioned my own personal beliefs and teaching). I found that the very nature of undertaking qualitative research by exploring and investigating the how, where, what, and why of situations and incidents in aspects of education and health care demanded me to be critical of the ordinary or Establishment. In other words, I needed to be punk!

As a punk I needed the essential qualities of questioning the ordinary ways in which society does things in relation to health care and then to think of alternatives. During the research process I quite often found situations or incidents that I did not like and I needed to make others aware of these. Sometimes these saddened me to the extent that I was not able to remain composed and objective. I had not realised when I started the research that in being a punk I would experience feelings of frustration and anger at what tradition or the Establishment supposes is right and correct. However, my questioning and thinking have helped me see alternative ways of approaching problems.

A Punk Questions

As a university lecturer who teaches health care ethics and research methodology I found myself faced with the problem, as to how far should a person's rights extend when they are receiving health treatment. That is, should people have complete autonomy over their health care and do those rights include their spiritual needs. This was compounded by the fact that I then realised I had no idea what spiritual rights people may want upheld, particularly for many multicultural people living in Western Australia. Although the subject of spiritual care and needs in relation to health care had been published in the literature (since around 1980), I realised after questioning and critiquing these documents that the information was not transferable to multicultural Western Australians. The problem of not knowing the health-related spiritual needs for this population became more urgent when I also realised that the Australian Hospital Standards Council stipulates that health care professionals will meet the individual spiritual needs of patients and clients. Clearly, I needed to do something about the problem I faced, as I believed it would have been unethical for me to ignore the situation. On considering the facts I realised that the punk in me

needed to do two things – find out about spirituality per se in Western Australia; and identify the health-related spiritual needs of multicultural Western Australians.

To find out about spirituality in Western Australia I sought information from the Australian Census (Australian Bureau of Statistics, 1996) about the multicultural population. I then contacted the different groups for data about their spirituality. Once the information was obtained it was analysed to identify common or universal themes. These themes I realised, were the components of spirituality: (1) the focus of the belief; (2) the truths and beliefs of the group; (3) the manner in which a member can access the focus of their belief; (4) members' personal beliefs (which may differ slightly from the group or organisation); and (5) the manner in which the beliefs and truths as behaviours are manifested (especially in relation to health care). In discerning the interrelationships between the themes I developed an emergent model of spirituality and developed questions that health care professionals could ask in order to understand more about a person's spirituality.

Once I had the information about the nature of multiculturalism and the various spiritual beliefs I was then able to incorporate the knowledge and understanding into my teaching. For example, in ethics I discussed with my students the importance of finding out what rights people may want. That is, a person from another culture may well have different rights that they want to uphold in hospital (i.e., a Muslim will want to face Mecca when dying and have the head of the bed raised). In teaching research methodology, I suggested that members of certain cultures may not want to participate in research studies as such practices may well contradict their beliefs and manifestations of spirituality. By explaining to you how I made my teaching more contextually appropriate I hope you can also discern how very important it is for researchers to adopt the essential characteristic of being punk. That is, to question the usual, normal, or traditional so that alternative ways of thinking can be developed.

A PUNK KEEPS ON QUESTIONING AND THINKING OF ALTERNATIVES

In order to identify the health-related spiritual needs of multicultural Western Australians, the questioning needed to continue, as did the thinking of alternative ways. For the second part of my research, that is, to identify the health-related spiritual needs of multicultural Western Australians I needed a philosophical framework that would enable me to validate the uniqueness of each person's mother culture and, at the same time, to explore commonalities amongst their spiritual needs (Lincoln and Denzin, 2000). I chose the philosophies of Heidegger (in Krell, 1978), Bakhtin (1986), and Bakhtin and Medvedev (1978), which I then translated into a research methodology for understanding the relationship between the phenomena of spirituality and health care and the nature of the culturally diverse population. To me, interpretative phenomenology is the ideal methodology for a punk to use when questioning the traditions of culture and spirituality. This is because it allows the researcher to understand everyday skills, practices, and experiences; to find

commonalities in meanings, skills, practices, and embodied experiences; and to find exemplars or paradigm cases that embody the meanings of everyday practices.

By identifying paradigm cases (i.e., situations and/or incidents) and exemplars (that represented strong instances of particular patterns of meanings), I was able to depict the research participants in their situations and preserve the meanings and contexts. In this way, the paradigm cases and exemplars enabled me to access the participants' everyday lived experiences and open up a new understanding of culturally diverse Western Australians' spiritual needs. The design allowed me to search for common meanings in the data, to be reflective in interpreting the various parts, to the whole, and to contemplate what further data could be gleaned from the information. Thus, the interpretative process moved back and forth between part and whole and between the initial concern or question and what was being revealed in the data (Benner, 1994; van Manen, 1990). There was also the constant mandate to question all the time so as to go beyond existing, available, publicly authorised interpretations of things and to follow a more authentic and deeper analysis that was projected in the possibilities (Bakhtin, 1986; Bernard-Donals, 1994).

A Punk Keeps on Questioning – The Research Participants and Myself

In undertaking an interpretative phenomenology approach, the feelings, thoughts, and behaviours of the participants in relation to their spirituality and health care become the text analogue (van Manen, 1990). The first person I interviewed was Ann, a woman in her early thirties with Australian/English parentage. Ann's health-care experience was traumatic childbirth when delivering her daughter Mary in a maternity hospital. Ann was university educated and had what the Western world would call a traditional spirituality in that she worshipped the Christian God and Jesus Christ. Ann's mother had left her father when Ann was a teenager and her father died several years later. On interviewing Ann, I discovered that her spiritual needs were related to her Christian belief. I then questioned myself as follows:

Would a non-traditional person have similar spiritual needs? I need to interview a non-traditional or non-Christian person.

This question and reflection led me to Red, a 'true blue' Australian, university educated, who had travelled extensively in his twenties and thirties. He married in his early forties and was now 54 years old with no children. Red's spirituality was related to his Australian culture. Although Red had what he termed a 'socialist perspective' of spirituality, in fact there were some strong characteristics of Humanism present in his story. At the time of the first interviews, Red had a painful trapped nerve condition. His spiritual needs were different from Ann's.

Are spiritual needs dependent upon the person's sex, psychophysiological state, or spiritual background (including culture)? I need to explore spiritual needs from another male person's perspective. However, this time I should interview someone who had a psychological/emotional condition.

Tom was 50 years old and not born in Australia, but in Singapore of Chinese heritage. He was not university educated, although he had several trade certificates. Tom described his health problem as being 'burnt out'. He worked as a mental health nurse, and his job included the assessment and treatment of people (at the psychiatric unit) who were suffering from a severe psychiatric episode at the time. This role sometimes involved the forensic nature of nursing when he needed to assess and treat people who had committed a civil or criminal offence. In these instances, the person was remanded to the hospital from the Ministry of Justice where the lawyers or judge thought the offence committed by the person may or may not be connected to a mental health/psychiatric problem.

Tom's spiritual needs were different from Red's in that they were of a deeper need, that is, more uniquely personal and reflecting his religious beliefs of The Society of Friends (Quaker). Tom's need was that he wanted peace within himself, and his story also included the spiritual care that he gave to people with psychiatric illnesses.

Were spiritual needs related to the length of time of the health problem? Red's health problem was short; Tom's health problem was long in duration. I need to interview a male with a long-term physical problem.

Geoff was interviewed next. He had a long-term health problem of Non-Hodgkin's Lymphoma and was in remission at the time of the interviews. His spirituality was similar to Red's (love of the Australian environment), but also to Tom's, in that he too wanted inner peace. Geoff did not have a traditional view of spirituality, and said he had never been to a church service. Instead he gained purpose and meaning of life through his relationship with his family, and his farm and animals.

Does the sex of the person make any difference to their spiritual need? A female with a non-traditional view (opposite to Ann's) needs to be interviewed.

Scarlet's health problem was similar to Ann's (traumatic childbirth), but she did not have a traditional view of religion and was what she termed 'a pagan Romany (gypsy)'. Scarlet came from a wandering life through Europe. Romanys do not have their own country, but have their own culture. Scarlet's spiritual needs reflected not only Ann's but also Red's, Geoff's, and some of Tom's. This suggested to me that traditional or non-traditional views did not alter the spiritual needs, neither did the characteristic of male or female.

I wonder whether physical illness affects spiritual needs differently from mental illness. I need to interview a person with a serious mental health problem.

Rosie was in her late forties, and came from Europe. She had a certificate in nursing, and worked part-time in a nursing home. Her family had a history of Bi-polar disorder (fluctuations between depression and manic behaviour). Rosie herself had been diagnosed with depression previously. Her recent episode was probably bought on by work stress, as she had injured her back at work; her doctor put her on workers' compensation, but her employer would not recognise her injury, so she

continued to work. Rosie told an emotional story of her difficulty in trying to get protection when she was physically harming herself (overdosing on sleeping tablets and burning herself). When I saw Rosie in hospital she had 'angry red wounds to her arms and legs' where she had burned herself with cigarettes (during episodes of harming herself at night when she could not sleep). She also had experienced two episodes where she had taken much greater than the recommended dose of sedation in an effort to get to sleep. She had known that the doses might kill her, but she was so desperate to get some sleep that she did not care. Listening to the audiotapes of Rosie's experiences were disturbing and I found myself crying on several occasions. Her feelings of being betrayed by her employer were evident (in not acknowledging her injury), as were her ineffectual methods of trying to obtain help for her unstable mental state. Rosie's graphic details of repeatedly burning herself with cigarettes, but not feeling the pain, demonstrated to me the complex anguish and the burden of the pain of hopelessness that depressed people must feel. In Rosie's words:

> When I couldn't sleep I quite often went for a drive in the car, but Fred [husband] thought that was too dangerous as he would be asleep and not hear me go out… so he would hide the car keys at night so I could not go out…The only other thing I could do then was walk around the house and out into the back garden for hours on end. I felt I did know who I was and what I was doing, life was just a great black abyss [pause]. I felt so unreal at the time, as though I wasn't me, but I didn't know who I was. So I would burn myself with the cigarette to see if I could feel if I was alive or not.

At interview, Rosie's spiritual needs were similar to Geoff's in that she too wanted that peace within herself. However, it was a different intensity; with Rosie, the need was urgent and imperative so that she would not commit suicide. As the interviews unfolded, I discovered that Rosie's father died when she was 10 years old and her mother at 16 years. She told of the anguish and pain of not being allowed to see her parents when they were dying, and the refusal of her older brother and sister over the years to tell her anything about her family history of mental illness and ancestry.

So, obviously the spiritual need of 'peace' is not specific to either male or female. Could it be due to Western religion? (Tom was a Quaker, Rosie was Brethren /Anglican.) It was time to interview someone with a non-Western view of spirituality.

Athika, was a Hindu woman, university educated, with a health problem of hypertension related to work stress in an academic environment. She had strong family and cultural ties to India and meditated each day. Her spiritual needs at the time were not that different from Tom and Rosie in that she too wanted peace and tranquillity in her life. Athika's story also included the manner in which she gave spiritual care to people living with cancer.

What about a person with multiple health problems? Each of the previous participants had only one health problem. Would spiritual needs change if a person had several problems?

Sophie was from Norwegian parents who came to live in Australia when she was very young. However, their language skills were poor so Sophie frequently needed to interpret in English for them. Sophie suffered from arthritis of the spine and hips, and had experienced a coronary occlusion. She was a heavy smoker, a

social drinker, and suffered anxiety and depression for many years until her children reached adulthood and left home. Her spirituality was related to the fact that she had rejected the Christian dogma she received as a child, and her own experiences in trying to find meaning and purpose in her life. Her spiritual needs included the ability to love herself, hope, trust in others, and acceptance by others. In telling her story Sophie also told the story of her husband, Alf, who had brain damage (related to chemicals that he had inhaled at work), suffered a stroke, and had previously been addicted to alcohol and cigarettes.

What type of person and health problem is left? Can't think of any at the moment.

I decided that Sophie was to be the last participant to be interviewed at this point and continued the analysis of the data of these eight participants. If I discovered that more participants needed to be interviewed, this would be done at a later stage. However, this did not become necessary, as the participants did not just tell a story about themselves. Instead, they included stories of their loved ones, of experiences in different hospitals and numerous health care professionals.

A PUNK FINDS ALTERNATIVE WAYS OF THINKING

It was through the raising of questions that I was able to find alternative ways of analysing the data. My analyses started out as surmises and questions, which came to mind as I listened to the participants' stories and the recordings of their interviews and as I read the hard copies. I reviewed all the data for comparison, in both recursive and progressive processes, for analytic induction (Erickson, 1998). That is, I reviewed all the evidence for a particular question and/or assumption until all the relevant data had been identified and compared. I then did the same for each assumption and/or question that I raised (Sandelwoski, 1986). When I found data to corroborate each assumption or question, I then went back to the participants to validate the findings. In other words, the punk finds other ways of thinking about a situation or phenomena by analysing research data that leads to the findings. This was done by finding exemplars, and coding the data.

A Punk Finds Alternative Ways of Thinking by Finding Exemplars

Of great importance in the data analysis were the exemplars (van Manen, 1990). These consisted of one or more parts of a participant's data (record) that were shaped (or constructed) to advance the developing conceptual argument. Exemplars were very important to the crafting of a rhetorically persuading research text, in that; they were embodiments of the inductive construct that was occurring at the time. I used exemplars to test a claim, and to evaluate how plausibly the data explained the descriptive act, and how well it explained new data for participants when appraising its truth-value. According to Benner (1994) and van Manen (1990) potent exemplars bring out the salience and the inherent order or contradictions of an event. Without

exemplars, the claims of a theme or word would be empty and unpersuasive. To do this I used examples from the data that lent insight into spirituality and health care to help me understand the study (Erickson, 1998).

A Punk Codes the Data

The coding experience gave me an opportunity to think through the data, and to infer what the information might mean. The construction of exemplars enabled forward movement in this process. Finally, analysis prepared me for quitting the interviews and starting the writing of draft reports. In all of this, the analysis of data and continuing investigation of participants went on simultaneously. Different levels of analysis were performed, at the same time as raising questions and testing out assumptions (Erickson, 1998). Level one analysis included the identification of paradigm cases, themes, and exemplars for all the interviews. Level two consisted of examining all the themes and exemplars for corresponding or universal themes. Level three involved the working out of relationships between the themes (van Manen, 1990).

In total, 24 individual themes were identified and supported by the participants. These themes, when grouped together with similar themes, told their own story of spiritual concepts or processes. These five groups included Being a Person, Spirituality, Spiritual Needs, Levels of Care, and Rite of Passage. The groups can be described as follows:

1. The participants' past health care of hospital experiences, past spiritual or religious experiences, present health care problem/s, and present spiritual situation/s, constituted the Heidegarrian and Bakhtin concept of *Being a Person*.
2. The themes of spirituality and meaning of life and purpose in life constituted the concept of *Spirituality*.
3. The themes of trust, love, peace, hope, became the S*piritual Needs*.
4. The themes of acknowledgment, empathy, and valuing became the desired *Levels of Spiritual Care*.
5. Finally, the themes of identification of health care problem, realization of dissonance between normal routines/daily rituals and/or feelings of anxiety or fear due to present condition, asking for spiritual care, receiving or not receiving that care, and reflection. These arose from the interrelationship between the themes of spirituality, spiritual needs, and the health themes. Together, they constituted the participants' *Rite of Passage*.

I used these five theme groups as chapter organisers when writing the findings in my thesis. Next, I explored the participants' social construct, that is Bakhtin's (Bernard-Donals, 1994), concept of textual analysis that allows and supports social change, in order to establish a starting point from which to recommend changes to the education of health care professionals and also to clinical practice. This done, I was able to suggest alternative ways of thinking about health related spiritual needs

including recommendations for the education of health care professionals. Once I had completed the research study I realised the value of adopting the essential attributes of being a punk by practicing the behaviours of constant questioning and thinking of alternative ways. I would recommend such behaviours to any researcher.

THE DISADVANTAGES OF BEING A PUNK

What I had not realised when I started on the research was that in being a punk I would experience cognitive dissonance as a result of the constant questioning of my own spirituality. I found that my study caused me to ask myself questions such as:

> *If other people believe these certain truths why don't I?*
> *Where am I in all of this?*
> *I have developed a super model, which makes sense to me, but is it causing me to rethink my own spirituality?*
> *There is nothing wrong with this in itself.*
> *BUT, from my own perspective, I need to explore the Christian theological implications and perspective of teaching in this manner.*

This personal questioning and challenging was not an easy process and took me many months. On examining my cognitive dissonance it appeared that while I work in a pluralist or multi-faith context (and try to foster acceptance, promotion, and celebration of diversity which are essential ingredients for the establishment and maintenance of a harmonious and peaceful community) my biggest source of doubt came from the concept that Christianity had been taught to me as one of the major missionary religions in the world. Being an ordained member of one of these religions, I needed to work through and reflect on this topic, that is, to address the question: what is the theology behind the concept of 'mission'? This made me question my own spiritual beliefs including the way I live, teach, and care for others. However, in the process I realised that I could remain true to my own beliefs, and at the same time suggest to other health care professionals with similar Christian beliefs a way of working with people of dissimilar spiritual beliefs. That is, perhaps they too can see their active participation in multi faith activities as legitimate and positive expressions of both their professional and missionary obligations. This is because I believe that at least one essential purpose of the spiritual life of the health care organisation, to which health care professionals contribute, is to build up community, not to lead to its disintegration.

I also experienced feelings of frustration and anger at the institutions of health care in Western Australia. This was because of their belief that what they were doing was right and correct. However, through my questioning and thinking of alternative ways I found this not to be true. For example, the health care institutions believe that they respect people's rights and that cultural and spiritual needs will be cared for. In reality the participants felt disempowered in the health care system. I

did not understand the use of power by some health care professionals to control many aspects of patients' lives to an extent that their spiritual needs could be denied.

The value of using a 'seventh moment' epistemology is that it supports those 'interactional moments when humans come together in their struggles over love, loss, pain, shame, betrayal, [and] dignity' (Lincoln and Denzin, 2000, p. 1052) and 'when the self and other are constituted in mutuality' (Jackson, 1998, in Lincoln and Denzin, 2000, p. 1052). The participants in this study did talk with me of these interactional moments, especially the betrayal of trust and dignity from health care professionals, their cultural shame, their loss of body image and self esteem, and their need for mutual trust, hope, love, and peace. This epistemology avoids 'jargon and incomprehensive discourse … and celebrates the local, sacred, the act of constructing meaning' (Lincoln and Denzin, 2000, p. 1052). In doing so, I tried to understand the conditions of spiritual oppression placed upon patients by health care professionals. These (co-)constructed meanings (by myself and the participants) became the starting point for designing spiritual education for health care professionals.

CODA

The purpose of this chapter was for me to explain how I conducted an interpretative phenomenology study. I have used the example of being a punk to emphasise the essential characteristics of being a good researcher, that is, to constantly question and to think of alternative ways. Hopefully, this has enabled you to have some insight into the research process and clarify some of the questions you have about interpretative phenomenology. The first section was concerned with the necessary qualities of being a punk and the value of questioning. This included my choice of a research topic and why I chose to use the interpretative and the phenomenological. Next, I discussed the continuation of questioning and thinking of alternative ways. This included an explanatory account of the methodology including some of the theoretical concepts and how I enacted these, in particular the development of the themes that became the findings of the study.

It is well to remember that in undertaking interpretative phenomenology there is no such thing as an interpretation-free, objective 'truth' account of 'things' in themselves, and there is no technical procedure for 'validating' that an account corresponds to the timeless, objective 'truth'. This is because criteria such as plausibility, coherence, and consistency do not help to determine the degree of correspondence between an account and the way things 'really are'. Rather, they help to determine how well an account serves to answer the original concern that initiated the line of inquiry. An interpretative inquiry always begins from practical concerned engagement, and never seeks to simply describe a phenomenon but is always dealing with some issue of human behaviour. In this case, it was the lack of knowledge and understanding by health care professionals of the spiritual needs of multicultural patients or clients. The ultimate criterion for evaluating adequacy of an interpretative account is the degree to which it resolves the issue and opens new possibilities for engaging the research problem. That is, the researcher's 'punkness'

involves thinking of suitable questions to explore what is beyond the traditional, and thinking of even opposing concepts in order to propose alternative ways.

Disputes in interpretation based on the plausibility of alternative interpretations cannot be reduced to a-priori derived, cut-and-dried criteria. In an interpretative approach there can always be another, perhaps deeper and perhaps more persuasive, interpretation of a phenomenon. According to van Manen (1990) the findings may be disparate from one study to another and will therefore produce quite dissimilar accounts of the same phenomenon. That is, competing accounts do not negate each other; rather, they create a conversation. This decreased emphasis on one true account of a phenomenon has effect beyond the scope of the individual research project, in that it encourages the creative exchange of perspectives and ideas to explore new phenomena and issues. Thus, punk research can be judged by how carefully the questions are framed and the initial interpretative stance laid out, how carefully the data generation was accomplished and documented, and how rigorously the interpretative effort went beyond what was previously available, creating alternative new and deeper possibilities for understanding.

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KWENA MASHA

A JOURNEY IN THE CONSTRUCTION OF MEANING: EXPERIENCING AND ACCOUNTING FOR EMERGENT RESEARCH METHODOLOGY

In resolving issues such as research problems, my opinion is that one should try hard to ensure the robustness of the solution and its reasonable lifespan. My respect for the processes that underpin research projects emanates from this position. Whilst I do not necessarily agree with him completely, it is against the same background that I understand Mouly (as cited in Cohen and Manion, 1980) when he writes: 'Research is best conceived as the process of arriving at dependable solutions to problems through the planned and systematic collection, analysis, and interpretation of data' (p. 29). Meanwhile, Schumacher and McMillan (1993) consider research as 'a systematic process of collecting and logically analysing information (data) for some purpose' (p. 8). The centrality of the need for systematisation in both cases cannot be overemphasised. However, the questions that arose for me were: what does it mean to be systematic? Is it planned or does it emerge? These questions sounded simplistic at first. However, it soon dawned on me that these questions are the core concerns of methods and methodologies. How one responds to them is largely dependent on one's set of beliefs and values, or simply put, on one's *paradigm* or an *interpretative framework* (Denzin and Lincoln, 1994).

In this chapter I make an attempt to address the question of systematisation by outlining the paradigm within which my study emerged. I do this by: (1) reflecting on the research paradigm that best captures what I have undertaken; (2) explaining my research strategies; and (3) addressing the issues of the status of the resulting research report. Where appropriate I use some extracts from the study so as to provide concrete examples of how I addressed the issues.

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 163–173.

THE BIGGER PICTURE: THEORETICAL PARADIGM AND PERSPECTIVES

In proposing constructivist inquiry as an alternative approach to positivism, Guba and Lincoln (1989) write: '[w]hereas positivists begin an inquiry knowing (in principle) what they don't know', constructivists typically face the prospect of not knowing what it is they don't know, (p. 175). And as they continue with their argument, they further propose to use hermeneutic dialectic, of which they write:

> The final element in the hermeneutic circle is that of emergent design. Initially, given that the inquirer does not know what he or she does not know, it is impossible to be very specific about anything. But as the design proceeds, the constructivist seeks continuously to refine and extend the design – to help it unfold. (pp. 179–80)

This cautious approach to research processes is traceable to constructivists' general position regarding ontology. Constructivists reject the notion of reality as accessible and interpretable outside our own experiences and instead ascribe our knowing to experiential reality (von Glasersfeld, 1981). In this context it is unimaginable to think of the possibility of casting into stone one's research design prior to the commencement of an inquiry. Doing so would be like locking the researcher's current and future experiences out of the inquiry itself. Therefore, one can safely conclude that within a constructivist paradigm, research design and therefore systematisation, is an emergent process. The whole idea of *qualitative researcher-as-bricoleur* (Denzin and Lincoln, 1998) is an acknowledgement of that emergent nature. Palmer (as cited in Alvesson and Skoldberg, 2000) is even more forthright by saying, 'the process becomes, as it were, its own result' (p. 59)

In terms of what it means to be systematic, the answer depends on where one stands with respect to issues of ontology and epistemology. In a positivist's paradigm, systematisation would refer to a close and neat adherence to a clearly outlined and predetermined research plan. Research instruments, sample sizes, unambiguous research questions, closed research settings, and clear analytical procedures are all set at the beginning of the study. In case of any doubt or lack of clarity, a pilot study would be undertaken so as to clean up the plan.

In a constructivist paradigm, systematisation is something that though one can tell when it is there, it remains difficult to explain. Guba and Lincoln (1989) are of the opinion that 'the nature of constructivist methodology cannot be inferred adequately from a two dimensional chart' (p. 173) and thereby conclude that 'probably only practicing that methodology will permit accomplishment of that end' (p. 173). In the context of 'experiential reality' this difficulty is understandable. Jackson (1995) tells us that:

> The thing about experience is that unlike language it covers everything that is the case. This is why words alone can never do justice to experience. As John Dewey observed, 'what is really "in" experience extends further than that which at any time is known. … Theoretical discourse creates an illusion of finitude and boundedness.' But as Adorno points out, there is no real identity between experience and language. 'No object is wholly known.' No concept covers the thing conceived. Experience does not conform to our descriptions. Words do not mirror the world. (p. 160)

And the same message is inherent in Stapleton and Taylor's (2003) argument that:

> In qualitative research the question of how to represent in writing our inquiries has been called a 'crisis of representation'. The concept of representation implies that written

> language is a necessarily limited means of (re)presenting for public viewing that which is inherently invisible – our thoughts, understandings, ideas, beliefs, values, attitudes, feelings, etc., especially their uncertainties, inconsistency, context-dependent, and contingency. (p. 2)

In short, the more one attempts to communicate the way one has conceptualised and constructed the research question itself, the emergent results, the emergent methods, and the resulting report structure, the more one is likely to misrepresent the actual experiences of what happened, how and why it happened. Hence, Guba and Lincoln's (1989) acknowledgement of the eminent challenge regarding the underpinning research processes. Alvesson and Skoldberg (2000) steered clear of the dilemma by taking a view that with respect to reflexive interpretation: 'the demand for rigour in procedure is relaxed, and that for reflection in relationship to the interpreted nature of all empirical material is increased' (pp. 257–258). In view of this, I found my research better explainable within a constructivist paradigm.

RESEARCH STRATEGIES

Schumacher and McMillan (1993) have a conception of a research design as 'the plan and structure of the investigation used to obtain evidence to answer research questions' (p. 31). Meanwhile Denzin and Lincoln (1998) broadly conceive research design as something that 'involves a clear focus on the research question, the purpose of the study, what information most appropriately will answer specific research questions, and which strategies are most effective for obtaining it' (p. 28). At the core of these statements is the research question. In this subsection I address the nature of my research question, describe fields of experience I explored in an attempt to answer the question, and finally explore particular research strategies that I have used in pursuing the question through those fields.

The Nature of My Research Question

The generative and concept relating questions (Strauss and Corbin, 1994) that were at the core of my study were:

- What does it mean to create a constructivist classroom learning environment?
- How are the emerging attributes for creating constructivist classroom learning environments relating to each other?

The purpose of the second question was mainly to guide my investigations and organise the emerging constructs so as to end up with, as Strauss and Corbin (1994) would say, 'a theory of great conceptual density' (p. 274). The core question of the study was the first question and hence it requires elaborate attention.

When the question 'what does it mean?' is asked, that might sound easy at first. However, a little reflection on this immediately exposes one to the complexity of the question. Von Glasersfeld (as cited in von Glasersfeld and Pitasi, 2001) is of the opinion that in communication words and other related signs do not act as containers of meanings. Rather, he goes on to say:

> You interpret what I say according to your own experiences and not according to my experiences. I can never be sure what meaning is that you read out of my words, because what moves from me to you are signals and not the meanings of signals. This is to me the basic fact of communication. (p. 4)

In this orientation the search for meaning cannot be located in the artefacts, words, and all other material that constitute one's research site. Instead the main focus becomes the illuminations, the things that become highlighted, and ultimately the concepts that are constructed into viable constructs that fit in with one's conceptual scheme. Steedman (as cited in Alvesson and Skoldberg, 2000) presents a similar view by saying:

> Nothing means anything on its own. Meaning comes not from seeing or even observing alone, for there is no 'alone' of this sort. Neither is meaning lying around in nature waiting to be scooped up by the senses; rather it is constructed. 'Constructed' in this context, means produced in acts of interpretations. (p. 246)

It is against this background that I understand Denzin and Lincoln (1994) saying:

> The product of the bricoleur's labor is a bricolage, a complex, dense, reflexive, collagelike creation that represents the researcher's images, understandings, and interpretations of the world or phenomenon under analysis. (p. 3)

That is, what a bricoleur presents is not the world or phenomenon under analysis but his or her images, understandings, and interpretations of that world or phenomenon. So, a bricolage could be thought of as shadows of one's thoughts. It is not a conception of the phenomenon but a shadow of that conception. As Figure 1 shows:

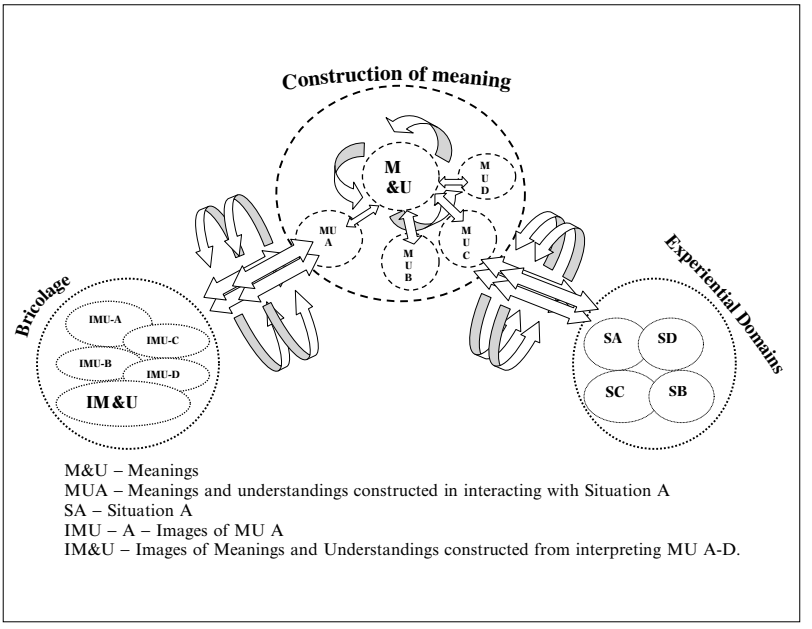

Figure 1. My Personal Interpretation of a Bricolage.

A qualitative researcher actively engages with an open situation or a phenomenon under investigation. This open-ended (perforated boundaries) and interactive (bi-directional arrows) investigation provides the researcher with experiences that guide his or her interpretations (circularity of the process) of the situation. Hence the situation can be regarded as an experiential domain. The dotted boundary represents a flexible nature of the researched. The domain can be constituted by several situations as represented by the non-bounded situations. The interpretations of those situations are represented by the researcher's constructed meanings and understandings (MUs A-D). Once all other situations are explored, the attention is then changed to the interpretations themselves leading to the constructions of the overarching MUs making them interpretations of interpretations.

Through the bricolage, the researcher attempts to present his or her emergent processes, constructed meanings, and understandings. But there can be no one-to-one correspondence between the bricolage and those emergent processes, constructed meanings, and understandings. Hence, the bricolage consists of shadows or images, or interpretations of the researcher's constructions. Shadows, being what they are, are never a full representation of the things they represent.

So, when I asked the question 'what does it mean to create a constructivist classroom learning environment?' the search for answers was not going to be confined to the empirical material alone. Instead the major focus became the interpretations of my interpretations of that empirical material. In a traditional positivist's context, research setting is about the site in which the empirical material is sourced out. In my situation that changed as the gap between the empirical material and my interpretations was diffused as the level of interpretation increased. In this case Lipson (as cited in Cutcliffe, 2000) talks of reflexivity in which researchers become part of, rather than separate from, the data. Therefore, in my study, the researcher and the researched became inseparable.

The nature of my research question as highlighted above provided a framework within which my engagement with the study is explainable. Henceforth, I use the framework to address the remaining aspects of the study.

My Experiential Domain: The Empirical Material of this Study

In terms of the empirical material, my experiential domain was constituted by literature on constructivism as a theory; literature on studies in which constructivism was used as a referent; observations of my own classroom; and lastly my students' perceptions of their mathematics classroom learning environments. A general approach in research is that in which literature is not taken as empirical data. However, I found that the status quo could not apply in my study in view of the nature of my research question. It is against this background that I found it necessary to address this issue in detail.

There are instances in which there is no consensus regarding the role of literature in research and there are those in which there is reasonable agreement. Generally, I found that there is agreement that literature review is meant to locate a new study within studies that have been conducted around similar issues that are

raised by the research question. Schumacher and McMillan (1993), for example, present the idea by asking the following questions: 'Has the problem been studied before? If so, should this problem be studied again?' (p. 53). Among several functions of literature review that Krathwohl (1988) has identified, he gives one as 'to relate the problem to the network of the theory, rationales, and previous explanations that already exists in the area' (p. 103). And the same message is inherent in Harlen and Schlapp's (1998) saying that

> a review of literature provides the context within which to interpret and report findings of the new study when it is undertaken, allowing their relationship to previous knowledge to be explored and possible future directions for the study to be suggested. (p. 1)

However, if questions such as when should the literature review be done and how should its results be factored into one's study, then researchers immediately split into their respective perspectives and paradigms. In studies that are mainly positivist in their orientation, the literature review is often expected to lead to an establishment of a theoretical framework for the study (Schumacher and McMillan, 1993). This is a lens through which the new research would be viewed and therefore should be addressed earlier in a study.

In grounded theory, there is sensitivity as to how literature is factored into the study. In attempting to ensure that the emergent theory 'is traceable to the data that gave rise to them' (Strauss and Corbin, 1994, p. 278), some researchers avoid doing literature review during the early stages of the investigation. Cutcliffe (2000) writes:

> It is well documented that when utilizing a grounded theory method the researcher should avoid conducting a literature review prior to data collection and analysis. … By avoiding a literature review at the beginning of the study it is more likely that the emergent theory will be grounded in data. (p. 1480)

Strauss and Corbin (1994) are, however, of the opinion that:

> In this methodology, theory may be generated initially from the data, or, if existing (grounded) theories seem appropriate to the area of investigation, then these may be elaborated and modified as incoming data are meticulously played against them. … Researchers may also usefully carry into current studies any theory based on their previous research, providing it seems relevant to these – but again the matching of theory against data must be rigorously carried out. (p. 273)

Irrespective of the timing of factoring existing theory into a grounded theory study, one cannot underestimate the central role that the incoming data is afforded in these kinds of studies. In this context I came to view incoming data and the emerging theory as having relatively higher status than the existing literature.

My belief, however, is that it is the nature of the question under investigation that should point the way regarding the role of literature and when and how its results are factored into the study. In my case, the question under investigation warranted that both the literature and the empirical data assume the same status – that of incoming data. Therefore, it really did not matter which one came first.

At the end I found solace in Alvesson and Skoldberg's (2000) opinion that:

> As regards the literature of the section the researcher wishes to investigate, different approaches are called for, depending on the character of the literature itself, which can vary in the degree to which it either encourages or discourages creativity. (p. 252)

I found literature on constructivism to be very open and therefore allowing creativity. The many interpretations that characterise this literature make it very fertile for new and creative exploration. This approach had structural implications on my report as all chapters that focused on my experiential domain had to be constructed in a parallel way.

Research Strategies through Which I Addressed My Research Question

When the purpose of investigation is to find or construct what it means to create a constructivist classroom learning environment, it becomes hardly possible to rely on a single prescribed research strategy. The emerging structure of my thesis became helpful in this regard. By affording the same status to all components of my experiential domain, I could approach each of them using ideas from the most suitable strategy. Consequently the overall strategy became a combination of at least seven research strategies. These are: (1) autoethnography (Holt, 2003); (2) grounded theory (Strauss and Corbin, 1994); (3) responsive constructivism evaluation (Guba and Lincoln, 1989); (4) teaching experiments (Steffe, Thompson, and von Glasersfeld, 2000; Cobb, 2000); (5) analysis of narratives (Polkinghorne, 1995); (6) hermeneutics; and (7) reflexive interpretation (Alvesson and Skoldberg, 2000). These strategies were not used in their purest forms as that would have been difficult to manage. Rather, I used their elements in such a way that they fused into each other making it difficult to see where one ended and the other began. One can visualise the combination as constituted by circles that are placed on top of each other in a way that other circles act as the backdrop for the one under focus. They interacted back and forth in such a way that there was 'fusion of horizons' (Alvesson and Skoldberg, 2000) among them.

Personal experiences played a crucial role in my study. As such it became important that I reflected on my own 'becoming' prior to the commencement of the study. Ideas from autoethnography became dominant in this regard. Meanwhile, teaching experiment methods became more relevant when I had to focus on my own teaching practices. Analysis of narratives became the focus when dealing with my students' perceptions. However, in all the chapters that constituted my experiential domain, I had to remain conscious of the emergent theory that would help me resolve the central question of the study. Ideas from grounded theory, therefore, became more relevant at that stage. That, however, implied that each chapter had to end with a section in which I continued to reflect on what it means to create a constructivist classroom learning environment. Cycling through those different personal experiences whilst continuing to reflect on my emerging constructs in a reflective turnaround of thought, is better explained within the realms of

hermeneutics and reflexive methodology. It is these two strategies that I want to elaborate on.

From Alvesson and Skoldberg (2000) I came to understand reflexive interpretation as a qualitative research process that involves a continuous interplay between four levels of interpretation: empirical material/construction of data, interpretation, critical interpretation, and self-critical and linguistic interpretation. The to and fro movements between these levels is best explained by hermeneutics. Or as explained by Alvesson and Skoldberg (2000) themselves:

> For existential hermeneutics, prior to anything else ('always already') every individual is enmeshed in her meaningfield, intentionally in time and space. In other words, she is never free from preconceptions inherent from the past, preconceived meanings. Nobody proceeds from *tabular rasa* and this includes the one seeking to understand. This is Heidegger's new version of the hermeneutic circle: to understand presupposes preunderstanding, but at the same time preunderstanding is an obstacle to understanding. To prevent this from developing into a vicious circle, the existential hermeneutician advocates a constant alternation between merging into another world and linking back into our own reference system. By means of this movement back and forth, we can successfully come to an understanding of the unfamiliar reference system, something which also leads to the gradual revising and/or enriching of our own: there is 'fusion of horizons'. (p. 84)

That is, whatever activity one engages with, one's existing conceptual framework will influence one's perception of the activity whilst that existing framework will also be influenced by the activity itself. The pre-understanding that one starts with grows into new understanding that becomes current pre-understanding allowing the search for new understanding to continue until a new conceptual framework is in place. That is, there is no sense of completeness in this process. At the core of all these is Alvesson and Skoldberg's (2000) notion of 'knocking at the text', of which they say:

> Sensitivity, the keen ear, is of the essence: to listen carefully to the text, as it were putting your ear close to it, in order to hear the answer as it emerges. The process is repeated time and again, whereby we ask the same question over and over, listening constantly to the text, until it no longer answers, or speaks to us so unclearly and faintly that the answer can no longer be heard. The idea is not to reach final answer; instead the journey is its own reward. At the end of the voyage, the question has been dissolved and a new question has begun to manifest itself, so that the journey(s) are the prize, not some final Shangri-La of knowledge at the end of the road. (p. 86)

This is the 'systematic asking of generative and concept relating questions' (p. 275) that Strauss and Corbin (1994) present as one of the distinguishing characteristics of grounded theory methodology. My understanding was that by asking my research question repeatedly, I could listen to my emerging construction of meaning until it became so clear that the emergent meaning fitted with my existing meaningfield. Below I provide a snapshot of how I actually went about these ideas.

Once I had selected all the literature that I found relevant to my thesis, I went through it article by article. In each case, I highlighted what I thought were key issues that could help towards the resolution of the main question or other questions that arose as I was exploring the article. I then used a word processor to transcribe all the highlighted texts from all relevant articles. During that process I subjected the text to numerous interpretations, listening carefully to my emerging meanings.

Sometimes I found the highlighted text insufficient in explaining the issue and in that case I explored its neighbourhood and thus expanded the selection. Sometimes I found the highlighted text too elaborate and trimmed it down. In other instances, my engagement with the text raised new questions or ideas which I recorded in between my transcripts.

Upon completing all the necessary transcripts, I printed the document in such a way that two pages were reduced to one A4 sheet. The idea was to bring all the selected text closer together to allow easy and further analysis. I then went through the whole printout highlighting common issues within an article and across the articles using a particular highlighter. For example, all issues relating to social interaction were marked by a yellow highlighter. At this stage, I continued to listen to my interpretations and where new issues or questions arose, I recorded such by writing on the back of the page or next to the text itself using a pen. Upon completion of this phase of analysis, I returned back to the electronic file and grouped all similar texts together and produced a new printout. This phase of analysis relates closely with what Strauss and Corbin (1994) refer to as *substantive coding*.

With regard to that new printout my interpretations included chronological development of the emerging issues, the search for rationale for the way the text is used, and many other issues. At this level I regarded my work as an *insight driven research* about which Alvesson and Skoldberg (2000) say that 'the work of interpretation is (more) central here, and the empirical material – text in various forms – is the subject of attempts to assess meanings and develop new insights' (p. 258). The process ultimately ended with a selection of the text to be used in my writing and my preliminary interpretations of it. At that stage an overview of the different subsections of the chapter and an early overview of where and how the chapter was going to fit in within the thesis would emerge. It is only at that stage that I commenced with the actual construction of my bricolage – the putting together of the shadows of my thoughts. In order to keep my interpretations as close to the data as possible whilst allowing my interpretations to surface, I used Erickson's (1998) notions of *fore-shadowing* and *after-shadowing*.

In engaging with my penultimate chapter, I first printed all the last sections of the four chapters and once more asked the question – what does it mean to create a constructivist classroom learning environment? I repeated the same process as above but this time focusing on the overarching emergent theory. Whilst Strauss and Corbin (1994) would call that theoretical coding, Alvesson and Skoldberg (2000) call it reflexive interpretation.

In constructing my final chapter, I subjected the whole of the previous chapter to further analysis and attempted to come up with more refined propositions about what it meant to create a constructivist classroom learning environment.

THE STATUS OF THE RESEARCH REPORT

Earlier on I presented bricolage as constituted by shadows of one's constructed meanings. Shadows are such that sometimes a reader would feel like he or she has

an idea of what they represent and sometimes the idea disappears in a flash requiring further engagement with the material. In this respect it is not helpful to talk of validity, reliability, and generalisability. These criteria, Guba and Lincoln (1989) concluded, 'are unworkable for constructivist, responsive approaches on axiomatic grounds' (pp. 235/6). It is not even idealistic to address issues of credibility, transferability, dependability, and confirmability in a traditional way. Instead, Alvesson and Skoldberg (2000) suggest that at least 'an "aha!" response should be part of the normal reader's reaction' (p. 279) when engaged with a good qualitative research product. The two authors present *interpretative richness* or *rich in points* as an important aspect of qualitative research. Of that they write:

> Point-rich research stirs up problems. The suggestion at least of an 'aha!' response should be part of the normal reader's reaction. The idea is that rich and freely interpreted data should encourage imaginative richness, at the same time that the empirical material – as well as functioning as a generator – also sets limits on the imagination. (p. 279)

The creativity in sustaining the balance between empirical material and interpretations is what qualitative research that is rich in points is about. Or as Alvesson and Skoldberg (2000) put it

> The creative act implies going beyond the consensual views regarding the empirical material. Saying something creative and novel is thus fully compatible with the ideal of maximising intersubjectivity as the way of achieving 'objectivity'. If we limit ourselves to what everybody agrees on, then it is difficult to say anything new or original, and there is a risk of repeating what everybody already knows. (p. 278)

It is this kind of thinking that captures how I went about my engagements with the empirical data and my subsequent interpretations of it. That is, the knocking of the text as explained earlier, continued to provide me with the guiding principles for dealing with all the incoming data.

Because of the way I have integrated my interpretations into my study, I could not view my research as a technical project. Instead I regarded it as an intellectual project (Alvesson and Skoldberg, 2000). In this framework the idea of systematisation ceases to be that of adherence to some linear and monolithic process and instead becomes that of circularity of reflection. In this case, Alvesson and Skoldberg (2000) continue to say: 'we adopt a view of research as a provisionally rational project, in which the kernel of rationality is a question of reflection rather than procedure' (p. 288).

The prominent roles of hermeneutics and reflexive interpretations in this study implied that there could be no sense of finality in terms of constructions and interpretations that I had been making. For if I were to expand on issues within my experiential domain, new understandings, new interpretations, and new constructs would continue to emerge. This is not a sign of weakness of the research strategies used. We have already heard from Alvesson and Skoldberg (2000) that the 'idea is not to reach any final answer; instead the journey is its own reward' (p. 86). It is in situations like this that Lomborg and Kirkevold (2003) would talk of *modifiability*. Within grounded theory, this concept means that the emergent theory might go through changes when new data emerge, generating qualifications to the theory. In fact the emergent structure of the thesis allows for continued growth as I can

continue to cycle my experiences in other areas of my experiential domain. Already there are at least four new areas that I have identified for future explorations. So, the journey continues. It is also fitting that I conclude this chapter at this stage.

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ELISABETH SETTELMAIER

EXCAVATING A RESEARCHER'S MORAL SENSITIVITIES: AN AUTOBIOGRAPHICAL RESEARCH APPROACH

EXCERPT FROM DOCTORAL THESIS

Reflecting on ethical issues in science brings me back to the time when I was studying at the University of Salzburg in Austria for my master's degree. I was enrolled in a science degree in genetics when I decided halfway through my studies to change over to science education. For me, the reason to study science in the first place, had been to 'contribute to creating a better world'. So what had changed? What were the reasons for changing from science to science education? Two disturbing memories emerged that might explain my motivation:

Professor Czerny's Rats

> The girl is wearing a white coat – Esther is crying. She is sitting in the cafeteria of the Natural Sciences building at the University of Salzburg in Austria. I have known her for a while because we have done a few lab-courses together. She is working on her Master's thesis. Esther tells me sobbingly that she cannot stand the experiment she has to perform. She must inject a thick syringe into the liver of a live rat in order to obtain a tissue sample – of ten lab rats only two have survived so far. When she had shown great concern about this to her supervisor, he told her off angrily that she should not be a 'wimp', 'If a rat dies, so what, take another one, and if that one dies as well, well take another one!' and 'If you cannot handle this then you should find yourself a different profession!' She was totally beside herself and was questioning her choice of studies altogether.

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 175–188.

My Time at the Radiation Lab

> During the aftermath of the Chernobyl accident in 1986, I was working at the radiation laboratory of the local government of Salzburg in Austria. It was my duty to prepare food and soil samples for measurement, then to perform the measurement and to add the data to a databank. As part of my contract, I was not supposed to tell any 'unauthorised' person about the outcomes of the measurements. It just so happened that, one day, I measured a sample of milk that had been drawn from a farm that is situated close to my parents' holiday house, and this is where we often buy our fresh milk from. The measurement showed a high level of radiation, so high that that milk had to necessarily be 'diluted' with less contaminated milk from other less affected areas. Now the dilemma for me was clear – should I comply with my work contract or should I tell my parents that they are facing a potential health risk by consuming the 'oh so healthy milk straight from the farmer's cow?' I have to admit that I decided to inform my parents, yet when I spoke to my boss about this dilemma he said that 'people are not supposed to know details – they might panic!' Well I did anyway.… After these events and with a certain degree of disillusionment about scientific research as a career, especially with the ethics of the research, I decided to contribute to a better world through teaching its children and becoming a teacher.

INTRODUCTION

Writing an autobiography had never been one of my priorities in life. I thought I was 'nobody special' and nobody would greatly benefit from my life story. This view changed dramatically during my doctoral research, which I conducted from 1999 to 2003. This was a very special time in my life, not only had I migrated from Austria in Europe to Australia only 1 year before commencing the study, I was also struggling with the effects of cultural border-crossing (Giroux, 1992) on me and my family. I was trying to overcome language barriers, to remain a professional in the field of education and to improve my qualifications, all at the same time. It was a time of asking questions and finding answers, a time of transformation. Whilst inquiring into the ways in which a values and ethics curriculum I had developed affected science students and teachers, I found myself confronted with choices – research related choices – that had close ties to my past. Whilst travelling the road of past experiences, nodal moments, epiphanies, and past decisions, I realised how closely connected were my research and my autobiography. These insights contributed to my writing of an autobiographical chapter in my thesis and to writing autoethnographically throughout the thesis.

In this chapter I explore how autobiography can benefit science education research through mapping the researcher's sensitivities toward her research topic which, in my case, was the teaching of ethical issues within science education. Exploring one's identity (Palmer, 1998) through critical reflective practice (Brookfield, 1995) can lead not only to enhanced awareness of one's personal practical knowledge as a teacher and a researcher (Connelly and Clandinin, 1988) but also to transformative learning (Mezirow, 1991) – research can then become a journey of personal development. For transformative learning to occur, we, as teachers or researchers, need to engage in a critically reflective process during which we examine our assumptions through different lenses, one of which can be an autobiographical lens (Brookfield, 1995): 'Our autobiographies as learners in

childhood, adolescence, and young adulthood frame our approach to teaching at the start of our careers, and they frequently exert an influence that lasts a lifetime' (p. 50).' Given this lifelong influence and drawing from Parker Palmer's work, we might want to ask the question, 'Who is the self that does the research?'

AUTOBIOGRAPHY AND SENSITIVITIES

In these postmodern – some say post-postmodern (Marcus, 1994) – times, especially if we ground our interpretative work in the seventh moment of qualitative research, which amongst other issues is concerned with moral discourse (Lincoln and Denzin, 2000), dealing with one's own background before interpreting and representing others becomes an important question of research ethics. The 'crisis of representation' has taught us to look critically at attempts to speak authentically of other people's experiences. Many researchers now accept that they are not disinterested but are deeply invested in their studies, personally and profoundly (Bullough and Pinnegar, 2001). Autobiographical research allows us to explore aspects of our interpretative horizons (Roth, 2000) and thus of our backgrounds. Regarding the legitimisation of the research, Lincoln and Denzin (2000) emphasise that interpretative inquiry in the seventh moment celebrates autoethnography and personal accounts grounded in striving to understand how others enact and construct meaning in their lives. Given that our autobiographies and our scholarly works are deeply integrated – we can therefore draw on our autobiographies to elucidate our knowledge (Roth and Bowen, 2000). One aspect that lends itself as a focus to our attention is the researcher's sensitivities towards her subject(s) which are characterised by a heightened awareness towards a certain knowledge area:

- What were the driving forces that led me to take up a study on the teaching of ethics in science education?
- How did 'the subject find me' – why did I choose a particular research topic?
- What were the incidents – the nodal moments – leading to the research?
- Who were the people that influenced me along the way?
- In what way has my upbringing and my own school education influenced my research and my attitude towards science education?

The Role of Sensitivities

Sensitivities are what make us more perceptive towards certain phenomena than to others. Sensitivities are part of the legacy of evolution, Skolimowski informs us in his book *The Participatory Mind*. Quoting Pierre Teilhard de Chardin, he explains that evolution is a process of augmentation of consciousness: after new insight is absorbed, the growing consciousness is expressed and articulated by the acquisition of new sensitivities. Sensitivities are therefore articulators of the growing consciousness (Skolimowski, 1994).

Being sensitive towards ethical dilemmas, I believe, represents the growing consciousness and awareness of my history and culture as I develop as a human

being. I can clearly trace back my interest in ethical dilemmas to my personal history and to certain formative events.

SOME THEORETICAL CONSIDERATIONS

Denzin (1989) defines autobiography as a person's life written by oneself or as inscribing and creating a life. Educational autobiographies in teacher education research have gained in importance, as Ken Zeichner, quoted by Bullough and Pinnegar (2001), pointed out in his presidential address to the American Educational Research Association in 1998. Self-study as a method to study our research practice points to a simple truth: to study a practice is simultaneously to study self – a study of self-in-relation to other. This type of self-study can also lead to the enhancement of personal practical knowledge (Connelly and Clandinin, 1988) and pedagogical thoughtfulness (van Manen, 1990).

Derrida asserted that real, concrete subjects live lives with meaning, and these meanings have a concrete presence in the lives of these people. As there is no direct window into the inner life of a person, the (auto)biographical method relies on subjective verbal and oral expressions. There cannot be a clear, unambiguous statement of anything, an intention or a meaning. Denzin (1989) explains that biographies and autobiographies are conventionalised, narrative expressions of life experiences. Through the method 'real appearances of real people' are created and they shape how lives are being told.

Autobiography and autoethnography blend ethnographic research with life writing, telling us about a culture as well as about lives at the same time (Roth, 2000). The two genres play an increasingly important role in the social sciences as the work of Ellis (1997), and Ellis and Bochner (2000) clearly shows. Roth explains that although these two genres have become a central means of critiquing other forms of representing individuals and their culture, their influence in science education remains minimal. I agree with Roth that, apart from a special issue of the *Journal of Research in Science Education Research* (Vol 30(1)) on autobiography, in which researchers such as Roth (2000), Tobin (2000), and Eisenhart (2000) published autobiographical accounts, as well as papers by Taylor and Timothy (2000) and Afonso (2002), the widespread recognition of this genre as a methodology suitable for science education research has yet to happen.

The postpositivist tradition of reporting science education research using a scientific, objectivist, 'scholarly' writing style, has made it difficult for alternative genres of scholarly writing to be accepted amongst the majority of the science education research community. Barone (2001) reports on authors who (still) fret about the potential contamination through subjectivity of objective findings about the 'real world', a soiling to be minimised. According to Cronbach (quoted by Barone) the primary purpose of (postpositivist) social scientific research is to reduce uncertainty, to seek literal truth.

Postmodernists, on the other hand, in their quest for understanding rather than explaining, have abandoned striving for certain and total knowledge that transcends a fallible, human perspective. Instead, they promote an epistemology of ambiguity whose purpose is the enhancement of meaning rather than the reduction

of uncertainty. Poststructuralists believe that every autobiography is a construct for a particular audience. It looks at the intention behind the construct – interaction between reader and author to reconstruct the writer (Rodriguez, 2000).

Integral philosophy offers a potential post-postmodernist stance by promoting an integral vision (Neumayr and Taylor, 2001; Settelmaier and Taylor, 2001; Wilber, 1995, 1997, 1998, 1999, 2000). Integral vision is a dialectical world view that recognises the following:

- There are different ways of knowing.
- Each phenomenon can be addressed from four perspectives (individual subjective, individual collective, collective intersubjective, collective inter-objective).
- Each perspective will yield different answers.
- The four perspectives serve a variety of research purposes.
- There are different truth-claims in each perspective.
- No truth-claim is privileged over the other.
- A truly integral study will include all four perspectives and will bring about asymptotic growth of knowledge about the whole from knowledge of the parts.

Researchers working within a post-postmodernist tradition, find themselves confronted with a variety of writing genres including autobiography, autoethnography, performance texts, etc., each serving as a tool for better understanding and supporting interpretation of the 'other'. Such experimental texts (Richardson, 2000) serve to facilitate to 'work the hyphen' as Michelle Fine calls it (Fine, Weis, Weseen, and Wong, 2000): when the 'self' of the researcher meets the 'other' – the participant's self. Using experimental writing genres within a postmodernist framework offers a possibility of addressing issues of legitimisation and representation in one's research.

WRITING MY AUTOBIOGRAPHY

As with any type of research, autobiographies need structure. This can be achieved by organising the writing around particular foci: Denzin (1989), in his book *Interpretive Biography*, examines different types of organisation of biographies and autobiographies. There can either be a chronological order from birth to death, or alternatively from death back to birth. Or less common, there can be no chronological order at all.

Linking Books

In my doctoral thesis, autobiographical stories or vignettes are organised around 'nodal moments' (Bullough and Pinnegar, 2001), epiphanies or turning points (Denzin, 1989), and 'mentors who evoked us' (Palmer, 1998). Autobiographical vignettes to me are like 'Linking Books' – well known to everybody who has ever played computer games, such as *MYST III Exile* (Presto Studios, 2001): in the game,

Linking Books are used to travel from one age to the next. The player (or the player's avatar) has to touch the Linking Book and is immediately transferred to another virtual reality. I believe this is very similar to what well-written vignettes do for us – they draw us into the world of the writer and for a brief moment we enter their reality. In my doctoral thesis, autobiographical vignettes interrupt the flow of the 'theoretical text' in order to relate the research to influential events, people, literature, and so on that have led to the development of my particular sensitivities. The connective tissue between the autobiographical vignettes and the text is provided through interpretative commentary in which I analyse and interpret the stories. I would like to invite you, the reader, to now touch the Linking Book with the title 'How it all began' and join me on a journey back to my early life.

How it all Began?

> Looking back I can see that some influences during my early life have probably made me very sensitive to ethical dilemma situations. One influential dilemma has to do with my birthplace. My father used to be a medical doctor before his retirement. He worked in medical research in Vienna, in the Netherlands, and in Britain, for many years before he gave up this academic career and became the senior anaesthetist at the local hospital in a semi-rural town in Upper Austria. My parents decided to move from Vienna to Braunau am Inn, a small but beautiful, medieval town of architectural splendour, only a few years before I was born.
>
> This decision presented me with the dubious pleasure of sharing my birthplace, with – of all people – Adolf Hitler, a fact that indeed was to be of some importance for my personal development later. It involves being confronted with an incomprehensible past at an early age, as well as being 'equated' with the Nazis of 60 years ago, no matter what your personal political stance really is. I believe that, due to a lack of historical knowledge, many people overseas tend to identify Nazi with German or even worse Austrian. The dilemma with Braunau for me was that, on the one hand, I love the place, I still have my parents and friends there. I like the people. I love the river Inn, its quiet hidden arms, the relatively intact ecosystems along the river, the bird and beaver colonies, the river-woods that offered us children a great adventure playground in the sixties and seventies. But on the other hand, times have changed: Braunau is now a border town within the European Union. In 2002 the river-woods are no longer safe for children to play in: they have become a different type of 'playground' in which illegal immigrants trying to cross the river into Germany play hide-and-seek with border patrols which are supposed to prevent 'illegals' from 'infiltrating' the German border. But this is a different story, reflecting the modern Austria…
>
> The peacefulness and sleepiness of the small town is deceptive: Braunau's historical background tends to relate us to a particularly unsavoury aspect of the past, even though Braunau's most notorious ex-citizen spent only two years of his life there – the first two years to be precise. Regardless how old Adolf was when he left, or how much political indoctrination he had received whilst playing in his nappies, to uncritical and unknowing overseas visitors, Braunau's reputation has been tainted for all times.
>
> The inhabitants of this small town do not really want to be seen in relation to this particular past. There is a strong spirit of political awareness about the past as this web-page example shows clearly http://www.hrb.at/. This political awareness was especially obvious when a granite boulder was to be set up in front of Hitler's birthplace as a monument against Nazism, carrying the words, 'Fűr Frieden, Freiheit und Demokratie – nie

> wieder Faschismus. Millionen Tote mahnen' (translation from the German: For Peace, Freedom and Democracy – Fascism never again. Millions of victims remind us!). The population of Braunau was split, with a great number of people rejecting the project, not (as might be presumed) because they opposed the monument or thought that Nazism was such great a thing, but out of fear that Braunau could become a pilgrimage-site for Neo-Nazis or other war-tourists from all over the world. Others saw it as a clear sign of Braunau declaring its standpoint openly. Yet others, especially the elderly, thought the past should best be left alone and not be touched, 'Let's be glad it's all over!'

This vignette introduces the reader to the environment I grew up in. In this vignette, I attempted to connect autobiography and history, thereby putting personal struggle into the context and ethos of time in order for my stories to become research (Bullough and Pinnegar, 2001).

In addition, I structured my autobiographical writing around questions. In particular, questions I drew from Parker Palmer's (1998) book *The Courage to Teach.* Reflecting on 'teaching', Palmer poses a set of questions, the first being, 'What do we teach?' This question turns out to be the most commonly asked question of all with regard to teaching and learning, followed in popularity by, 'How do we teach?' Somebody might even ask, 'Why do we teach?' But only rarely does anybody ask: 'Who is the self that teaches?'

In my autobiography, I adjusted these questions to the context of my research:

1. *What* is my research about?
2. *How* do I perform this research?
3. *Why* do I bother to inquire into a certain topic?
4. *Who* is the researcher doing the study?

These questions helped me with engaging in critical self-reflection or in other words pondering about the implications of these questions on my own research. I realised how closely related to my own autobiography were the answers to the four questions.

Denzin and Lincoln (1998) recognise this close connection between interpretative research and the researcher's biography by proposing that behind every interpretative study stands the biographically, multiculturally situated researcher. They suggest that

> three interconnected, generic activities define the qualitative research process. They go by a variety of labels, including… ontology, epistemology, and methodology. Behind these terms stands the personal biography of the gendered researcher, who speaks from a particular class, racial, cultural, and ethnic community perspective. (p. 23)

I, as the researcher, approach the world with a set of ideas, a framework (ontology) that specifies a set of questions (epistemology) that are then examined (methodology) in specific ways (Denzin and Lincoln, 1998). It is thus important to bring to the fore the historical background of a research study. In the case of my doctoral thesis, autobiography has served as a tool to put into its biographical, historical context an interpretative research study about teaching ethics in science classrooms using dilemma stories. This is especially important for the interpretative act, as Roth (2000) reminds us.

Critical Voices and Autobiography

Despite the reasons that speak for the use of autobiography, there are critical voices, questioning the 'scientific' legitimacy of the autobiographical enterprise. Can autobiography ever be rigorous? How can we make sure that we do not only indulge in solipsism? Does autobiography as a form of arts-based, fictional writing not open the door for scientific dilettantism – research for the pleasure or benefit of the researcher only?

HOW TO READ AN AUTOBIOGRAPHY – QUALITY GUIDELINES

A number of researchers have suggested guidelines and quality standards for narrative and self-studies in particular. I would like to draw from Barone (2001) as well as from Bullough and Pinnegar (2001). Barone lists qualities that turn a narrative into an arts-based text, suggesting that the language should be expressive and contextualised. The text should create a virtual reality and present an aesthetic form. It should carry the author's signature and above all, it should show a degree of textual ambiguity (Barone, 2001).

Bullough and Pinnegar (2001) ask the most crucial question of all: When does self-study ever become research? Answering their own question, they explain that history and biography need to be joined: 'When the issue confronted by the self is shown to have relationship to and bearing on the context and ethos of a time, the self-study moves to research' (p. 15). In order to answer the famous "so what?" question about the significance of the work that 'wise' readers tend to ask, they emphasise that there must be a balance in evidence not only in what data have been gathered and presented but in how they have been analysed, in how they have been brought together in conversation. Ultimately they add that the aim of self-study research is moral, to gain understanding necessary to make that interaction, between the researcher's self and others who share a commitment to the development and nurturance of the young.

According to Bullough and Pinnegar (2001) self-studies should ring true and enable connection and the author's voice should appear. This brings in the notion of verisimilitude (Adler and Adler, 1994). The stories should promote insight and interpretation. History should be engaged forthrightly and the author should take an honest stand. A good self-study should be a good read, and attend to nodal moments of our biographies, thereby enabling the reader to gain insight or understanding into the self. Good autobiography should reveal a lively conscience and balanced sense of self-importance, tell a recognisable story, portray character development, give place to the dynamic struggle of living life whole, and offer new perspectives. The plot of the autobiography is a series of events deliberately arranged so as to reveal their dramatic, thematic, and emotional significance. Similar to fiction, a good autobiography tries to reproduce the emotional impact of the experience to move the reader.

Autobiographical writing results in narratives about our lives. But why, we may ask, is this worth the effort? What might be the intended purpose of writing an autobiographical narrative? Barone (2001) (quoting Bruner) suggests that narratives

are designed to do what art does so well by laying bare questions which have been hidden by the answers. With regard to autobiography we might start to question that which seems unquestionable to us, a given fact, something that 'has always been there'. We might begin to confront what the phenomenologists call the 'natural attitude' about ourselves. Mezirow (1991) explains that when self-reflection is critical, it involves a searching view of the unquestioningly accepted presuppositions. He continues that most of what we have learned about ourselves has not been examined for unconsciously incorporated assumptions. Instead of asking, 'Why would anybody be interested in my unimportant life?', we might want to ask, 'What experiences, issues, stories, from my life can be of benefit for others? How can this affect my research and my attitude about who I am dealing with as a researcher and what I hear from the participants? What can I learn from getting to know myself better?' In order to illustrate my attempt to trace back my interest in science to a nodal moment in my early childhood, I would like to invite you, the reader, to now touch the Linking Book with the title: *A small step for a man, a giant leap for mankind*.

A Small Step for a Man, a Giant Leap for Mankind (Neil Armstrong)

> Cuddled into the black leather TV-chair in my parents' living room, wrapped up in a blanket, I am watching the black and white, fuzzy pictures delivered from the moon's surface into our home in a small Austrian town. I remember having a strange feeling about the fact that some human beings are actually 'up there' and are able to look down on 'us'…
>
> I was five years old when Neil Armstrong first set foot on the moon. My family had gathered around the television set, my parents, my brothers, their girlfriends … I remember the tension in the room during those last moments before the landing – fear something might go wrong in the very last moment. At last it was certain – humankind had achieved something unique and I remember feeling that I had just witnessed something extraordinary. Pride of what humans can do, pride of what science can help us achieve. I believe that in this very moment the foundations for my interest in science were laid. As a child, I never wanted to become a nurse, a police-woman, least of all a teacher. Marie Curie as an idol was much more like it – funny enough, events and choices made during my later life have turned me into a science teacher. What is the meaning of that?
>
> Later I remember seeing pictures from the Houston control room. My mother pointed out a man to me, tall and blond, amongst the scientists and technicians, 'This is Wernher von Braun', she said, 'He originally came from Germany and is now one of the great American rocket scientists. He has contributed considerably to this event tonight.' I was impressed to say the least. The fact that he came from a neighbouring country with some cultural and historical commonalities left us with a feeling as if we also to some degree shared the glory of the moment.

This vignette describes a defining moment when I seem to have made the decision to choose a direction in my life that would somehow link me to science. Before engaging in autobiographical analysis, I had not been aware of this detail of my history. The vignette partially answers my question as to why I ever engaged in

science, let alone the study of the teaching and learning of ethics within science education. This leads us to other questions I have asked in my self-study.

THE WHAT, THE HOW, THE WHY, AND THE WHO? QUESTIONS THAT INFORM THE RESEARCH

As an example of the questions I asked during my research, I would like to focus on the 'what' question and on the 'why' question later in this chapter. My research was based on the use of ethical dilemma stories. Dilemma stories are a genre that is characterised by ethical dilemma situations. The purpose of telling dilemma stories within moral education is to introduce students to a moral dilemma situation in which choices have to be made by the characters in the story. The flow of the stories is interrupted at each dilemma situation. Students are asked to identify with the character having the dilemma, and reflect on how they would solve the problem. Then students are asked to exchange their views with colleagues. Eventually this teaching approach culminates in a whole-class discussion. The dilemma teaching approach is deeply grounded in radical and social constructivism (Gschweitl, Mattner-Begusch, Neumayr, and Schwetz, 1998).

The following dilemma story is the summary of one of three, that was evaluated within the research. I chose this story because it has, as I found out through autobiographical analysis, a close relationship to my biography. The story is about research ethics, about whether there should be any restrictions to scientific research, and if yes, what they might look like. Sandra, the collaborating teacher who was not only the form teacher but also the mathematics and physics teacher of the Year 10 students, told the story freely within the context of the astrophysics curriculum. At several points throughout the story, questions relating to the moral dilemmas in the story were presented to the students and they were asked to make choices and explain these choices, first by themselves, and later in the form of group work.

The Rocket Dilemma (A Short Summary)

> The story is about a rocket scientist who has a life ideal: he wants to build a rocket that can fly to the moon. As the political situation in his country changes and a new regime comes into power, he is confronted with making a choice between staying on in a country where human rights violations are reportedly happening, or leaving his research behind which means having to start anew somewhere else. At the same time, the new government offers him generous research funding – he decides to stay on and collaborates with the totalitarian regime. At some stage, he encounters serious problems in his research that can be resolved only through human experiments – the government offers him the 'use' of concentration camp prisoners for this purpose. By this time, he is so driven by his goal that he overcomes any initial inhibitions and agrees to this offer. Many prisoners lose their lives. The government has engaged in a war and eventually the government forces him to change his research focus from rockets that can fly to the moon to missiles that can reach the enemy's territory. Once again he regards this

> 'interruption' to his plans as only temporary. After the war, the researcher whose reputation has reached the leaders of the USA, is 'invited' to the States to support the US space programme with the knowledge he has gained during his career in his homeland. Despite the fact that his knowledge was derived from the sufferings of many victims from the concentration camps, he is now a sought after man, and he does not disappoint: The Americans are the first to reach the moon. An awe-inspiring moment, yet who thought about (or knew about) the price that had to be paid to reach this goal?

You might have guessed whilst reading the story – the man in the story, the researcher, the torturer, is a fictitious character based on the biography of Wernher von Braun, the man I had come to idealise from the moment of the first landing on the moon when I was 5 years old – the same man described in my fourth vignette. Von Braun was one of my idols when I chose a career in science. You can imagine the shock when the truth about this man was revealed to me during my twenties. The impact of this revelation was strong enough for me to choose him as an example of bad research ethics many years later by making him the main character in one of the dilemma stories I evaluated with the students. Yet, at the time when I was writing the dilemma stories, I was not aware of this connection – it became obvious to me only whilst I was writing my autobiography, by looking more closely at the reasons for which I chose to write particular stories.

It has also become clear to me that the reason why I am actually sitting here right at this moment, is because one day when I was a little girl I was sitting in my parents' living room in front of the television and watching the first landing of astronauts on the moon. It was then that my love for science was awakened. It was during my doctoral research that the sensitivities regarding research and research ethics were sharpened due to the big disappointment I had when my idol turned out to be different from what I wanted him to be. It is only now, writing this chapter about reflecting on my doctoral research, that I can see the bigger picture and perhaps in the future, based on new insights and discoveries I might see an even bigger one.

WHAT HAVE I LEARNED FROM WRITING AN AUTOBIOGRAPHY?

For me as a researcher, writing an autobiography has yielded many valuable insights into how past and present are interrelated. Reflexivity, fostered through the process of writing, has led to transformative learning through reconsidering my own value and belief systems: an enhanced awareness or sensitivity towards ethical dilemmas is firmly grounded in the biography of the researcher. I believe that much of what I have learned can be understood by applying the 'theory of transformative learning' (Mezirow, 1991). Mezirow explains that, through critical self-examination and assessment of assumptions, we can change our perspectives of how we see ourselves and our environment. With regard to research, this has led to a much clearer understanding of where my sensitivities towards ethical dilemmas come from and how they have affected and continue to affect my research.

In the past, when I asked myself the question, 'Who is the researcher doing the research?', I might have responded: I am a white, middle-class, Catholic, middle-European, female researcher with south-eastern European (Austrian,

Croatian, Czech, Hungarian) family heritage, with German as a mother tongue and several other languages such as Croatian floating around the household, with a Catholic father and a Protestant mother, and in recent years with a growing interest in spirituality, human consciousness development, Integral Philosophy, and yoga. But of course, this covers only a small proportion of who I really am, after all I am the mother of four, and partner of … and the colleague of … and a friend of … in the mean time converted to Buddhism … and much more. I might even add that I am a science teacher, an adult educator and a university lecturer with a vision – the vision to contribute to a better world by supporting students in their quest to become critical self-determined citizens and consumers. Mentors, academic supervisors, and certain turning points along the way, have contributed in the shaping of this path.

For the reader, provided the stories are written well, there can be opportunities for identification with the researcher and for self-reflection and transformative learning in order to enhance awareness of personal-practical knowledge and for developing further as science teacher(s) and science teacher educator(s). At this point, I would like to invite you, the reader, to touch the last of my Linking Books in this chapter with the title: *Braunau? Isn't that the place where 'you know who' was born?* This vignette answers partially the 'why' question of the research.

Braunau? Isn't That the Place Where You Know Who Was Born?

> When I was a teenager, the source of my literary and philosophical 'impulses' was my German teacher Walter. He was a German, history, and philosophy teacher. One might say, he never only taught German or history or philosophy. He always combined all three of his subjects which resulted in an 'exciting' mixture of: Who wrote what, and why? What were the historical circumstances of this text? What was the philosophical background at this time and of this author? He presented his subject in a way that I as a student lived the text.
>
> One day, I think it was during Year 10, he told us about the moral purpose of his teaching (this is at least how I remember it). He said that, 'Teaching German in Hitler's birthplace, I see it as my foremost duty to educate my students towards being critical thinkers. First of all, don't believe what anyone tells you without checking, then think about it and then speak up! Be especially wary of any so called 'authorities' whoever they might be. Make up your own mind. Be yourselves, walk upright and be aware that democracy is a fragile thing carried only by those who "live it."'
>
> Bearing this background in mind, we read all sorts of literature (not only German literature of course) and over time we became very much aware of critical and contentious issues, because Walter would tirelessly show up uncritical tendencies in our essays and our thinking. At that time, I thought he was too critical sometimes but I enjoyed the challenge of actually having to think. I am convinced now, that the 'tragic' coincidence that Hitler was born in Braunau, contributed considerably to make us much more aware of possible ethical and political dangers. Walter made it quite clear that being uncritical left your mind open to influences of any kind, which is especially dangerous for adolescents, who are just developing their personality and belief systems. The only remedy against this is to have an opinion that you should be able to defend. I think now that Braunau, due to its past, is probably one of the places in this world where you can find young people who critically reflect on both the past AND modern day society!

My generation grew up facing a terrible incomprehensible past. 'How could anyone do such things like the Holocaust?' For us, this meant that we were living together with people who had been alive at the time of World War II, who had some kind of relationship to us (family members, neighbours, etc.) and who had played some sort of a role during this specific time. People who, like me, were born in this beautiful little Gothic town will always have to struggle more than other people with the legacy of the past. Later in life when people asked me, 'Where were you born?' my answer was more often than not countered with another question, 'Braunau? Isn't that the place where 'you know who' was born?' I still feel like saying, 'Yes, he sure was. But I was born there too just like several thousand other people since then!' On the other hand, I suppose I need to be more grateful about my birthplace: I would not have become who I am if I had been born and grown up somewhere else! And I am still grateful for the gift of Walter's teaching.

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LES PEREIRA

DEVELOPING PERSPECTIVAL UNDERSTANDING

> And in the midst of his deliberations, the voices of all those for whom the bell would toll reverberated in a cacophony of concern betwixt and between the constructs that populated his mind.

INTRODUCTION

Perhaps the place to start, in this discussion between you and my written word, would be to ask with what assumptions you approach the academic world of research. Would you argue that qualitative research is concerned with the generation of deeper and richer understandings of human experience? Do you approach your research with the belief that you will be able to identify a generalisable truth that will serve the interests of others? Do you believe both of these … or neither…? How you answer these questions will impact greatly on how you make sense of what is now in your hands.

My research has involved many of the ideas described in other chapters of this book. And like Jack Whitehead (1985.), I have moved forward having consciously chosen to understand the world from my own position in it. This would appear an inescapable situation if I heed the warnings of constructivist philosophers. For my doctoral thesis, understanding the world from my own position in it entailed an inquiry into my own practice that began with maintaining a journal of my experiences as a school leader during what turned out to be the most tumultuous year of my professional life. I investigated these experiences by integrating several research approaches including narrative inquiry, writing as a method of inquiry, auto/biography, and fictional writing.

It is perhaps pertinent to *your* reading of this chapter to emphasise the significance of my earlier comment as this has significantly impacted on my approach to research, on my representation of it, and the extent to which I 'claim to know':

I have chosen to understand the world from my own position in it.

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 189–203.

It is perhaps worth you pausing here to consider the ramifications of my admission. What does this statement *mean* for you? *How* will it affect your approach towards what you are going to read?

I believe research offers no definitive advice for future practice, for the perpetual decision-making that lies at the heart of the process of living. And although this leaves me with the perennial problem of choice, I am, for the moment, content with *my* target for research; that is, a greater understanding of the issues embedded within a particular problem. In this chapter, I have chosen to concentrate on describing an approach that has proven to be a powerful ally in my search for understanding, one that aims at developing a perspectival understanding for a postmodern world.

POSTMODERNISM AND THE GHOST OF KNOWING

The postmodern age brings with it a greater awareness of the problems underlying our attempts to know. For some, it strips away all foundations upon which we might build a case that justifies our claims of knowing. In many quarters postmodernism has brought forward reactions as intense as those that could be heard when Nietzsche proclaimed that 'God is dead' (1997, p. 5). But, in much the same way, it is not that knowledge is dead – it has just taken on a different, less traditional form.

The division of this text into sections reflects different '[st]ages' in the history of qualitative research. Each of these [st]ages are based on different assumptions about the nature of knowledge and reality, and each can contribute to a deeper understanding of the nature of qualitative research. For, as Paul Feyerabend argues:

> There is no idea, however ancient and absurd, that is not capable of improving our knowledge. The whole history of thought is absorbed into science and is used for improving every single theory. (Feyerabend, 1978, p. 11)

My research is heavily influenced by postmodernist thought and recognises the ghostly nature of knowledge. Consequently, it reflects many of the characteristics identified by Denzin and Lincoln (2000) as representative of the sixth and seventh 'moments' of qualitative research. Research in these moments includes such approaches as fictional ethnographies, ethnographic poetry, and multimedia texts; it is concerned with the needs of democratic societies and with questions of morality and ethics (Lincoln and Denzin, 2000). And perhaps a key development in the seventh moment and beyond will be an (unforced) integration that seeks to dissolve the dualities of the one and the many with the creation of new ways of understanding informed by a more inclusive approach to other ways of knowing. For me, postmodernist thought provided the stepping stone towards these understandings.

Although there are many colours involved in trying to paint a picture of postmodernist thought, I agree with Ken Wilber (1998, p. 121) who suggests that three key features are common in postmodernist approaches:

1. Reality is not in all ways pre-given, but in some ways is a construction, an interpretation.
2. Meaning is context-dependent, and contexts are boundless.
3. Cognition must therefore privilege no single perspective.

These features are reflected in my research in several significant ways. The first two features provide the basis for my intention to understand the world from my own position: if I am able *only* to interpret, and meaning is *context-dependent*, I am *unable* to understand the world from any other perspective. This, however, conflicts with the advice of the third feature. So, in wanting to understand in the most complete way that I can, and to guide my actions from the most moral standpoint that I am able to take, the third feature advises me to *develop* my perspective, interpretative as it is, by trying to understand how others view the same issue. Laurel Richardson's (1994) concept of crystallisation is a useful way of visualising the advantages of multiple perspectives and coming to understand the natures of our lived realities.

CRYSTALLISATION AND THE SEARCH FOR UNDERSTANDING

A crystal provides a multifaceted image that sheds light on the complexity of perception. The concept of crystallisation exposes the limitations of individual perspectives while providing a multi-levelled metaphor that supports the development of our own perspective. At the surface level, the multiple facets remind me that the position from which I view any phenomenon will greatly affect what I perceive; a crystal may take on a completely different shape and/or expose different aspects of itself (shape, texture, etc.) depending upon how we look at it and our distance from it: this distance may be emotional, cognitive, and/or physical. On a deeper level, if we peer into the heart of the crystal, certain angles may expose an array of colours that would otherwise be invisible and this uncovers still other issues; it raises questions of what we might consider to be 'real'. It might be that these colours simply do not 'exist' from any other angle of view, the 'reality' of the colours may only be brought into existence by the way the crystal *interacts* with aspects of its environment; by how we hold it up to the light. The colours then, are not representative of a thing, but of an interactive *process*. On another level, the word crystallisation can be used to understand the temporality of knowledge and understanding; crystallisation as a process is the physical action of a liquid cooling into a solid. The totality of the liquid gradually solidifies over time into crystals, separated into partial representations of the original liquid, much like the

solidification of our interpretations, our knowledge, and our beliefs. We view a phenomenon which we then 'shrink' into our own narrow construction of it. So the metaphor of crystallisation, the gradual shrinking and solidifying of an originally fluid 'reality', complicates both the concept of perception as well as the temporal reality of what is perceived – the number of crystals you see will depend upon how long the liquid has been cooling and when you happen to look. As a metaphor then, crystallisation can provide insight into the nature of perception and knowledge, and into the significance of the third feature of postmodernist thought suggested above. But as Laurel Richardson puts it:

> [c]rystallisation provides us with a deepened, complex, thoroughly partial, understanding of the topic. Paradoxically, we know more and doubt what we know. (1994, p. 522)

THE SEVEN WAYS OF KNOWING

Through crystallisation, Valerie Janesick (2000) argues for a more inclusive, multi-perspectival approach to understanding. These multiple perspectives, rather than being viewed as actualities, can be limited by considering them as referents (Tobin and Tippins, 1993). In recognising perspectives as referents, reference points from which I view the phenomenon under investigation, I am reminded again of the limitations of each perspective. I am able to make space for the insights of alternative perspectives by limiting the applicability of every perspective, of every way of knowing (Pereira, 2005).

Henderson and Kesson (2004) have described seven ways of knowing that can be traced back to early Greek thought: techne; poesis; praxis; dialogos; polis; theoria; and phronesis. Each of these ways may serve to facilitate a change in a researcher's perspective with respect to the phenomenon being explored. In the way I have used them, they became points of reference that guided my thinking and enabled me to remain aware of, and focus my thinking towards, different aspects of a particular issue. The following example demonstrates how I was able to generate a wider and deeper understanding of the concepts and ideas surrounding and impacting on the idea of method while engaging in a process of writing for inquiry (Richardson, 2000).

Table 1 outlines some of the characteristics of each of the seven ways. In the example that follows you will be able to recognise these characteristics in their contributions to the dialogic inquiry.

Table 1. The seven ways of knowing.

Way of knowing	**Focus**	**Description**
Techne	Craft reflection	Techne is governed by a concern for the end product. Through this perspective the researcher applies known strategies and techniques to achieve the desired end.

Poesis	Soulful attunement to the creative process	Poesis recognises the centrality of the individual in the application of strategies and techniques. Through this perspective the researcher engages with the tacit dimensions of their experience: emotionality, perception, intuition, and creativity.
Praxis	Critical inquiry	Praxis is concerned with the differences between natural constructs and those of human invention. Through this perspective the researchers take a critical approach to the phenomenon they are researching. They pay attention to the power relationships in operation, to whose interests are being served, and whose voices are silent.
Dialogos	Multi-perspectival inquiry	Dialogos recognises the impact of the issue on those closely involved. Through this approach the researcher gives voice to those who are affected by the phenomenon being researched. It opens an avenue for the reconstruction of meaning.
Polis	Public moral inquiry	Polis is concerned with the opinions and concerns of the wider community who are not directly involved with the phenomenon being investigated. Through this perspective the researcher considers the public knowledge, understandings, values, and ethical considerations with respect to the phenomenon being researched. Polis encourages the researcher to investigate the alignment of the interests of the wider community with those uncovered by the other ways of knowing discussed above.
Theoria	Contemplative wisdom	Theoria is concerned with questions of what is worth knowing and of possible resulting futures. Through this perspective the researcher envisions the ramifications and the foundational assumptions of the various perspectives and understandings that have been gathered. There is a theoretical questioning of what 'all of this' means, where it leads, and whether this is where we want to go.
Phronesis	Practical deliberative wisdom	Phronesis is governed by a moral concern for contextually appropriate judgement. It binds the phenomenon to its context. Through this perspective the researcher is encouraged to bring her or his own sense of morality to the decision-making processes involved in research design and process. It is through an application of phronesis, informed by each of the ways of knowing described above, that the researcher comes to an understanding of how to proceed.

In attempting to understand methodology through the lens of my own experiences, I utilised the seven ways of knowing to inquire into the nature of method. I have reproduced the inquiry below as a real example of the generation of understanding that can occur through the agency of multiple perspectives. The section appears as it did in my doctoral thesis. It includes conversations between me and the 'me' that was positioned by the seven ways of knowing. As in the original, the right margin records the voices of those who 'spoke' to me in my earlier years. Although they might have been represented by polis I chose otherwise and allowed them to speak from the sidelines: as past thoughts, they suggest a predisposition rather than a current voice of inquiry. The left column exposes thoughts-to-me that occurred as I was engaged in this writing-for-inquiry. Here, then, is how I developed a perspectival understanding of the concept of method using the seven ways of knowing to position my thinking.

Eight travellers sit at a table in a motel - 'the Journey's Pret - End''. They have taken a break at the suggestion of Theoria and are enjoying the warmth of the hearth fire. Les has recently joined the seven friends having come across them on his journey. He had met Poesis, Praxis and Phronesis before but never in the company of the Others. They took turns introducing each other to him: Techne as the Craftsman, Poesis as the Artist, Praxis as the Activist, Dialogos as the Agitator, Polis as the Politician, Theoria as the Questioner and Phronesis as the Juggler. They had laughed uproariously during their introductions as if the descriptions had applied to all of them rather than the presented friend. Despite their differences, and perhaps because of them, they had developed a strong bond that served them well in their navigation of uncharted seas.

Praxis as the Activist		*Theoria as the Questioner*		*Poesis as the Artist*	
Phronesis as the Juggler		*Techne as the Craftsman*		*Dialogos as the Agitator*	
		Polis as the Politician			

Figure 1. The Seven Ways of Knowing.

Looking … Back on Method

The issue of method is central to the question of how we come to know. As with all prospective doctoral students, I was required to outline my intended methodology when I submitted my application for candidacy: how was I planning to answer the research questions I had proposed? At the time, this process appeared normal. Now, however, I find myself questioning this aspect of the research process.

Scene 1

Techne: You would have to agree that it's important to have a method in mind.

Les: Well … yes … but when I look back on my research the method has progressively changed. I had initially begun with the intention of using Guba and Lincoln's (1989) hermeneutic dialectic process. I explained this in my application for enrolment in the Ph.D. programme:

> Research for the award of the Ph.D. is intended to build on the pilot study. The study will extend to a wider range and greater number of respondents to build richer understandings of the personal factors which either facilitate or inhibit change imposed at system level. Ken Wilber's work on the evolution of individual consciousness within the 4-quadrant model of the Kosmos, supported by Spillane's 6 P's Model of Teachers' Enactment Zones, provides a framework through which to investigate these personal factors… As with the original pilot study, I propose to continue with a qualitative research technique originating from the Hermeneutic Dialectic Process (Guba and Lincoln, 1989). (Pereira, Application for enrolment)

Techne: So what's the problem? That was a perfectly good method … you said so yourself.

Les: Yes … but I didn't use that process. Although it seemed right before I embarked on the research it didn't match the evolution of the study. I applied for candidacy nine months later, after having completed a doctoral level unit on constructivism and having collected 'data' for three months – my perspective had changed. I put this to Peter (Taylor, my supervisor) in an email:

> First, with respect to my candidacy application, what I have written does, on reflection, appear to be a square plug in a round hole. I understand the need to pitch the proposal carefully but it does seem as if I have tried to use a framework that doesn't fit the essence of what I am trying to do. I will rewrite, starting from the frame of reference of a 'postmodern proposal' for a postmodern world. (Pereira, Personal communication, 29 April, Year 2)

Les: I gravitated towards a phenomenological approach (van Manen, 1990) and suggested in my candidacy application that the research would proceed in three stages:

Stage 1:

- Investigation of a phenomenological methodology informed by van Manen's (1990) concept of lived experience. I will write an autobiographical account of defining moments to critically examine my own perspectives and assumptions (Brookfield, 1998). This will enable me to identify themes that may be central to others' experiences of change.

- Research theories of transformative adult education and the concept of Living Educational Theories.

- Maintain a journal of experiences with respect to leadership issues and experiences.

Stage 2:

- Identify participants and negotiate parameters of the research.

- Collect data in the form of 'lived experience' descriptions. This will take the form of participant writings, biographies/ autobiographies, experiential descriptions in literature, interview, and observation.

Stage 3:

- Data analysis (although this will be ongoing throughout the previous stages) and interpretation.

- Final writing up of the Thesis.

Techne: But that's okay. You just reselected your methodology. What's wrong with that?

Les: Remember, I was already nine months into the programme by now. And that wasn't the end of it. Later on I changed the methodology again. So … I wonder about this idea of methodology.

Phronesis: Maybe we should take a look at some other opinions? Polis, you keep an eye on these things. What is the literature saying?

Polis: Okay. Well recently Valerie Janesick has spoken about the dangers of privileging method. She calls it methodolatry:

> Methodolatry is the idolatry of method, or a slavish attachment and devotion to method, that so often overtakes the discourse in the education and human services fields. (Janesick, 2000)

Theoria: So she's not against method, as such. She's more concerned with it being some kind of fetish. Where it becomes more important than the research.

Poesis: Yes. She's recognising method as a tool… something to be used by people rather than some kind of cage enslaving them. I like that. It's an acknowledgement that research is about people's experiences of the world…

Polis: …that we should concentrate on what we find rather more than how we intend to look for it.

Praxis: So it's really a question of being critical about the idea of method…

Phronesis: …yes, more inclined to be selective about how method is used… when it is used… and to what extent it is used…Is this supported by anybody else, Polis?

Polis: Yes. Paul Feyerabend puts forward a more aggressive argument. He refers to science as a 'fairy-tale':

> According to the fairy-tale the success of science is the result of a subtle, but carefully balanced combination of inventiveness and control. Scientists have *ideas.* And they have special methods for improving ideas. The theories of science have passed the test of method. (Feyerabend, 1978, p. 300)

Les: So the process is self-referential!

> [T]his is where the fairy-tale of a special method assumes its decisive function. It conceals the freedom of decision which creative scientists and the general public have even inside the most rigid and the most advanced parts of science by a recitation of *objective* criteria. (Feyerabend, 1978, p. 303)

Poesis: It tries to remove the people aspect from the process by creating an objective methodology…

Theoria: …but fails to recognise that the methodology was created by people and so cannot be objective.

Techne: And the technique to achieve that objectivity is in the illusion of removing choice.… You don't have to select…

Phronesis: (laughing)…AND I'll be out of a job! The methodology will provide the decisions for you…

Les: Except, as Neo advised us in *Matrix Reloaded* (Wachowski and Wachowski, 2003), the eternal problem for the human condition is choice…

Praxis: So method, or technique, downplays the link between theory and practice!

Polis: …and a political power is built up because of previous successes. As Paul says:

> Basic beliefs are protected by this reaction as well as by secondary elaborations, [as we have seen], and whatever fails to

> fit into the established category system or is said to be incompatible with this system is either viewed as something quite horrifying or, more frequently, it is simply declared to be non-existent. (Feyerabend, 1978, p. 298)

[fade to black]

So there is significant concern about the idea of methodology, and in particular the dominant scientific discourse.

Scene 2

Theoria: Okay, Les so you are trying to step away from the traditional thesis structure and expose how your research evolved. Your interest is more in trying to represent the changes that occurred as you carried out the study? Do you think you can actually do that?

Les: Well, I think I can shed *some* light on the vast difference between how it could be assumed to have taken place compared with how it actually did take place.

Techne: Isn't there some danger here, though? How does the general research community look upon this kind of approach?

Theoria: Hmmm…. Is there such a thing as a 'general' research community?

Polis: I think I can help here. In my conversations with people it seems there are at least three perspectives on this. There are those who think this kind of approach is absolute bunkum…

Aside: This exposes a technical interest aiming at funding rather than a practical interest aiming at understanding?

Les: Yes, yes. I've heard that! Someone told me that qualitative research impresses your colleagues but doesn't attract research funding…

Polis: …that real research fits into the scientific paradigm. Then there is the opposite view that this kind of approach speaks to areas that cannot be explored using a scientific paradigm. A third perspective, perhaps reminiscent of the Buddhists' 'Middle Way' recognises that each has value…

Dialogos: Aristotle used to talk about the 'Golden Mean'.

Polis: Yes! And, then of course there are all those people who are splattered either side of the Middle Way, between the two extremes. So, the 'general scientific community' doesn't really exist.

[fade to black]

So if there is no 'general scientific community' it is probably true that there is no 'general methodology'…. And if this is the case, where does methodology meet the

researcher? Mills argues that 'Every man is his own methodologist!' and further, 'that methods must not prescribe problems; rather, problems must prescribe methods' (Bullough and Pinnegar, 2001).

[fade to black]

Polis: The literature presents at least one significant precedent for this concern about method and suggests another perspective:

> The assertion by Derrida that deconstruction is not a method (*'pas de methode'*) can be 'read' in a different way: 'The word *pas* in French means both 'not' and 'step', so this ambiguous phrase can be translated as either "not a method" or a "methodological step" (Freshwater and Rolfe, 2004).

Techne: Well maybe, in a similar way, the scientific method is simply a methodological step! Like a starting point worked out at the beginning of a research project simply to get things going – maybe it was never intended to be 'stuck to'. Maybe *that* is a better technique? Maybe that will lead to a more effective result?

Les: That seems to make far more sense to me. It's possible that, over time, one interpretation of 'method' has become so entrenched because of the successes of science in the quantitative domain.

Polis: Well let's have a look at what is meant by method.

> Bruce: When there is freedom from mechanical conditioning, there is simplicity. Life is a relationship to the whole.
> (Lee, 1975)

> Trevor: [Enrico] Fermi was asked by an Indian physicist, Chandrasekhar, about the process of discovery in physics, and he replied, I will tell you how I came to make the discovery which I suppose is the most important one I have made. We were working very hard on the neutron induced radioactivity and the results we were obtaining made no sense. One day, as I came to the laboratory, it occurred to me that I should examine the effect of placing a piece of lead before the incident neutrons. And instead of my usual custom, I took great pains to have the piece of lead precisely machined.
> I was clearly dissatisfied with something. I tried every 'excuse' to postpone putting the piece of lead in its place. When finally, with some reluctance, I was going to put it in its place, I said to myself, 'No, I do not want this piece of lead here; what I want is a piece of paraffin'. It was just like that; with no conscious prior reasoning. I immediately took some odd piece of paraffin I could put my hands on and placed it where the lead was to have been.
> (Leggett, 1987, p. 141)

method – 1541, from M.Fr. *methode,* from L. *methodus* 'way of teaching or going', from Gk. *methodus* 'scientific inquiry, method of inquiry', originally 'pursuit, following after', from *meta-* 'after' (see *meta-*) + *hodos* 'a traveling, way'. *Methodology* is attested from 1800. (Etymology Online, 2004)

Aside: Maybe this is what Derrida meant about Deconstruction… it isn't something you plan, it just happens.

Theoria: Meta-hodos, eh? So may be method is actually something that comes at the end of a research piece. A record of what you did rather than a plan to follow. That seems to be much better. Someone who was reading your research would surely be more interested in what you actually did rather than what you planned to do…

Praxis: That's interesting, I would agree. But that's taking an old definition, we've progressed past that and method has a particular meaning. The academic community recognises method as…

Techne: Hang on … didn't Polis say that the concept of a unified 'academic community' is flawed?

Theoria: Good point, Techne … and are you assuming an inherent value in 'progress', Praxis?

Phronesis: Yes! Remember context…

[fade to black]

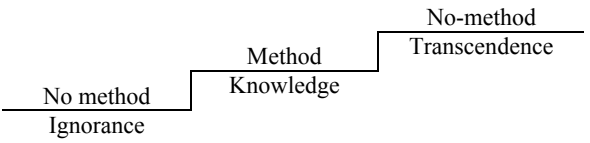
Methodology, then, on closer inspection, appears to display a number of different shades that open the door to a more inclusive construct. If seen both as a 'methodological step', as Derrida implied, and as 'following after the journey', implied by its etymological roots, then I can see a legitimate space for the methodology that has evolved throughout my research. As a methodological step, method implies a connection between the past and the future – no authoritative 'locking-in' of techniques or approaches – no 'methodolatry'. As a looking back after the journey it implies a representation of what the researcher remembers as impactful on their 'conclusions'. So maybe we need to look beyond the idea of 'method'.

An alternative construct is one that reflects the Zen traditions and the concept of 'no-mindedness'. A refusal to be 'stuck' within a particular method leads to the idea of 'no-method'.

No-method is not a denial of systematic approaches neither is it a simplistic laissez-faire attitude that accepts any approach;. Both acceptance and denial are necessary, it is the 'non-stuckness' of the researcher that exhibits an understanding of no-method. No-method exists before and after - but it is most effective during the present.

Bruce: No-mindedness is not a blank mind that excludes all emotion; nor is it simply a callousness and quietness of mind. Although quietude and calmness are necessary, it is the 'non-graspiness' of the mind that mainly constitutes the principle of no-mindedness. (Lee, 1999)

'No-method', as opposed to no method, reflects a different understanding of the concept of method.



> Bruce: There is a subtle difference between 'having no form' and 'having no-form'; the first is ignorance, the second transcendence.
>
> (Lee, 1999)

Polis: That's reminiscent of Wilber's (2000a, b) model of the evolution of consciousness. He describes three stages in the movement between levels of development: identification, differentiation, and integration.

One, the self evolves or develops or steps up to the new level of awareness, and it *identifies* with that level, it is 'one with' that level. *Two*, it then begins to move beyond that level, or differentiate from it, or dis-identify with it. And three, it identifies with the new and higher level and centres itself there. The new rung is actually resting on the previous rungs, so they must be included and integrated in the overall expansion, and that integration or inclusion is the third and final subphase (Wilber, 1996).

Polis: In terms of our focus on method, initially we have no method (or are strongly identifying with one kind of all-pervasive method), we just, uncritically, 'do'! Then we begin to identify with alternative perspectives. Consequently we begin to differentiate ourselves from the established method. Then (or simultaneously) we begin to identify with our 'new' method to the exclusion of the old. [Krishnamurti would argue that we have simply transplanted one master for another (1969)!]. Finally, we integrate our understandings and transcend previous methods.

Dialogos: What the Taoists might term 'dissolving the duality'…

Techne: Isn't that still a method?

Phronesis: Yes.… But I can see it would free me up – I wouldn't feel trapped but free to choose. I wouldn't be one method but all methods. And I guess that's the concept of transcending method.

> *Aside: This is why the Zen priests and the Taoists refuse to speak – 'The way that can be spoken is not the constant way; The name that can be named is not the constant name.'*
>
> *(Lao Tzu, 1963)*

[fade to black]

> Bruce: Because of style people are separated. They are not united together because style became law, man. But the original founder started out with hypotheses but now it has become the gospel truth and people that go into it become the product. It doesn't matter how you are, who you are, how you are structured, how you are built, how you are made – it doesn't matter. You just go in there and be that product. And that to me is not right.
>
> (Bruce Lee)

Ending the Example

This inquiry, as you can see, contributes to developing a much richer understanding of the concept of methodology. Each of the ways of knowing positioned and repositioned my thoughts bringing different facets of the concept into focus. They encouraged me to hold the crystal up to the light, to rotate it, to explore its deeper features and as a consequence, my perspective on research methodology underwent a significant transformation. Just like the snake that sheds its skin as it grows beyond the dimensions of the current 'suit', this new, revitalised understanding of method offers the promise of a richer research experience, sensitive to the newer contexts of our times.

APPROACHING FIVE THOUSAND WORDS

I am coming close to the end of my allocated space. It is a pity we could not engage in a dialogue wherein I would have gained from being exposed to your perspective. But, this could not be. So I leave you with the following.

It seems to me that a multi-perspectival approach is a powerful way to respond to the insights offered by postmodernist thought. However, there is a danger of thinking that one can get to the truth if 'enough' perspectives are gathered. But, under a postmodernist paradigm, this is a mistake. Postmodernism accepts *only* the partiality of description, and it is *with* this limitation in mind that a multi-perspectival approach has value. It promises no solution, offering only a greater understanding of complexity through the development of a wider and deeper perspective; an understanding that assists the practicing researcher. But this is my perspective. A more pertinent question for your research is: What do *you* think?

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TANYA VERNON

BEYOND BRICOLAGE

INTRODUCTION

'Have you thought how you are going to represent this?' John asked me the dreaded question again. I think this was the third time, and I was beginning to wonder why it was a grave concern of his. After some consideration, I realised at the heart of his questioning is some fundamental reasoning in qualitative research – when I know, or think I know how I am going to represent something, it is far easier to work out when I am finished collecting data and begin the writing process!

The balance between immersion in the field/data and knowing when it is time to consider representation is a kind of battle scar hard won by experienced researchers and supervisors. In recent years more and more researchers in qualitative research apply Denzin and Lincoln's (2000) concept of bricolage (see below). What is not clear is whether I, as a researcher, approach research as a bricoleur, or, during the course of naturalistic exploration of phenomena, bricolage approaches me. At my most cynical, the bricoleur/bricolage metaphor reminds me of a fifth grade rock collecting and classification assignment. Bricolage is metamorphic rock – a conglomerate of igneous and sedimentary rock – possessing no qualities of its own, just an admixture of what time and happenstance accrete.

This chapter is exploratory in nature and aims to consider issues of representation in qualitative research, particularly the use of bricolage and metaphor, with a view to developing a new way to approach increasingly complex and sophisticated data acquisition and information structures in educational research. As introduced by Denzin and Lincoln (2000), bricolage is a methodological and representational metaphor increasingly adopted by researchers who require multi-methods in conducting and writing contemporary research. The first section of the chapter, entitled 'Bricolage and Virtuality', examines the notions of bricolage, research in the next two decades and the promise of virtuality overwriting postmodernism.

The second section expands virtuality, illustrating the application of the World Wide Web metaphor as an organisational device, but also considering virtual research methodology as an evolutionary model, lifting research beyond the realm of

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 205–216.

the printed word. To achieve this, I use a case *Solving to solve* from my fieldwork with electronic engineers to virtualise research discourse. I give two examples of how virtuality overwrites postmodernism. The standards by which I judge what occurs in virtual discourse are taken from Mulholland and Wallace (2003) and presented in the final section entitled 'Legitimation of Virtual Research'. I conclude with a discussion of what I mean by beyond bricolage.

BRICOLAGE AND VIRTUALITY

Bricolage

Bricolage is a lovely French word which rolls off the tongue.

> **bricolage** \bree-koh-LAHZH; brih-\, *noun*: Construction or something constructed by using whatever materials happen to be available. (Dictionary, 2004)

Increasingly, qualitative researchers use the concept of bricolage to represent research. It has been popularized by Denzin and Lincoln (2000) who define four kinds of bricoleur – interpretative, narrative, theoretical, and political:

> The product of interpretative bricoleur is bricolage – an [emergent] construction that changes and takes new forms as different tools, methods, and techniques of representation and interpretation are added to the puzzle. Bricolage is a pieced-together set of representations that are fitted to the specifics of a complex situation. The quilter stitches, edits and puts slices of reality together. This process creates and brings psychological and emotional unity to an interpretative experience. The interpretative bricoleur understands research is an interactive process shaped by his or her personal history, biography, gender, social class, race and ethnicity. A methodological bricoleur is adept at performing a large number of diverse tasks, ranging from interview to intensive self-reflection and introspection. The theoretical bricoleur reads widely and is knowledgeable about the many interpretative paradigms (feminism, Marxism, cultural studies, constructivism) that can be brought to the problem. A political bricoleur knows that science is power, for all research findings have political implications. A narrative bricoleur knows that researchers all tell stories about the worlds they have studied. (Denzin and Lincoln, 2000, pp. 4–6)

In terms of representation and validity, Denzin and Lincoln call upon the metaphors of crystals (from Richardson, 2000), film montage, as well as the vehicle of performance texts or plays, an area in which Norman Denzin himself now works:

> Triangulation replaces validity with the simultaneous display of multiple refracted realities where readers or audiences are invited to explore competing visions of the context, to become immersed in and merge with new realities to comprehend. (Denzin and Lincoln, 2000, p. 6)

The image of scholars tirelessly piecing together multi-methods, interpretative paradigms, and a variety of narrative styles to create a technicolour dream quilt is easily envisioned. It is a metaphor which has a high degree of verisimilitude, it sounds like, looks like, it should be true. But is it? At the end of this sewing project, I am left with a quilt, a tangible thing within which I can cocoon myself and perhaps never emerge. It is still a process ending in a product to be used by someone,

perhaps only the researcher himself or herself. It is scarcely pluralistic. Performance pieces may offer greater exposure, but are potentially as esoteric. I cannot envision, for example, an anthology of the 100 best research plays. Denzin and Lincoln got it right, but restrained themselves at the final moment when it came to media type… they remained pedestrian, when in fact they could have rocketed into the virtual space of the information age. Certainly the virtual space of the World Wide Web offers far better prospects and is more a 'set of fluid, interconnected images and representations' (Denzin and Lincoln, 2000, p. 6) than a quilt. The promise of knowledge layering a web page provides 'to become immersed in and merge with new realities' (as above), suggests increasing interactivity which is only available in virtual space.

Virtuality

In 20 years, research will not be conducted as it is today. With the imminent arrival of voice over Internet, workstations will become at once voice recorder, transcription machine, and video camera. Fieldwork will take on a new meaning when it can be achieved by remote web cameras. All data, in voice, image, or text, will be available to the researcher and reader at the click of a mouse. When researchers and researched simultaneously inhabit virtual space, the concept of moving from fieldwork to field notes to text to interpretation to research report is concatenated. Interpretation is shared between researcher and user, and dialogic texts, virtual discussions will have the ability to become sacred textualities – critical conversations about democracy, race, gender, class, nation, freedom, and community (Lincoln and Denzin, 2000, p. 1048).

Concepts of virtual co-created space are not new. Any player of networked or inter-networked games such as *Warcraft* or *Battlefield Vietnam* would realise that virtual communities of global players already come together, unknown to each other, but conducting virtual relationships often as tangible, challenging, and thrilling as real ones. What sets networked gaming apart from chat rooms and e-mail (signal/response), is that it is real time, participative, and co-evolutionary. Simultaneous transactions by multiple users are not only permitted but encouraged. Players perform as characters with attributes within a range of game scenarios. Games can be saved for other occasions when the same players wish to play (to further the mission) or players can walk away from the game, allowing it to progress without them. A model of virtual gaming which exists today allows us more easily to envision a virtual research space which is created, pursued, and completed by participants. Lunenfeld (2001) noted in his collection of essays entitled *The Digital Dialectic:*

> Rather than thinking of the digital media and environments mentioned herein as though they possessed the stability of painting or architecture, better to embrace their mercurial qualities and conceptualize them as being somehow evanescent. (p. xx)

The computer, beyond film or television (media one might consider when representing research in an age beyond the seventh 'moment') creates an environment in

which a variety of PCs, mainframes, routers, servers, base stations, and satellites relay information along a seemingly limitless network:

> The computer, when linked to a network, is unique in the history of technological media: it is the first widely disseminated system that offers the user the opportunity to create, distribute, receive and consume audiovisual content with the same box. Thus, theorists have to strive to create new models of commentary that consider more than consumption or spectatorship. (Lunenfeld, 2001, p. xix)

Since the time of publication of Lunenfeld's book, the technological atmosphere itself has changed substantially, a wired world hands over to wireless space – mobile phones now relay information globally, browse the web, and deliver pictures and video. So while it is important not to 'literalise the metaphor of cyborg life' (Lunenfeld, 2001, p. xix), some future dwelling, particularly in the area of educational research, may prove a welcome diversion for those searching for something beyond bricolage, as I am.

Virtuality Overwrites Postmodernism

In moving beyond postmodernism, N Katherine Hayles (2001, p. 69) provides a definition of virtuality as the cultural perception that material objects are interpenetrated by information patterns. For Hayles, materiality and the dialectics associated with postmodernism are overwritten by virtuality:

> Similarly, materiality can be understood as being generated by dialectic of presence and absence. In each dialectic, one term has historically been privileged over the other.… Deconstruction gained theoretical leverage by placing absence rather than presence at the origin of language; the Maximum Entropy Formalism gained theoretical leverage by regarding randomness rather than patter as the generator of information. When information is privileged over materiality, the patter/randomness dialectic associated with information is perceived as dominant over the presence/absence dialectic associated with materiality. The condition of virtuality implies, then, a widespread perception that presence/absence is being displaced and preempted by pattern/ randomness. (Hayles, p. 78)

Table 1 summarises how Hayles differentiates postmodernism and virtuality:

Table 1. Postmodernism vs. virtuality (Hayles, 2001, p. 79).

	Postmodernism	**Virtuality**
Defining dialectic	Presence/absence	Pattern/randomness
Integration into capitalism	Possession	Access
Psychologic crisis	Castration	Mutation
Theoretical inversion formalism	Deconstruction	Maximum entropy
Creation of narrative	(De)Construction of Origin	(De)Construction of chaos

To illustrate how virtuality can overwrite postmodernism in education scholarship, I consider three basic tenets of qualitative research – thick description, metaphor, and the literature review. Thick description can arguably be considered the foundation of narrative and contributes substantially to evidencing quality. Metaphor contributes

both organisationally and representationally to qualitative research. Also, metaphor (lens, grain) can assist the reader organisationally as a map, in following a complex structure or ways of thinking of the scholar. Representationally, metaphors such as bricoleur, and crystal (Richardson, 2000) relate to how research is conducted (method and methodology), situated, and legitimated. Metaphor is extremely important in understanding one complex thing in terms of something more easily understood. As Bartlett and Mercer (1998, p. 636) note, metaphor is intended to '(a) make theoretical models more accessible to a variety of interested parties; and (b) make the process of thinking through such issues practical and possible, rather than mystifying and difficult.' But essentially, these two concepts, thick description and metaphor, are dualistic, where metaphor seeks to simplify, thick description seeks to expand, complicate – 'say a lot about a little' (Silverman, 1993, p. 3).

In virtuality, however, metaphor and thick description are rewritten by hypertext. With hypertext, the reader can easily read over the word OR click on it to reveal a vast network of incredibly thick definitions, descriptions. Icons serve a similar purpose. The icon I clicked on to begin this document is not the programme – the programme lives in the virtual memory of the machine, the icon is a way of representing and providing access to another thing.

I have long pondered the concept of the literature review, wondering whether it is noun or verb. How can a literature review be complete when I know that should I log-in to Taylor and Francis, Kluwer, or any number of databases I have, access to, I will locate another reference which may alter my standpoint, even if only slightly. Literature reviews are temporal. I have stopped thinking of 'a' literature review (noun) because I believe that the time-boundedness of literature reviews will disappear with virtuality. I know the beginning, but I do not know the end. That positivist vestigial which exists, persists, in qualitative research today, is replaced in virtuality by looped searching and sifting of scholarship available – literature review*ing*. The limit is access, not time.

VIRTUAL METAPHOR AND APPLICATIONS

In a sense, Denzin and Lincoln have themselves given us license to move beyond bricolage: 'If new tools or techniques have to be invented, or pieced together, then the researcher will do this' (Denzin and Lincoln, 2000, p. 4). Qualitative researchers are more lithe than scientists when faced with revolutionary/evolutionary shifts in method, methodology, and techniques in the disciplines. Hence qualitative researchers are poised to deeply engage virtuality and research opportunities presented therein. Virtually evolutionised metaphors and language increasingly pop up in everyday life, note for example the following terms: web, memory, laptop, interface, icon, disk, cookies, virus, file, server, slave, net, mouse, browser, code, floppy, and copy are just a few words which now conjure meanings vastly different from two decades ago. Consider this account of my self-image.

Tanya

In many ways, I see my life as a file. Each day the file is written over, re-created in almost exact replication of the previous day, but with perhaps a few new characters, or documents added. In such a way, new information is layered each day upon the old layer. People, situations, articles, events all are saved to the hard disk drive within me as I, like most others, question the human condition. The transparent 'saves', perhaps imperceptibly different, come to represent an image of me which seemingly stays the same but changes as new layers are saved over old ones. I am as an embedded structure. Surrounding me on the hard drive are other files, some very close to me, so close to me they contain some of the same information as I have in my file. My file is a very small file within tens of thousands of other files on hard drive, and those files situate among billions of files on the human community network. My research is another file linked to me. Sometimes, I define the research, and add new documents in layers over the old ones, sometimes the research defines me.

In this account, I utilised files, hard drives, and networks as a metaphor for my research and life. The net has replaced the encyclopaedia as a first preference search tool. To move past bricoleur and bricolage, new metaphors and perhaps methodologies are suggested. Virtual organisational metaphors such as the file, homepage, web/Internet, server, or network can be employed. Words referring to researchers might be programmemer, webmaster, virtual master, dreammaker, virtuoso, or moderator. In writing about my study group, an Australian laboratory of Ph.D. students studying electronic engineering, I might consider utilising a homepage as an organisational and representational metaphor to link the inter-connectedness of various phenomena and multi-methods (ethnography and case study), like a dreamweaver. For example, a site map can serve as an introduction chapter, at once organising the study and locating it within the wider context of qualitative research in postgraduate education and innovation in Australia. Other elements of the homepage can include (but are not limited to):

People	'Images' of the lab supervisor and each of the seven students, key informants, myself
Space and Equipment	Description and use of physical space, type and use of equipment and software
History	Genesis and evolution of the lab are discussed and the lab is contextualised within the university and wider spheres
Policies and Procedures	Written and unwritten codes for behaviour

Today most websites are primarily informational or commercial and essentially sit atop the organisational fabric of the unit they represent – a filter for the viewer to see just what and how the company wishes them to see. The day-to-day lives of the people, the politics, the strategic behaviour, and negative information such as failure of projects and people and personal conflict can only be guessed. To represent these in the thesis, I borrow the concept of *View Source*. In web browsers, this option

allows a view behind the graphical interface into the html (hypertext markup language) code. I will present numerous sections which *View Source* code, the tacit detail which contributes to the dimension, complexity and validity in the flux of the daily life of the laboratory. This may, for example, be juxtaposed to personal biographies or discussions of laboratory activity. My analysis of the phenomena can then be represented alongside the code, as textual remarks – much in the same way that programmemers remarks are embedded in programmes as guides for other programmemers on how to 'read' the code.

The best way to illustrate how this might work in a written thesis (not an actual homepage) is to provide an example. Dock is one of the students in the laboratory I studied. He came to the university to pursue a Ph.D. after obtaining an undergraduate degree from a Melbourne university. In my thesis I present an image of Dock, not a visual image, but one conjured from my field notes and interviews, a biography. The image will situate him in the laboratory, discuss his research and future endeavours; all those things normally associated with biographical detail available on the web. For example, Dock loves to solve puzzles, visual puzzles as well as mathematical ones. I call this quality 'solving to solve' and his love of puzzles will be mentioned in the biography. Dock will be given the opportunity to comment on the image I have created of him. Just after the biography I present a section of code or raw data, a discussion or activity taken directly from my field notes. Following the code, I present my remarks or analysis. Below, for example, are my notes from a conversation between Dock and another student, Safwan. They are discussing a particular optimisation problem which illustrates *Solving to solve*. I present it here as <Code> and <Remark>:

Applying the Metaphor: Solving to Solve

The following is a discussion between Safwan and Dock which occurred after Dock had solved an optimisation problem. It indicates a particular aspect of Dock's personality – namely, that he loves to solve puzzles, visual puzzles as well as mathematical ones. I call this quality 'solving to solve'

<Code>
28 July 2003, 10.45 am

Dock: Oh, by the way Safwan, I solved that problem [indicating a thin piece of notebook paper]. These mean we have N degrees of freedom. But it should be N-1, right? Z here should not be in the subspace of x — when you differentiate the signal.

Safwan: This is orthogonal to x.

Dock: No, no, no. V is orthogonal to y. Z here is to the subspace of q, which is orthogonal to y.

Safwan: I'll have a look at y.

Dock: V should be in subspace q … that is the solution … see …

Safwan: Yeah, but v is any here? It is one of the solutions. You can put a constraint.

Dock: It is actually N-1.

Safwan: You can try with a simple example and see how it works.

Dock: Yes, but we need to be explicit.

Safwan: Did you do it for work or just mathematics?

Dock: No, I will probably throw it away.

Safwan: Dock dot com.

<EndCode>
<Remarks>
23 December 2003

The above dialogue illustrates a number of important phenomena in the laboratory. Firstly, it demonstrates Dock's strong desire to solve equations/problems evidenced by his three-page solution. The optimisation problem had actually been raised several days earlier and Safwan was involved in that discussion. I don't think the solution took Dock three uninterrupted days, for him, it was just a bit of play he did when he wanted a break from something else more difficult. However, in this instance, the desire to know is compounded by the fact that the optimisation problem had been a topic of discussion in the laboratory, so some competitive pressure may have been added for Dock to solve it. Secondly, it illustrates two decidedly different approaches to problem solving. Dock worked the equation on paper and was prepared to commit to a definitive response only after he had the mathematics right. This proved to be Dock's approach to all of the signal processing problems he encountered. Safwan, on the other hand, wanted to jump quickly from equation formulation to trial with examples. If the equation needed to be tweaked later, Safwan would discover that through trial and error. This proved to be Safwan's approach to signal processing problems.

In the end, Dock did throw away the three transparent pages of notebook paper. I quickly asked for them as artefact. When Dock said he would throw it away, Safwan affectionately (as I came to discover) said 'Dock dot com'. This was Safwan's way of affirming that throwing the paper away was in 'character' for Dock. Safwan did this frequently when people in the lab behaved in 'character'.

<End Remarks>

The fact that Safwan speaks of people as websites seems particularly relevant in my discussion today and while the above is a print representation of how, using virtual metaphors and organisational devices I can represent my thesis, research in virtual space will become more and more prevalent in the future. Imagine for example, how much richer my data might be if the biography of Dock, transcript (or even actual conversation) and analysis are posted to a web page for him to check and respond? If both Dock and Safwan respond to my recorded dialogue above and my 'remarks', and

I subsequently publish their response and my reaction to them, how much more complete is our 'audit' trail?

Virtuality is not just a place for cyber punk gamesters. It will be a non-print bound virtual space only dreamt of by Denzin and Lincoln: '[A] reflexive collage or montage – a set of fluid, interconnected images and representations.… This interpretative structure … [is] a sequence of representations connecting the parts to the whole' (Denzin and Lincoln, 2000, p. 6). But how do we judge the quality of this research? For this, I shall turn to Mulholland and Wallace's (2003) concepts of legitimation of research texts using the ideas of strength, sharing and service.

LEGITIMATION OF VIRTUAL RESEARCH

In writing a research diary recently, I reflected how each new day of my quest for knowledge brought me to the world anew. Sometimes I would reread journal papers three or four times, several months apart. I was constantly amazed as to how a paper spoke differently to me each time. What it meant was that I had changed, I accommodated information between then and now that allowed me to view the article through a new frame of reference. But then I noted the analogy with websites. They are the same, yet each day different – sometimes only a small detail is changed such as when as people move, but also, new documents are added and material is moved. Doing a survey of Australian university web-based postgraduate policy some months ago, I discovered differing webstructures, each with slightly different meta organisational tools (icons) taking the user to various locations where knowledge should be. But with some basic 'rules of thumb' derived heuristically, I very quickly noted patterns, not randomness and honed my search technique. In short, I was surprised at how different, yet how similarly each university conceived of their postgraduate student policy.

It is in virtual space that I see a concept of knowledge accommodation that actually mirrors life. Life is constantly updated, refreshed, rewritten – only in a virtual world can research be constantly (not incrementally) updated. If I suggest a virtual research space as above, where Dock and Safwan can comment online on the images I have created of them, have I considered by what criteria my research can today be judged? What about tomorrow? Vidich and Lyman conclude that 'a new outlook of epistemology has come to the fore. It disprivileges all received discourses and makes discourse itself a topic of the sociology of knowledge' (Vidich and Lyman, 2000, p. 39). Virtuality presents an opportunity for such discourse. When research discourse materialises into the virtual world, quality criteria will centre on authenticity. How can I be sure that it is a picture of Dock, that he really spoke those words? Authentication validates – servers, networks, accounts, logins, people. In a postmodern research space, authentication abstracts legitimation. Let me illustrate how Mulholland and Wallace's (2003) concepts of legitimation of research texts can be applied to the above (hypothetical) case where Dock and Safwan are allowed virtual discourse with me about the 'images' I create of them in storying *Solving to solve* and the subsequent analysis of their dialogue.

Mulholland and Wallace's first criterion – truthfulness or strength, relates to the 'use of multiple data sources, participants sharing in the interpretative process, presence of the researcher's voice, and documentation of researcher subjectivity' (p. 7). If virtual research retains virtual discourse of participant and researcher as fundamental, then it cannot help but meet this first criterion. However, it is important for the researcher to clearly document for the reader the actual process he or she went about in setting up the virtual discourse, what were the goals, rules, etc. and what worked and what did not work. Is the web discourse itself enough? Should it be framed pre-discourse and analysed post-discourse for it to contain elements fundamental to research? If discourse is privileged over all, can it stand alone as virtual research?

The second criterion, sharing, as suggested by Mulholland and Wallace (2003) refers to validation or legitimation that is won from the reader. They refer particularly to the point I have just made regarding the need of the 'image', in this case of Dock and his penchant for *Solving to solve*, to be a whole research story, with appropriate framing by the researcher. In this way, and combined with the transcript of the conversation and Dock's, Safwan's and my comments/analysis, the virtual discourse is deeply contextualised and leads to believability or vraisemblance. However, in order to enhance plausibility, the researcher should ensure that web discourse should always contain date and time stamps, for example.

The final criterion, service, as suggested by Mulholland and Wallace is concerned with the outcome or purpose of the study and related ontological and educative authenticity. They note:

> The text needs to be a social experience in which the researcher assists others to construct knowledge by describing a case in such a way that the reader makes useful comparison. We consider that this final set of criteria is related to the benefit or service provided to an area of human endeavour by research (Mulholland and Wallace, 2003, p. 9).

In terms of how to judge a piece of research on the service criteria, Mulholland and Wallace suggest a testimony of respondents, ethnographic case study, and an audit trail. As these are 'core business' for a virtual research project as hypothesised in *Solving to solve*, it cannot help but meet the criterion. But again, the virtual researcher must be ever wary of the perception that what is created on the web is a fantasy, a fiction of the creator.

Reducing the researched and myself to 'objects of the researcher's gaze' (Louden and Wallace, 2001, p. 68) in a virtual space where anyone with net access and a PC can stumble across it presents a dilemma. When Dock, Safwan, and I, and any other genuine web researcher/researched hang there openly in virtuality, could we not become a kind of sideshow, with sundry onlookers able to gawk and point and giggle? Shouldn't research only be consumed by the like-minded researchers who are able to bring appropriate experience and knowledge to the virtual space? Perhaps access to virtual research can be limited somehow? But if restrictions are placed, what becomes of our original notions of a more pluralistic research space so desired by Lincoln and Denzin in the seventh 'moment':

> In the seventh moment, the means (methods) of social science are developed, refined, and cherished for their contributions to communities characterised by respectful and

> loving difference, social justices and equal access to material, social, educational, and cultural capital (the ends of ethnography). (Lincoln and Denzin, 2000, p. 1062)

And when access is limited, legitimation, and therefore authentication fails! So while some indicators suggest we cannot risk research transcending to a virtual space, where works like (the hypothetical) *Solving to solve* could be given the status of fantasy, fiction or worse, ridiculed, we cannot risk remaining bound in our terrestrial, print-based bricoleur. Schön elegantly summarised practice as 'a successful reframing of the problematic situation leading to a continuation of the reflective conversation' (Schön, 1995, p. 136). The aim is to keep inquiry moving, so when today I suggest a move beyond bricolage, I accept and even insist that tomorrow will herald the rewriting of quality criteria.

CONCLUSION

The discipline and practice of education research is well situated to embrace virtuality. As I have noted, bricolage currently allows researchers the freedom to approach research from a variety of epistemologies, methodologies, and methods, allowing multiple representations. Today's educational researchers are adept at 'cultural border crossing' to incorporate aspects of anthropology, sociology, psychology, metaphysics, phenomenology, constructionism, postmodernism, constructivism, feminism, critical theory, queer theory, testimonio, grounded theory, action research, represented by narrative, performance, poetry, autoethonography in education research. John, my supervisor who asked the dreaded question about representation, also talks about 'working the hyphen'. Working the hyphen seems to mean different things in different contexts, but mostly it encompasses the concepts of educational researchers *as* practitioners. Schön, like Denzin and Lincoln, gives us license to shape our practice:

> [The inquirer] shapes the situation, but in conversation with it, so that his own models and appreciations are also shaped by the situation. The phenomena that he seeks to understand are partly of his own making. (Schön, 1995, p. 151)

Indeed, practice in virtuality is a situation imbued with new meaning and may challenge the nature of questions to be explored (Schön, 1995, p. 151). Even as I completed this chapter, my colleague Vaike Fors drew Pink's (2002) text concerning visual ethnography to my attention as we discussed issues relating to digital representation. Certainly the time has come to consider how educational researchers will write, inscribe themselves in the future by embracing the simultaneous participatory digital media as research place, research method and virtuality as an epistemology that is beyond bricolage.

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BAL CHANDRA LUITEL

STORYING, CRITICAL REFLEXIVITY, AND IMAGINATION: A TRANSFORMATIVE APPROACH TO RESEARCH AS/FOR CULTURALLY CONTEXTUALISED PROFESSIONAL DEVELOPMENT

FOREIGN MATHEMATICS

'Wake up. It's morning.' My mother's voice awoke me. It could be any morning in March 1980. The vernal morning was very beautiful with yellowish-red horizons and dark green eastern landscapes. Sitting on a table-like mat-covered wooden bed and viewing the northern cascade horizon of the grassy Mahabharata mountain range, I reluctantly opened my mathematics homework book. The pages were distracting me from being within this space. My pen was less interested in writing mere numbers than drawing 'the Devanagari One', a creature symbolised as a representation of local gods and depicted as a person without hands and with a single leg. 'How might the one-legged creature travel around?', I murmured to myself. 'Could "the one" speak to others? If trees and mountains could communicate to each other, why couldn't "the one" speak?' Unwillingly, I saw my pen begin to write 'answers' to the arithmetic problems. However, I felt barely connected with the answers. Instead I was situated aside from them, a disinterested stranger who wanted to know something different.

I had finished everything by eight. However, I was not enthusiastic enough to say: 'I have finished my homework … hurray!' I did not have as much fun doing mathematics as I did when reading the story of an eight-year boy who had a good time with his friends: crow, camel, elephant, mountain and tree. I used to find myself within the story talking with these friends. Recently, whenever I opened my mathematics book, my brother's answer –…'Because it is foreign therefore it doesn't have any stories'– to my question—'Why are there no stories in my mathematics textbook?' – echoed in me frequently. However, I had not seen any foreign creatures until my childlike drawing of an imaginative giant with a big head and eye.

P. C. Taylor and J. Wallace (eds.), Contemporary Qualitative Research: Exemplars for Science and Mathematics Educators, 217–228.

'A flower garland for the storyteller and a gold garland for the story listeners' is a famous Nepali adage spoken at the end of each storytelling ritual. It indicates the value of telling stories in our cultural context. It also indicates the value of reading and interpreting others' stories, as the listener is supposed to be awarded a gold garland. With this inspiration, my initial narrative journey starts with a story about my experience of primary school mathematics. Gradually, I create an impressionistic plot with a special focus on my theme – *foreign mathematics* – that emerges from my experience. Perhaps, it depicts my predisposition towards the way I had been taught mathematics in my school education. In the very beginning of my exploration, I wish to raise a number of questions: Why did I raise this issue? Why did I write this particular story?

Standing upon different nodes of time, I am using narratives to connect between past, present, and future; between yesterday, today, and tomorrow; between birth, life and death; and between many dimensions, facets, and incidents. In doing so, a thatch-roofed and local brick-constructed four-roomed hut appears on my memory screen, bringing forth images of the corn and cattle farm situated in the northern part of the school and the south-eastern oval from where as children we viewed the majestic scenery of the eastern Mahabharata hills. During March and April, the place was so beautiful with skeleton-like deciduous trees sprouting new leaves. It seemed that many migrating birds were inviting us to play games of hide-and-seek.

The school's interior was not as beautiful as the outside. It was not only because of uneven floors, old wooden benches and desks, wooden blackboards, broken windows, a roof with cracks, but also because of the *number-crammed* mathematics lessons. During the first year of my schooling, at age 6, I had to remember number names and multiplication tables, and perform simple addition, subtraction, multiplication, and division related to *no-word-problems* of the appended exercises of each lesson. Perhaps, I would have been happier had I been assigned to count the cattle at the nearby farm. Perhaps I would have learned more meaningfully if I had been asked to find the total number of pebbles in two bins kept in the classroom. There was many a mismatch between the world of a 6-year-old child and the world of adult-oriented mathematics.

Once, my teacher asked us to write the word *unit* in the top right cell and *ten* in the left one. He told us to follow the example in order to write all the given numbers in tabular form. I drew many tables and put numerals in places labelled unit and ten, but I didn't understand why the unit-placed three was smaller than the ten-placed two in 23. In retrospect, I can see that writing numbers was an act that was independent of knowing numbers in context. We did not have *base ten blocks* or *Cuisenaire rods*, nor did we have expensive *counters*. Instead, our school used locally available materials – wooden blocks, used matchboxes, small pebbles and used paper – to develop our number sense. But more importantly, there remained an unfulfilled need to bring mathematics in from outside the textbook and the four walls of the classroom – Nunes, Schliemann, and Carraher (1993) called this *street mathematics*. In my experience, the wide rift between street and school mathematics dispelled the image of mathematics as a *we-friendly* subject.

Searching for possible reasons for my brother's declared image of school mathematics as 'foreign' takes me once more into his bookcase, with *Hall and Knight's Geometry*, *Ganguly's Algebra*, and many other high school textbooks. Perhaps, he was not taught that mathematics could be constructed from our day-to-day life experiences. Perhaps, he was taught that mathematics needed to be learnt from voluminous books written by foreign authors. His *would-be* foreign image of mathematics might have been strengthened further during the ten-month teacher-training programmeme he completed in the mid-seventies. Presumably, the training was organised in a resource-rich setting aimed at enhancing village teachers' practice by enabling them to use experts' imported knowledge.

(Luitel, 2003, pp. 12–14)

INTRODUCTION

This is one of 20 sets of stories and accompanying interpretative commentaries that I wrote during a year-long inquiry into mathematics education in Nepal (Luitel, 2003; Luitel and Taylor, 2006). The stories were constructed from my experience of being a student at primary school, high school, and university, and from my subsequent observations of teaching and learning in schools throughout rural Nepal. My inquiry focused on the problem of the rampant Westernisation of mathematics curricula in Nepali schools. The inquiry grew out of my professional experience as a mathematics teacher educator in which I faced the dilemma of serving an elite (Anglicised) education system that was striving to prepare the country for participation in the global economy whilst, at the same time, witnessing widespread underachievement in mathematics classrooms throughout Nepal. I attributed this outcome in no small way to the cultural irrelevance of imported mathematics curricula and textbooks.

Situated in a graduate centre of mathematics education at an Australian university with no prospect of returning to Nepal to 'collect data' on this problem, I made a strategic choice of research epistemologies. In the belief that the positivist research tradition, with its embedded Western values, would not help promote a multi-layered understanding of my professional practice and cultural situatedness, I chose the paradigm of qualitative-interpretative inquiry to explore the problem of the culturally decontextualised nature of Nepali mathematics education. I drew upon the emergent Arts-based movement in education research (Eisner, 1997), and combined aspects of *autoethnography* and *writing as inquiry* (Ellis and Bochner, 2000; Richardson, 2000) to help unfold and examine critically my experience of key moments of pedagogical importance during my life. In representing my experiences, I made use of autobiographical, storied, poetic, theatrical, and dialogic genres to create data texts and reflective-autobiographic genres for writing subsequent interpretative commentaries.

Subscribing to the notion of *critical reflexivity* (Gergen and Gergen, 2000), which liberated me from any illusion of a crisis-free professional context, my research journey continuously focused on relationships, contradictions, and the transformative possibility of my thinking and actions. In the process, I used the metaphor of *writing as envisioning* (Henderson and Kesson, 2004) whilst

constructing my stories and their commentaries. Indeed, the imaginative approach of linking aesthetics with inquiry opened up new avenues for developing my *theoria* (which helped me dream future possibilities), my *phronesis* (which helped generate my practical wisdom for making decisions about day-to-day professional realities), and my *praxis* (which unfolded existing power relations of domination and oppression in my lived experience) in preparing my transformative actions. Given these modes of inquiry, I developed research standards aligned with the idea of invoking my readers' *pedagogical thoughtfulness*. I used Max van Manen's (1990) four criteria for judging pedagogical texts: (i) *orientation* – the extent to which my lived reality is oriented towards addressing my research questions, (ii) *strength* – the degree to which my texts create a pedagogically dialogic relation with the intended readers, (iii) *richness* – the extent to which my stories are richly represented, and (iv) *depth* – the degree to which the explanatory dimensions of my situatedness are represented to evoke readers pedagogically.

It is my purpose in writing this chapter to outline important aspects of the process of transformative professional development that I undertook and to address the issue of the legitimacy of this form of research. I refer to powerful qualitative research movements that promote epistemological deregulation, especially the seventh 'moment' of qualitative research (Denzin and Lincoln, 2000) and the seven inquiry modes of 'curriculum wisdom' (Henderson and Kesson, 2004). The former offers a space for researchers to engage in artful inquiry and moral discourse, developing their praxis as agents of social and cultural transformation. The latter offers a space of exploration and envisaging conducive to addressing Parker Palmer's (1998) question: 'Who is the self who teaches?'

Given this, I begin this brief journey with an account of my emergent research questions. Next I explain how several theoretical referents enabled me to practice critical reflexivity as the main tool of inquiry.

MY EMERGENT RESEARCH QUESTIONS

My inquiry did not begin with predetermined, fixed and value-free research questions; instead, I strove to articulate a personal dilemma from which my research questions could arise. Unlike in positivist research, my dilemma was initially vague, implicit, and difficult to reduce to a single problem statement. A couple of questions can be raised here: How did you start your research without a fixed set of research questions? Would it not lead you to the position of going nowhere? I started my inquiry with the elusive goal of exploring the extent to which Nepali mathematics curricula are (and should be) culturally contextualised. Sharing my educational (hi)story with my supervisor led me to uncover a dilemma I had faced during my primary school days when I had asked my elder brother, 'Why are there no cultural stories in my mathematics textbook?'.

As I moved on with this dilemma, I explored many possible research questions. Such questions were related to my practice, to my situatedness which framed my pedagogical perspectives, and to my views of others – teachers, students, curriculum experts, and so forth – regarding their pedagogical standpoints. You (the reader) may raise a couple of questions: Did you initially

categorise your research questions? What was their structure? No, I did not categorise them, rather I let them unfold and I integrated them within the 'diachronic representational structure' of my research writing (Stapleton and Taylor, 2003).

As my research questions have a (subjective) (hi)story, you may be curious about *the* beginning of my research questions. However, I perceive many beginnings: the beginning of my educative life, the beginning of my subservient acceptance of Westocentric knowledge, the beginning of my critical thinking, and many other beginnings. Indeed, as I started to design my research proposal I tried to squeeze my many beginnings into one. More than that, I attempted to unearth a *holy grail* for making a single question for my autoethnographic inquiry. At times, I became frustrated because of the ever-developing and crisis-laden nature of this cutting edge of research practice which hardly prescribes anything for the research community. The *context-based-ness* of exemplars that I read rarely spoke to my specific research needs (Ellis and Bochner, 2000). Perhaps, because of the *meaning-is-out-there* metaphor rooted in my thinking, I was trying to find ready-prepared research questions for my self-study research.

The developmental history of my research questions is worth portraying here. To me, the ritualistic tradition of the positivist 'jigsaw puzzle' – research problem, objectives, hypotheses, methodology, results, conclusions, implications – is rampant in our educational research tradition. Although I was desperate initially to write a simple, linear, and monovariable research question, my supervisor did not express dissatisfaction with my inability to do so; instead, he insisted that I continue to focus on my research problem which concerned the lack of cultural context-ualisation of mathematics.

In desperation, I read Clandinin and Connelly (2000) in order to make sense of criteria for good narrative research questions. They mention that narrative research questions should possess the qualities of being represented in multiple dimensions: what? how? and why? This reading reassured me that I was not going in the wrong direction nor was I making the serious mistake of 'going nowhere' by refusing to subscribe to a history of research questions as fixed, momentumless, and static. Indeed, such traditional research questions hardly allow researchers to be reflective or reflexive throughout the process of their inquiries.

Rather than drawing a one-sentence conclusion for each of my research questions, I regarded them as evolving foci of my inquiry. Therefore, in each chapter of my research report I constructed answers to my unfolding questions, such as: Why did the *algebra* not include local materials? Did I choose mathematics to be an autocratic teacher? Why did my teacher not include a Shanai (a Nepali musical instrument) to illustrate the concept of pseudosphere? In constructing answers to these questions, I also raised plenty of other questions. Towards the end of my research writing, I asked myself: Why don't I just end my research without summarising the research questions? However, I realised that such a list would be helpful to my readers, and so with hindsight I distilled them into the following three.

1. To what extent do the school mathematics curricula of Nepal incorporate Nepali contexts within the subject matter?

2. To what extent do Nepali mathematics teachers embed Nepali contexts in their teaching practices?
3. In accordance with various curriculum metaphors, what are the prevailing images of mathematics curricula in Nepal and what culturally contextualised images might be possible?

MY MULTIPLE THEORETICAL REFERENTS

I prefer to use the term 'referent' (Tobin and Tippins, 1993) rather than 'framework' to describe the role of theory in my inquiry. I feel that the rigidity of a framework does not allow me to move from one perspective to another in order to uncover multiple truths of a social reality. Perhaps it is worthwhile mentioning the popular adage, 'to think outside the box', which urges me to be perspectival rather than to be caged within the frame of *out-there ideas*. Given the emerging nature of my inquiry, which aimed at liberating my uncriticality, I needed to use different theoretical perspectives in a way that did not overshadow my reflectivity.

Although many educational perspectives shape my educational values and ideals, in this inquiry I made use of five powerful perspectives – Curriculum Images, Critical Constructivism, Critical Ethnomathematics, Multiple Epistemic Metaphors and Geometry Theory Model – as key referents for both generating the stories (or data texts) that I wrote and for my subsequent interpretation of them.

Curriculum Images

I used Schubert's (1988) notion that curriculum can be perceived better by images than propositional definitions. I took into account different metaphorical images of curriculum – *subject matter, planned activities, intended learning outcomes, cultural reproduction, experience, discrete tasks and concepts, agenda for social reconstruction, currere* – in order to appraise my teaching-learning practices. I used these images, together with other images that I constructed imaginatively, to depict *qualitative maps* of school mathematics curricula of Nepal.

Critical Ethnomathematics

In my inquiry, the notion of ethnomathematics served to uncover the relationship between culture and mathematics (D' Ambrosio, 1999, 2000; Pinxten, 1994). Ethnomathematical perspectives have been contributing to a transformation of the traditional concept of a Eurocentric and monorepresentational system of mathematics towards context-based and multicentric concepts (D' Ambrosio, 2001). Ethnomathematics does not study only the number systems and symbols of different ethnic groups but also the representational systems of their mathematical knowledges. For instance, some cultures deal with logico-mathematical knowledge whereas others subscribe to narrative, paradigmatic, and structural knowledge (Seeger, 1998).

Blending it with criticality, I employed the notion of ethnomathematics to reflect on my experiences of the cultural context of mathematics teaching, learning,

and the nature of the discipline and to critique the perspective of a culture-free knowledge tradition (Clements, Grimison, and Ellerton, 1989). Furthermore, I employed a critical pedagogical perspective (Skovmose, 1994) to demonstrate transformative alternatives to authority-centred, hierarchical, and repressive mathematics. As my educative experiences include rampant Westernisation (or Anglicisation) of mathematics curricula, I used this theoretical referent as a lens through which to view critically the way this tradition promotes monocultural perspectives through the politics of knowledge selection (Huntington, 1997). In essence, the notion of critical ethnomathematics served my inquiry as one of the perspectives for constructing a culturally relevant mathematics curriculum image.

Critical Constructivism

My understanding of the basic notion of constructivism is: to construct knowledge actively from the milieu rather than to receive knowledge from it (von Glasersfeld, 1995). Viewing multiple forms of constructivism and their different purposes led me to subscribe mainly to radical and critical constructivism as referents for my inquiry. Taking radical constructivism as a referent, I used my own culturally situated experiences to construct and frame my perspectives on the nature and images of Nepali school mathematics curricula. By embracing critical constructivism as a referent, particularly the three knowledge-constitutive interests of Habermas, I was able to interrogate the sociocultural contexts of mathematics knowledge construction (Grundy, 1987; Taylor, 1998, 1996) and deconstruct the cultural situatedness of my educational experiences. In essence, critical constructivism served as a referent for advocating cultural reform of Nepali mathematics curriculum practices.

Multiple Epistemic Metaphors

Metaphor played an important role in my inquiry process. I utilised Lakoff and Johnson's (1980) notion of metaphorical knowing with a view to uncovering the layered, hidden, and implicit meaning of my cultural situatedness. I used a number of metaphors to depict multiple ways of knowing: *phronesis* (practical knowing using personal practical wisdom to make moral judgements), *poesis* (knowing as aesthetic making), *storying* (knowing through storied narrative), *deconstruction* (ironic critique, decentring the meaning of texts), *interpretation* (developing the scholarly significance of my literary texts), and *reconceptualising self* (exploring self-identity by reflecting critically on my lived context). Perhaps it is apposite to mention how these sociolinguists construe metaphorical knowing in their book *Metaphors We Live By*:

> [M]etaphor is not merely a matter of language. It is a matter of conceptual structure. And conceptual structure is not merely a matter of the intellect. It involves all the natural dimensions of our experience, including aspects of our sense experiences: color, shape, texture, sound, etc. These dimensions structure not only mundane experience but aesthetic experience as well. (Lakoff and Johnson, 1980, p. 235)

A question may be raised here: Why was metaphorical knowing more appropriate than literal knowing for your research? The purpose of my inquiry was not only to produce an answer to each of my research questions but also to uncover deep meanings of my experiences. In my research, epistemic metaphors were embedded in the process of inquiry as a means of uncovering noteworthy, unforeseen, and unanticipated multiple truths of my educative world.

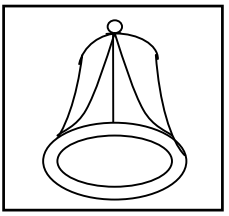
Geometry Theory Model

The Geometry Theory Model of Kawasaki (2002) served as a referent to sensitise my inquiry to the cultural and lingual incommensurabilities between Nepali and English world views. I used this model to analyse prevailing incommensurabilities between the official Eurocentric mathematics tradition within Nepal and an imagined multicentric perspective that is sensitive to a range of cultural beliefs, values, practices, and symbologies found throughout the country.

The following story, *Bell, Parallel*, *and Perpendicular Lines*, and subsequent interpretative commentary represent a section of my research writing that demonstrates how some of my theoretical referents were used to promote my critical reflexivity.

Bell, Parallel, *and Perpendicular Lines*

> 'These are parallel lines', Dharma continues to explain to the class, 'Because they never meet if they are produced indefinitely'. Sitting on the last bench in the grade-six room of Mahendra Middle School, I am making notes of the classroom activities – a day-to-day routine of classroom observation. 'Why is he explaining all this stuff rather than conducting a discussion?', I murmur to myself. However, it is not time to comment about his teaching. I make a note for post-conferencing: 'too much teacher talking'.
>
> 'Why don't I tell him that his teaching is too bad? Why don't I conduct an exemplary activity?' A wild idea appears in my thinking and goes quickly as my superego suppresses the egocentric ideas. Again, Dharma seems to be less confident about his teaching. I make another point: 'lacks clear explanation'.
>
> It seems to me that Dharma is trying to read my face. Perhaps, he reads that I am not happy with his activities. Gradually, he moves to each student and starts to ask him/her to define parallel lines.
>
> 'They never meet when extended.'
>
> Most of the students reproduce the definition. However, Dharma himself seems unclear about the pedagogical purpose of the definition. It seems to me that he is trying to prove that his students can absorb his definition. I make another note: 'more like a deductive approach'.
>
> After a brief 'class-work activity', Dharma opens the 'math textbook'. 'We will start a new topic', Dharma informs them. Some of the students seem to be busy talking with their bench-mates. A nearby student, who is sketching something, draws my attention. 'What are you drawing?', I ask quietly. 'This is a bell', replies the student.



Dharma starts to teach the new topic of 'perpendicular lines'. I again look at the boy's drawing. He draws two concentric circles depicting the interior and exterior edges of the bell. As Dharma asks all students to be quiet, the boy raises his hand and invites his teacher. I am rather curious. 'Are these two lines parallel, sir?', the boy asks pointing to the picture. 'They are not lines. They are circles. This is out of the topic', Dharma replies. 'But they never meet sir!', the boy contests again. Dharma returns to the blackboard. The boy now gives a final touch to his drawing by sketching some vertical (cf. perpendicular) lines connecting between the node and the circular edge of the bell. Perhaps, he will contest again why the vertical lines are not perpendicular to the edge of the bell.

My purpose in writing this story was to depict my extensive experience, as a teacher educator, observing lower secondary mathematics classes, most of which tend to be 'teacher-probed' student-centred rather than dialogically student-centred. I admit that the story is imbued with my 'present perspective' and that it represents my predisposition towards the nature of teaching and learning. It would be equally true to me that we all have biases and dispositions. However, I hold the view that we need to use our biases and dispositions for the well-being of as many people as possible.

My story attempts to situate the typical classroom context in a 'bigger picture'. In saying so, I need to point out that most of the classroom activities I observed were guided by externally mandated curricula and textbooks. In the textbook there was no bell and there were no examples of *concentric (curved) parallel lines*. Perhaps, the teacher was oriented to following the curriculum document as though it was the only goal of teaching. However, a creative teacher could think beyond this *slim document* in order to address the complexity of teaching. He or she could take many emerging issues into account in order to make their teaching more student-oriented. For example, He or she could take the students to a Hindu temple to study the geometric properties of the bell; or to visit a Buddhist temple to observe Buddha's symmetrical face. In essence, a creative teacher could conduct many culturally meaningful activities regardless of the prescriptive, monological nature of the curriculum process.

In rereading the story, I revisited my role as a teacher educator and asked some critical questions of myself. Was my role adequate for improving the situation? How did I help the teacher to be more inclusive and dialogical in conducting his activities? To what extent did teachers benefit from my ways of supporting them? I could claim that my activities were excellent; and I could bring many *proofs* to illustrate my superiority. However, I chose to read the story differently. I tried to reveal my weaknesses in my situatedness, as well as my strengths. I reflected upon

the unworkability of some of my suggestions in the classroom contexts as well as my successes in adapting new approaches in collaboration with local teachers.

At this stage, I am interested also in uncovering my multiple roles as a reader. Perhaps, my primary role as a reader is to critique authoritarian classroom landscapes and to suggest alternatives. Similarly, I have to take into account students' powerlessness because of the seemingly expert- and teacher-oriented knowledge-constitutive interests. Reflectively, my own institutional power could also be (implicitly) playing a role in establishing control over the classroom activities, as evident by the teacher looking suspiciously at the observer's face. However, the power of my gaze was directed less at indicating my own authority and more at considering improvements in teaching.

CONCLUSION

At the end of my inquiry, a retrospective crystallisation of three emergent research questions constituted a type of conclusion. However, these questions (per se) do not tell the entire history of my inquiry which detoured through multiple twists and turns. To me, representing the conclusion of an emergent qualitative inquiry is crisis-laden. Given this perspective, I drew two types of conclusion.

First I confirmed that the chosen research methodology of critical autoethnography helped to liberate me from conventional pedagogical and epistemological perspectives. Arriving at the final detour of my research journey, it was clear to me that my future pedagogy, as a mathematics teacher educator, will be more contextual and transformative so that my students are able to transform the uncriticality embedded in their own epistemologies and pedagogies.

My second conclusion was more ritualistic in the sense that I chose to address the three crystallised research questions. In answering the first and second questions – *To what extent do the school mathematics curricula of Nepal incorporate Nepali contexts within the subject matter?* and *To what extent do the Nepali mathematics teachers embed Nepali contexts in their teaching practices?* – I summed up evidence from the various research texts I had written and concluded that (i) very few of the curricula under which I had studied and taught had included Nepali contexts and (ii) very few of my teachers had tried in any way to contextualise mathematics in their classrooms. However, my answers to these questions were not presented as a set of generalisable findings; instead they signify my professional understanding and concern about the extent to which Nepali mathematics curricula are not contextualised in relation to Nepali culture.

In answering the third research question – *In accordance with various curriculum metaphors, what are the prevailing images of mathematics curricula in Nepal and what culturally contextualised images might be possible?* – I constructed two 'qualitative maps' of Nepali mathematics curricula on the basis of my imaginative understanding of various curriculum metaphors. To me, curriculum as discrete tasks and concepts, curriculum as subject matter, curriculum as cultural reproduction, curriculum as authors' texts, curriculum as silence, curriculum as centrally prepared documents, and curriculum as power imposition are metaphors that are constitutive of conventional curricula images found throughout Nepal's

educational institutions. By contrast, curriculum as activities, curriculum as experience, curriculum as currere, curriculum as cultural reconstruction, curriculum as dynamic text, curriculum as voice, curriculum as local enactment, curriculum as power sharing, and curriculum as learning outcomes are potentially transformative curricula images that can help legitimate the cultural contextualisation of Nepali school mathematics.

In a nutshell, this type of research is worth undertaking for a practitioner who wishes to transform her/his own pedagogical practice. Specifically, my inquiry made me critically aware of my lived reality and helped me to understand various paradoxes inherent in my pedagogy. I end with two reflective questions for my reader. Can this type of research be used elsewhere to sensitise other professional educators to rethink their own pedagogical practices? Does this type of research help sensitise other researchers to alternative 'liberating methodologies' (Smith, 2001) which make research more immediately meaningful, useful, and readable?

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Adrienne T. Gibson is an adjunct faculty member in the school of education at Capella University in Minneapolis, USA. Recently retired from public education she also serves as science curriculum coordinator in the Arizona school district where she was employed for many years. Adrienne began her career as a middle school teacher and later taught at the high school and community college level, as well as serving in district staff development and as both a high school and middle school principal. Although presently not involved directly in research she maintains strong interest in curriculum and instruction.

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The Reverend Georgina Hawley is principal lecturer in the School of Health and Social Care at Oxford Brookes University, Oxford, England. A qualitative researcher, she specialises in the areas of professional development of health professionals, client and patients' experiences of health problems, and spirituality in relation to health problems.

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David Lloyd is a lecturer in science education at the University of South Australia in Adelaide. David has spent much of his teaching career as a senior secondary chemistry teacher and middle school educator in country and city schools in South Australia. His research interests focus on young people's images of possible futures and pedagogical issues in science learning.

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Bal Chandra Luitel is an Assistant Professor in mathematics education at the University of Kathmandu, coordinating the master's programme within the School of Education. Bal Chandra uses the research metaphors of *professional development*, *reconceptualising self* and *inquiry as life writing*. He has been involved in qualitative research based intervention projects funded by UNESCO Kathmandu, Department of Education Nepal, Norwegian Agency for Development Cooperation (NORAD) and the University of Kathmandu.

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Kwena Masha teaches mathematics in the foundation year programme at the University of Limpopo in South Africa and supervises students undertaking honours and master's studies in mathematics education. He worked as a secondary school mathematics teacher and was head of mathematics at a teacher training college before moving to his current position at the end of 1996. His research interests include qualitative accounts of classroom learning environments, and classical, current, and emerging theories of learning.

Masha, J. K. (2004). *Creating a constructivist learning environment for meaningful learning of mathematics*. Unpublished doctoral thesis, Curtin University of Technology, Perth, Western Australia.

Catherine Milne is Assistant Professor in the science education programme within the Department of Teaching and Learning at the Steinhardt School of Education at New York University. After teaching in high schools for almost 15 years, Catherine left teaching in the Northern Territory of Australia in order to study questions about the philosophical and historic origins of school science. Her research interests include urban science education, the nature of representations in learning science, the nature of self-assessment, teaching, and teacher education, and the role of history and philosophy of science in school science.

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Russel Montgomery is a middle school teacher at Carey Baptist College, Perth, Australia. His particular focus is education as social process; the socialisation of the individual and the social matrix of education. Over the last decade he has faced the rigors and joys of being househusband, parent in community and teacher. This multiplicity of roles has given him a deep appreciation of the context of human development: community. His current interest is in exploring the concept of "communities of practice" as a way of thinking about and practicing "education".

Montgomery, R. (2001). *Out of the ashes, an autoethnography*. Unpublished master's dissertation, Curtin University of Technology, Perth, Western Australia.

Judith Mulholland is a senior lecturer in science education at the Brisbane campus of the Australian Catholic University. Judith began her early career as a lecturer and teacher in biological science in Australia and the United Kingdom, and has been associated with teacher education in Australia for over 20 years. Her major research interests are in science education for elementary teachers, development of teacher knowledge, gender and education and qualitative research methods.

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Les Pereira is a lecturer in education at Edith Cowan University in Perth, Australia. He is guided by an interest in integral philosophy and reflexive practice and has a

particular interest in understanding how we come to 'know'. Les' research engages studies of transformative education, ethical practice, arts-based research, consciousness, and the nexus between the individual and the collective.

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Elisabeth Settelmaier is a former secondary science teacher who migrated to Australia from Austria in 1998. Her doctorate focused on teaching ethics in science. Now a teacher educator herself, she teaches in undergraduate as well as postgraduate programmes at Curtin University of Technology. Her research is mainly qualitative interpretative using auto/ethnography and autobiography with an emphasis on cultural and social contexts of education, ethics in school science and school change.

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Jill Slay is a senior lecturer in information technology security and Director of the Enterprise Security Management Laboratory in the Advanced Computing Research Centre of the University of South Australia in Adelaide. Her conceptual pedagogical research interest is the role of culture in science and technology education, with a particular focus on Chinese culture. She is co-author of *IT Security* (John Wiley, 2005).

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Peter C. Taylor is Associate Professor of Transformative Education in the Science and Mathematics Education Centre at Curtin University of Technology, Perth, Australia. He specialises in the use of qualitative research as/for the professional development of teachers and teacher educators. He is particularly interested in auto/ethnographic inquiry and literary genres, and has helped to pioneer arts-based dissertation/thesis structures in science and mathematics education.

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John Wallace is Professor of Science Education at Curtin University of Technology in Perth, Australia. He is currently on leave with a Professorial appointment to the Ontario Institute for Studies in Education of the University of Toronto. His research interests include teacher learning, qualitative inquiry, curriculum integration, teacher leadership, and school reform. His previous (co-edited) books include *Dilemmas of Science Teaching: Perspectives on Problems of Practice* (RoutledgeFalmer, 2002) and *Leadership and Professional Development: New Possibilities for Enhancing Teacher Learning* (RoutledgeFalmer, 2003).

Robyn White is Principal of Perth Modern School in Western Australia. She gained her Ph.D. through Curtin University of Technology. Having previously been a science teacher in several Australian states, then a head of department and deputy principal, her interests in leadership and teaching and learning guided her research directions. Robyn's doctoral thesis focused on the way in which systemic leaders implemented curriculum change in a geographically diverse education jurisdiction.

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John Willison is the coordinator of the Graduate Certificate in Higher Education at the University of Adelaide. He taught science at primary, secondary, and tertiary levels, especially focusing on the integration of reading and writing with collaborative hands-on tasks. His current research concerns the development of student information literacy from primary school to postgraduate level.

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