Grappling with methodologies in educational research: science and engineering educators finding their way

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Introduction

How does one learn to do educational research? Many people schooled in a scientific background believe that educational research is no different to doing research in the natural sciences. Some teachers simply start conducting research in their own classrooms. We argue that the new educational researcher needs to grapple with a range of different methodological and theoretical positions which have a critical impact on what research questions can be addressed. Furthermore, becoming part of a research community is a challenging social process that can also limit or enable research development.

The analytical approach adopted in this chapter is that of personal inquiry, which involves a reflection on one's own experiences in a conscious and critical manner. In motivating for the usefulness of this approach, Mann (2003, p.113) writes that "The process of personal inquiry is founded on the assumption that personal experience is a valid source of knowing and that critical reflection is an essential process in this coming to know." Thus, personal inquiry as a methodology is well suited to an attempt such as ours to develop research findings based on the process of reflective practice (for example, Schön, 1995). Because of this orientation, the chapter is written in a narrative style (Clandinin & Connelly, 1998): it is personal, situated experience and not abstract theory which provides the starting point for each stage of this analysis.

Methodology is a term used to refer to the philosophical and epistemological underpinnings of an approach to research data collection and analysis (cf. Burton, 2002). It is important to note that the focus in this chapter is on methodology, and not on methods. We consider the distinction between qualitative and quantitative methods to be relatively unimportant, and the emphasis in this analysis is geared accordingly. We focus largely on the methodological shifts that we have made over time and which have been reflected in our research outputs. The entire notion of a 'methodological shift' is not common in the scientific disciplines where we received our initial undergraduate training. Here we were taught about the 'scientific method' and we therefore naively assumed that formal studies in education would also equip us with the 'right' way of conducting research. In the world of educational research, however, things are not quite that simple. Apart from there being no one 'correct' methodology presented in the literature, the analysis in this chapter shows that depending on the researcher's epistemological commitments, particular research questions will tend to be valued, and the choice of methodology will be linked to this.

A useful perspective on this multiplicity of methodologies is provided by Habermas (1971), who has argued that there are three main areas in which human interests lead to the generation of knowledge. These three 'knowledge interests', viz. technical, practical and emancipatory, focus respectively on prediction, interpretation and understanding, and social liberation, and are therefore also related to different research methodologies. In our quest to understand and improve our students' experiences of learning we found ourselves traversing a range of

perspectives as we made the shift from a position informed by 'the scientific method' (akin to Habermas' technical knowledge interest) through interpretive perspectives (the practical knowledge interest) and towards embracing more critical perspectives in social science (the emancipatory knowledge interest). The relationship between Habermas' knowledge interests and research methodologies is illustrated in Table 1 below. In the analysis we also reflect on how these methodological shifts have been shaped by the contexts in which we have been working and conducting our research.

Table 1. Knowledge Interests and Research Methodologies

Knowledge Interest	Research Methodology	Examples
Technical (prediction)	Positivist	Empirical-analytic
Practical (interpretation and understanding)	Interpretivist	Hermeneutics
Emancipatory (criticism and liberation)	Critical	Critical discourse analysis

(Based on MacIsaac, 1996)

As researchers on student learning we were acutely aware of our own learning as we grappled with these different methodological positions. In analysing our learning experiences, we found that the theory of situated cognition (Lave & Wenger, 1991) provided a useful perspective. Here it is suggested that learning is not simply a cognitive process, but involves entry to a community and the adoption of a new identity. In order for learning to be successful, newcomers to a community need to have the opportunity to practice what is termed 'legitimate peripheral participation'. This theoretical perspective highlights the social and distributed nature of learning, as well as the potential difficulties when learners struggle to access a new community. As new educational researchers we found ourselves amongst many different communities and had to make choices as to which influential voices to follow. As highlighted by situated cognition we found that the methodological shifts we undertook were not simply intellectual exercises, but played crucial roles in our accessing new communities and leaving others. Throughout this learning we found that we needed to craft new identities for ourselves within the departments and faculties in which we work.

Our context

South African universities have seen dramatic changes since the late 1980s and central amongst these has been the changing student body as a result of equity and redress measures. At the University of Cape Town (UCT) and the University of the Western Cape (UWC), the widening of access to students who were regarded as coming from educationally disadvantaged backgrounds saw the introduction of a range of academic support activities and structures, fuelled by relatively high failure rates and low graduation rates among these students. Concern for creating the best possible learning environment for the 'new students' resulted in many of the academic appointments in these new structures being made on the basis of teaching experience and expertise, providing an injection into the institutions of new forms of skills and experience in teaching and learning. These staff were charged with establishing educational systems that might help improve student learning and this led to an increased interest in educational research. At the same time there was an expanding interest

in student learning research worldwide, motivated in part by the massification of higher education and concerns about greater diversity in traditionally white, male disciplines such as physics and engineering.

Who are the education researchers in tertiary science and engineering contexts? From the experience in our institutions we have noted that some of these researchers are disciplinary experts with an interest in teaching and learning, while others have an undergraduate grounding in science followed by teaching experience at secondary and tertiary levels, and postgraduate qualifications in education, not in the sciences. The three of us fall within the latter category, and we all began our academic careers at university teaching on courses ranging across mathematics, applied mathematics, computing, physics and chemical engineering. While teaching in these disciplines we chose to focus our research on the educational context of our work. For each of us the primary motivation has been a desire to improve the quality of student learning in the classrooms in which we work. We were encouraged from early in our academic careers to present conference papers and write articles describing our experience and what we had learnt from our teaching practice. We joined colleagues at science and engineering education conferences in sessions to share anecdotally both experience of practice ("What I do in the classroom") and good ideas ("What I intend to do"). Some presentations were in the form of basic evaluation research while others were versions of action research projects, often as work in progress. Locally, presentations such as these occurred at the numerous national workshops arranged to discuss the effectiveness of science and engineering foundation programmes and at the early academic support programme conferences in the 1990s. Essentially the message we received at such conferences was that educational research primarily involved reporting on one's practice and that anyone could and should be doing it.

Our participation in these conferences gave us the opportunity to share our experiences. It also exposed us to the arguments of those who had begun to move beyond this anecdotal stage. We began to realise that for our work to be taken seriously we needed to find a way to make it more rigorous and theoretically grounded. This has been integrally linked to our efforts to improve our teaching and our students' learning, but at the same time we have also had to respond to the pressures experienced by all academics to improve our formal qualifications and to sustain an acceptable research output.

Methodological shifts in our research practice

In this section, we reflect on how the way in which we have conducted and justified our research has changed with time. To illustrate the methodological shifts that we have made, we draw on two research areas that we have individually and jointly pursued over the last decade: one focused on issues related to diversity in engineering (Research Area A) and the other on the student experience of learning (Research Area B). Within each of these research areas, we refer to several discrete research projects. Table 2 below gives a broad chronology of these research projects referred to in our discussion of the methodological shifts in our research practice.

Table 2. Overview of Research Areas A and B

	Positivist phase	Interpretivist phase	Towards critical frameworks
Research Area A: Diversity in engineering	'Factors' influencing women to study engineering	Why NOT engineering?: an in-depth, qualitative study	Engineering students' experiences of vacation work: situated cognition
Research Area B: The student experience of learning	Students' misconceptions of the 'mole'	Students' approaches to learning: small scale, contextualised studies	Alienation and engagement: an alternative characterization of the student experience Learning as identity formation Teaching first year science and engineering.

Making it more 'scientific': The positivist phase

Our initial attempts to move beyond the anecdotal phase and do more 'rigorous' research were informed by our undergraduate scientific training, and so we took readily to hypotheses, experimental designs which used pre- and post-tests, and statistical analyses. When we looked for help on 'how to do educational research' we came across many academics – often successful science or engineering researchers - who saw no difficulty in applying the 'scientific method' to educational problems. Later, we came to recognise this as characteristic of a 'positivist' methodology, in which social phenomena are studied in much the same way that scientists study physical phenomena.

An example of such positivist-framed research from our own work (in Research Area A) is the initial research which Jeff and Jenni conducted on women's participation in engineering (Jawitz & Case, 1998). This study explored why so few women chose to study in this area. The argument made was that if you could find out what motivated the few women who did choose engineering, then you might be able to design interventions and recruitment programmes to encourage more women to do so. This was in line with many education projects in South Africa at the time looking to identify 'factors' influencing particular career choices or learning strategies (for example, Agar, 1990; Louw & Louw-Potgieter, 1986). Although they were phrased fairly cautiously, the extract below reveals how the claims represented in the findings tended towards generalisation.

> '...while white female students appear to be primarily influenced by their school mathematics and science teaching, and a family environment that supports this career choice, the majority of black female students appear to be motivated by the opening up of opportunities to serve their community, and to prove themselves in a career traditionally dominated by white males.' (Jawitz & Case 1998, p. 239).

In this project, a qualitative pilot study was used to identify an initial set of 'factors' influencing career choices. However, as it was driven by the desire to ensure that our research approach was 'scientific' and within that frame, the logical next step was to attempt to undertake a large study of all students in the region that would verify that the categories

and factors that had emerged were significant. We were able to include most engineering students at three of the regional institutions and worked with a sample of 532 students. Given the methodological underpinnings of this research, it was important for us to work with this large and extensive sample.

In conceptualising the study we never expected that we might have to defend this research approach to a department head who objected vehemently to our request that students indicate their race and gender on their responses. This reaction was an important reminder to us of the contested nature of what constitutes research in social contexts, and pointed to some of the difficult methodological issues that we needed to learn to address.

A second example of a project that characterised our early attempts at education research is drawn from Research Area B – the student experience of learning. This research was undertaken by Jenni, who focused initially on looking for student 'misconceptions' after an induction via a Masters in Education qualification into what were then the dominant modes of doing research in science education. Involved in the teaching of first year chemical engineering students she chose to focus on the "mole" - a standard unit of measure in chemistry which has traditionally presented difficulties to students (Case & Fraser, 1999). Small groups of students were interviewed to identify prevalent misconceptions, and a questionnaire for the whole class was designed based on these findings. A series of practical activities were designed to address these misconceptions, and the effectiveness of this intervention was gauged by comparing students' pre- and post-test scores on the questionnaire. These interventions were then incorporated in the regular teaching of first year chemical engineering students, and in a revised format are still used today.

Strong elements of a positivist methodology are evident in the two studies described above. Although both studies had quite substantial qualitative elements, large scale quantitative analyses were included in order to 'validate' the findings. In both cases we found ourselves quickly up against the limitations of what these approaches could offer. The focus on correlations and prediction was of little use when one tried to understand *why* students made particular career choices or went about their learning in particular ways.

The first tentative steps out of the box: the interpretivist phase

As our focus shifted from quantitative correlations to understanding how students perceived the contexts they found themselves in, we began to conceptualise our research in a different manner. We no longer felt the need to 'validate' qualitative findings by means of large quantitative studies – the assumption instead was that these findings have value on their own. This marked the start of a shift towards an interpretivist methodology, in which the aim is to identify people's "culturally derived and historically situated interpretations of the social life-world" (Crotty, 1998, p. 67).

For example, the second study in Research Area A, on women in engineering (Jawitz, Case, & Tshabalala, 2000), had a very different research design. We had started to feel that we had been interviewing the wrong set of students and maybe asking the wrong questions, and that we needed to talk to women who had excelled in mathematics and science at school, but who had not chosen to do engineering. Instead of a large–scale quantitative study with 532 students, we conducted in-depth individual interviews with 12 students. However, in the abstract, we did not mention the sample size possibly because we were still under the sway of the notion that a larger sample made the study 'better'. The analysis we used diverged sharply

from the 'factors' approach in the first study: here we simply reported on themes that appeared to be dominant in the data, for example the first choice of medicine as a career for a female student who excelled in mathematics and science. Interestingly, given the South African context, the issue of race hardly featured in this study and was only mentioned in the data describing the interview sample.

Conference presentations and seminars provided additional stimuli for the shift in methodology. A particular version of constructivism, construed as a theory of learning, was particularly popular in science education at the time, building on the theories of Piaget and Vygotsky (see, for example, Driver, Asoko, Leach, Mortimer, & Scott, 1994; Fensham, Gunstone, & White, 1994). Moll has summarised this perspective as a 'a core of theses and propositions that suggest that new knowledge arises in children out of real developmental mechanisms, some of which are social and some natural, and on the basis of activity that is simultaneously cultural and individual' (Moll, 2002, p. 28). As educators we readily embraced this theory for thinking about student learning, although we didn't really know what a constructivist epistemology would mean for our research. For example, in the mole study mentioned earlier (Case & Fraser, 1999), we worked with a constructivist view of learning but did not engage with epistemological issues.

Later work in Research Area B − the student experiences of learning - began to explore a more interpretivist methodology which is underpinned by a constructivist epistemology (Crotty, 1998). Our research on student approaches to learning began to critique the positivist framing of many of the studies being done at the time, in particular the reification of the constructs of deep and surface approaches. In each of Delia's (Marshall, 1995) and Jenni's (Case, 2000) PhD studies they used small scale qualitative studies to explore the particular approaches that were represented in the classroom contexts under investigation. Using a constructivist view of research they identified an approach which fell outside the standard deep/surface dichotomy which they termed a procedural approach (Case & Marshall, 2004).

Jenni and Delia have argued for a particular way of conducting student learning research (Marshall & Case, 2005). They favour small scale qualitative studies that take account of context and personal experiences, rather than heavily statistical studies which rely on large sample sets and standardized instruments. They agree with the critics of the approach to learning literature that this latter more quantitative approach lends itself to unwarranted reification of the framework and prescriptive rather than descriptive theory. In their current work they are attempting to build further on these directions in adopting more socio-cultural and critical stances into a student learning framework.

It is important to note that this engagement with the more interpretivist approaches was not a sudden Damascus experience. From our earliest research attempts we felt uncomfortable with the dominant view that scientific knowledge was the only form of legitimate knowledge. The real challenge was in trying to use these ideas in our research with little formal training in the social sciences.

Although the shift to a more interpretivist methodology represented for us a significant change in the way we did our research, the methodologies we used were relatively contained and almost prescriptive. For example, Delia had been drawn to the phenomenographic perspective on learning while doing her PhD. In contrast to the cognitivist perspectives on learning that dominated physics education at the time, phenomenography takes a relational view of learning rather than one that focuses on mental schemata. At the same time however,

researchers are encouraged to disregard individual characteristics and focus on a generalised typology describing ways of experiencing phenomena.

The position we found ourselves in felt relatively safe and nearly scientific, avoiding some of the messy social stuff. Things started to fall apart however, when we found that we could not adequately address some of the complex issues that form a central feature of our context, such as race and gender, in our research. We naively considered these to be quite unproblematic extensions of some of our conventional research questions, but we struggled to argue for the contextual validity of the results which we generated.

New challenges: grappling with critical frameworks

In attempting to address issues of social justice and inequality in our educational contexts, we were drawn to explore alternative research perspectives. For example, in Research Area A, Jenni and Jeff had begun to move from a focus on individual students towards trying to understand the operation of power in social contexts and were drawn to explore socio-cultural perspectives on learning. They also recognised that the project needed to broaden its scope from an exclusive focus on gender to include other aspects of diversity, particularly race. In their study of engineering students' experiences of vacation work (Case & Jawitz, 2004) they used a situated cognition perspective for considering students' engagement with the workplace. Feedback from journal editors and reviewers helped in the process of working out how to theorise race and gender.

In the Research Area B – the student experience of learning - Jenni and Delia began to explore other methodologies because approaches to learning theory could not account for how individual students engaged with the learning environment, nor could it explain the persistence of social and educational disadvantage in higher education. A focus on alienation and engagement as an alternative characterisation of the student experience pointed to the role of the lecturer in maintaining or challenging the status quo, and thus led to a critique of traditional power relations in the classroom (Case, 2007). Another perspective was provided by the critical discourse analysis of Gee (1999) which places identity formation as central in learning (Case & Marshall, 2008). A further methodology explored was that of narrative analysis (Polkinghorne, 1995) which allowed us to problematise the notion of educational 'disadvantage '(Marshall & Case, 2007).

The challenge we faced in both our Research Areas was whether our research was making an impact in terms of addressing power relations or inequalities in our work situations. It was all very well to have a better understanding of how female and black students experienced their vacation work or how students experienced their learning, but in what ways would our research be able to effect change in these contexts?

In the diversity in engineering research project, one of the implications of our research was that in order to get more women into engineering studies and into the workplace we would need to work towards changing the culture of engineering both within academia and industry. Critical theory tells us that it is not sufficient for research to highlight and illuminate power relations; the point is to address them. Action is the key element (Carr & Kemmis, 1986). Similarly in the student experience of learning project, we would need to go beyond just characterising students' approaches to learning or implementing changes in isolated classroom situations. In fact, one study in this research area (Case & Gunstone, 2003) had demonstrated how curriculum changes in one course are limited in success if not applied

systemically. Yet we were faced with the question of how to address these systemic and structural issues in our higher education work contexts. Critical theory proponents Carr and Kemmis (1986) see these structural issues being addressed through democratic communities of researcher-practitioners, yet we found that concept hard to envisage in our contexts.

We found that perhaps an easier place to start was with the emancipatory potential of what we teach and how we portray scientific knowledge. It may be easier to address the implicit power relations between different forms of knowledge by challenging the dominance of the positivist perspective in science and engineering, with its neglect of the wider social, ethical and political contexts of science. This requires a different form of activism, that is located in the heart of what matters to us and what drives our research – teaching and learning. A study of students' conceptions of science (Linder & Marshall, 1997) shows the beginnings of a grappling with the ideas of critical theory. The study was conducted in a teaching context that promoted transformative learning and developing critical and reflective learners, in contrast to the technical-rational perspective that tends to dominate undergraduate physics teaching practice. However, the paper itself down-played that value-position, and no explicit mention was made here of critical theory in relation to science education. In subsequent work we have taken our research on learning as identity formation and have developed innovations in our first year courses aimed at improving the development of discursive identity and the building of community (Case et al., 2007; Lesia et al., 2007).

Learning to be a researcher: entering the community of practice

We have sketched above the shifts that are apparent in the way we have conducted our research over a period of time. As stated earlier, we consider this learning to have taken place within a social and situated context, involving at its heart an entry into a community of practice (Lave & Wenger, 1991). In this section we consider more closely our interactions with those multiple (and sometimes overlapping) communities, and the way these engagements influenced the directions outlined above. These communities comprise influential colleagues, supportive mentors, key articles or books, conferences, students, etc. These interactions have taken us down certain roads, helped us through difficult terrain, and pointed out important signposts. We also consider briefly some communities we experienced early on in our journey, some of which we consciously chose not to identify with. The purpose of this analysis is to highlight what aspects of a research community are critical in supporting new researchers.

<u>Trying to find a community – following the influential voices</u>

Early on in our journeys we often found ourselves in awe of people who had 'made it' in the research world: experienced colleagues, supervisors, etc. However there were times when what these people suggested did not fit with our intuitions. One example would be the advice to use the scientific method (in the positivist phase outlined above) or the need to use quantitative data to 'verify' qualitative findings. Some of these discussions took place in the context of co-supervision arrangements where we were working alongside more experienced colleagues. At these early stages we lacked the confidence or the knowledge of the broader research field to be able to adequately follow our intuitions and so we found ourselves following this advice and producing papers in this mould. Nowadays we find ourselves making use of the advice of more experienced colleagues, but we pick this advice more carefully, preferring to follow the lead of those who are doing the kind of research that we feel is more likely to have a meaningful influence on our teaching and learning contexts.

Conferences provided opportunities for finding a place to fit in. Early on we found ourselves in conference environments that supported positivist methodologies, where it was reassuring to find that our work was appreciated, yet at the same time we became more aware of the limitations of these approaches. We also sometimes experienced challenges to our 'positivist' research as we presented at these conferences, and although we were often not ready to receive the interpretivist-inspired criticisms, they might have reinforced the shifts that we had begun to make. We also noticed that different conference communities seemed to share views on the validity of particular research approaches, and so, for example, there was little critique of positivist research at engineering education conferences, while considerable questioning of this at some of the other higher education communities. Some conferences like those of the Southern African Association for Research in Mathematics, Science and Technology Education (SAARMSTE) seemed to contain a multitude of voices – with the concept of research in this environment always a contested and shifting terrain. At any point in one's journey it was possible to find a home for our paper, to look back to where we had been, and to encounter papers that stretched us in new directions.

Creating a community of our own: a safe space

Efforts by Jeff, Jenni and colleagues in engineering disciplines at UCT to develop educational research in this area led to the establishment of the Centre for Research in Engineering Education (CREE) in the mid-1990s. As part of this initiative Jeff and Jenni were involved in coordinating and reviewing papers for many of the local engineering education conferences from the late 1990s onwards. Here we found ourselves mainly trying to find a balance between anecdotal work based on practice, and research coming from a range of approaches. In this research community, our stance of insisting that anecdotal papers should not be regarded as research was seen as controversial. As much as this shaped the form of the conferences, and maybe the kinds of work that our colleagues strove towards, it certainly impacted on how we saw our own roles.

The group in CREE spent considerable energy attempting to create a research community by means of seminars, newsletters and local conferences. In 2001 a series of discussions with a team of Swedish education researchers gave new impetus to these efforts. The key goal of these discussions was to work towards a better understanding of the critical elements of learning and teaching in science and engineering in higher education. Five video conferences were held over a year during which participants shared their research perspectives and findings. More important than the international collaboration, was the bringing together of educational researchers in the Faculty of Engineering and the Built Environment at UCT with colleagues in the faculties of Science at both UWC and UCT. These local participants chose to use the project to build their capacity for doing educational research in their contexts and decided to set up a reading group. This reading group has sustained regular meetings since 2001 with participation ranging from 10 to 15 colleagues all actively researching in tertiary science and engineering education.

The reading group has provided a safe space to voice confusion, grapple with unfamiliar terms, and share new insights. We have been surprised by the energy and excitement generated in these meetings, and for many it has provided an intellectual 'home'. We have found ourselves in a community of individuals in similar positions, none of whom have social science undergraduate backgrounds, trying to find appropriate methodological frameworks. We have focused on developing a 'metaview' of research by reading texts concerned with the

epistemological underpinnings of research methodologies (Crotty, 1998; Webb, 1996).   One of the drivers for us to take this metaview and to explore critiques of interpretivist approaches to research was the nagging dissatisfaction we felt with the capacity of our existing interpretivist methodology to contribute towards addressing power and equality issues in our teaching contexts.

While a core group of about 8 people have been involved from the start, there have been individuals who have not been able to sustain their participation. Inevitably hierarchies have emerged between the old-timers and the newcomers, those who have begun to acquire the 'jargon' and those who haven't, and the frustrations experienced by someone grappling with new methodologies and new terminology is strongly reflected in an email from a colleague who joined the group near the end of the second year:

> I am generally very "confused" when I attend the meetings, but usually things become clear when I listen to the discussions. I did not always understand the chapters from Crotty, but at least the discussion was focussed in the sense that the chapter under discussion dealt with "one topic" (positivism for instance). I found myself leaving yesterday's session without really knowing what it was about. It seems as if people in the group have some prior knowledge which they can use to "make sense". I unfortunately do not have that. I personally would really love it if somebody in the group, who is an accomplished researcher, would present their research. Through this presentation the person would then define the terminology used, and hopefully things will make even more sense. Maybe, this is not what you guys want to do with the group, but ....
>
> I do not know whether it is worthwhile attending the meetings anymore. Maybe I should first get "jargonised"... (email 4th March 2003)

In reply to this email Jeff, reading group convenor at the time, wrote

> When we first started the process two years ago we used the model you suggest. Different people presented their research for discussion. We even invited a colleague who lectures in research methodology to come and present. These sessions soon lost their punch - it was possible to come along and be a passive participant. We wanted a model that removed the passivity out of the equation. Everyone would be required to struggle with the texts and the discussion. I was worried initially that "newer" members of the group would feel left out but it seemed that many managed to overcome this. While initially the newer members sat and listened - it soon became clear that they (and the group as a whole) would benefit much more if they put their issues on the table for discussion.
>
> I realise that you might feel many levels of difficulty in engaging with the group, but I think it would be valuable for you to put what you have written in your email to the group as a whole rather than just to me. I am sure many members of the group can relate to what you have expressed. (email 10 Mar 2003)

The colleague was unable to follow up on the suggestions made above and while attending from time to time has never been able to fully participate in the group. Clearly the space we had created did not feel safe to all who enter it. To address this, a decision was made to pass control of the reading group over to newer members of the group.

The reading group alone would not have impacted on our work as significantly had we not also all been engaged in a range of research projects, many of which were collaborative. As the reading group proceeded, these research projects became the practical sites for engaging with the theoretical lessons emerging from these and other discussions and readings.

We continue to feel our way forward tentatively, gingerly. A recent exercise of the reading group saw us trying to apply Carr and Kemmis' notion of critical research to our individual research contexts (Carr and Kemmis, 1986). With newfound confidence we were able to articulate why it 'just didn't fit' and it felt as if we beginning to engage with the discourse of critical theory sufficiently to be able to critique it. Somehow it felt as if the discourse was becoming our own. We have also worked through Kvale's notion of interviewing (Kvale, 1996) and in the process we have been exposed to the (dis)comfort of postmodernism with respect to practical aspects of our own research. More recently, the reading group has read Flyvbjerg's Why Social Science Matters and we have found his contrasting of Habermas and Foucault's analyses of power particularly illuminating. (Flyvbjerg, 2001)

In late 2006, the reading group started to write, in an attempt to draw together the multiple research perspectives we had explored over the years and to apply these to build a more coherent research-based position on teaching and learning. In the introduction to our paper (Allie et al., 2007), we wrote:

> This paper has been developed through a collaborative writing process amongst science and engineering education researchers in the Centre for Research in Engineering Education. We are all involved in actively researching our own educational contexts, and this work has been published widely. However, in responding to the current debate around improving throughput in science and engineering, we felt that it would be appropriate to draw together a collective 'position' on student learning, building on our knowledge of key theoretical work in the education literature.

Conclusion

Often the methodologies that we operate within are hidden, and it is difficult to be explicit about the values and assumptions that inform one's research (Burton, 2002). Using the approach of personal inquiry in this chapter, we have tried to make overt the methodologies that have been underlying our research over the past ten to fifteen years. We have also found that the social context within which we have worked has profoundly shaped these methodologies. Traditionally academics interested in their teaching tend to inhabit a form of "pedagogical solitude" (Shulman, 1993) where each person is stuck within the concerns of their own context. The most powerful contribution towards the development of our individual research approaches has come from our participation in a collaborative research community. Central to facilitation of this community has been a reading group where we have grappled with the theories that inform research methodology, and collaborative research projects where we have attempted to implement these theories.

On reflection we can see that the methodological shifts we have undergone have been prompted by changes in the research questions that we have sought to address. In particular, we continue to be challenged to find ways to better understand the effects of power in the context of student learning. It is therefore noteworthy that in our own learning to do research

we have started to recognise the power dynamics involved in this community. The 'safe spaces' that we have created would appear to have their own power dynamics. The challenges for the future are therefore clear. The critical and emancipatory methodologies would appear to have great potential not only for our attempts to characterise our students' learning experiences, but also as we seek to build research communities that are inclusive and empowering.

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