AC 2009-528: SUSTAINING AND ENJOYING A MULTIDISCIPLINARY, MULTIDEPARTMENT, MULTICAMPUS RESEARCH COLLABORATION ON WOMEN IN ENGINEERING

Julie Mills, University of South Australia
Judith Gill, University of South Australia
Suzanne Franzway, University of South Australia
Rhonda Sharp, University of South Australia

© American Society for Engineering Education, 2009
Abstract

The development of a successful, long-term, multidisciplinary research collaboration is not something that happens easily or quickly. Since 2001 the authors have collaborated in research projects related to women in engineering, in both the professional workplace and education contexts. What is unusual about this particular research group is the widely varying discipline backgrounds of the members. The group comprises professors in feminist economics, sociology, education and civil engineering. The collaboration has faced numerous challenges in terms of geography, methodology, availability, finding a common language and understanding, differing practice in the various disciplines with respect to writing for publication and what grants count. This paper identifies four inter-related themes that have emerged from our reflections on our experience of gender-based multidisciplinary research.

Introduction

Multidisciplinary research has received considerable support in recent years. In the resource starved climate of the current Australian neo-liberal university [1], [2] a multidisciplinary approach is thought to operate in ways more effective for real-world, complex problems – and hence be more attractive for industry funding – than when research occurs within the boundaries of just one discipline, faculty or department. The success of multidisciplinary research is evident in engineering education. For example, Borrego & Newswander [3] cite acceptance statistics for journal articles submitted to the Journal of Engineering Education as “20-30 percent when a social scientist is a member of the author team, but only 2-3 percent if the authors were all engineers” (p. 123). However, although we are increasingly urged to work collaboratively and to adopt multidisciplinary approaches by our University leaders, the incidence of multidisciplinary work is relatively rare.

Our multidisciplinary team comprises four professors in civil engineering, economics, education and sociology. Team members have a common interest in gender issues and each had previously published in related areas. The civil engineering professor has extensive industry experience, had chaired the national Women in Engineering committee in Australia and has published in engineering education and women in engineering. The education professor is known for her expertise in the area of girls and mathematics, and debates around co-educational versus single sex schooling. Both the economist and the sociologist are known for their expertise in areas relating to women and work – the sociologist particularly in the area of gender, work and the trade union movement, and the feminist economist in the area of public policy. The non-engineer members of the team have also been working in critiques of their own discipline areas from feminist perspectives. All team members share a commitment as feminist scholars to making a contribution to the research on women and work. However, the apparent commonality of approach and interests between us had to be re-woven once we started to grapple with the collaborative study of women in engineering.
Here we should briefly note that there are several different definitions of multidisciplinary research [4], [5], [6]. The terms multidisciplinary and interdisciplinary are often used interchangeably, but Borrego & Newswander [3] have provided an excellent discussion of these terms in the context of engineering education research. They define multidisciplinary collaborations as those where “collaborators come together to work on a problem, each bringing his or her own expertise and unique contribution. There is limited exchange of information in this approach … collaborators leave the project without having learned much about the other discipline(s)” (p.124). On the other hand interdisciplinary collaborations are defined as those where “researchers from different disciplines work in a more integrated way to solve a problem together. Rather than each contributing separate pieces to the solution, the collaborators work closely together, combining their knowledge from their own disciplines to work toward a solution … At the end of a truly interdisciplinary collaboration, each collaborator is changed by the experience” (p. 124). Using these definitions, our collaboration began as a multidisciplinary one and progressed towards interdisciplinary collaboration but for the purpose of this paper we use the generic term “multidisciplinary”.

We had no road map to guide our multidisciplinary research when we began. In hindsight we now realize that we were initially inclined to underestimate the difficulties of the road ahead as we grappled with questions of methodology, perspectives, language and the everyday practicalities of doing research in an increasingly managerialist framework and institution. However, reflecting on our eight years of experience working on a series of studies of women in engineering, we can offer some guidance on multidisciplinary research around four main themes:

- Feminist commitment
- Uneven paradigmatic engagement
- Negotiating knowledges
- Material conditions

To provide context for the discussion we will first summarise the series of studies we have undertaken to illustrate both the nature of the research and the progressive development of our collaboration.

The studies

Our collaboration has revolved around the fundamental question of “Why are there so few women engineers?” The approaches taken to answer this question have evolved over time. In 1999, the engineering member of our team managed a large scale survey of the career experiences of women engineers in Australia, which indicated the dimensions of the problem [7]. She then approached the Research Centre for Gender Studies (RCGS) at the university to see if they would be interested in taking on qualitative research to explore these issues in more depth. This resulted in the formation of our research team.

The research team successfully applied for a university collaborative grant in 2002 to conduct an interview based qualitative study total of the work experiences of male and female engineers (41 women and 10 men engineers, across a range of engineering disciplines around Australia). Issues explored included the education experience that had led them to engineering, what makes a ‘good engineer’, discomfort in the workplace, work-life balance, and why women leave the profession [8], [9]. The study was undertaken in the feminist spirit of letting women’s voices be
heard about a situation in which they are centrally involved [10], [11]. However, the focus on individual women in this study did little to explain engineering’s resistance to gender diversity and equity, since the women’s narratives of their experiences indicated complexities of gender relations and discourses that extend well beyond gender roles. What this study did suggest though, was that neither the problem nor the solution lies simply with women, but nor does it lie with men. At this early point in the research we also began to debate the question of why the study of women in engineering mattered in the broader context of research on women and work: What was it about the engineering profession that made it so resistant to women’s entry, progression and retention compared with other professions and why was this so important to the study of a feminist politics of work? [12].

We reframed our research focus towards the organisational context and workplace culture and designed a second study: Engineering diversity: An investigation of gender, workplace culture and change. This study was funded by a national grant from the Australian Research Council (equivalent to NSF in the United States) from 2004 to 2006. We sought to create new understandings of engineering workplace culture and to politicise its apparent gender neutrality by identifying and documenting the dominant normative patterns, as well as the mechanisms reproducing these norms. The case study approach used mixed methods, including the collection and analysis of organizational documents, online surveys (62 women and 295 men across three organizations), observations, interviews (25 women, 52 men at all levels of the organizations) and focus groups with women engineers (19 women) [13], [14], [15].

As we mined the data and searched for causes, explanations for and strategies to improve the low participation rates of women engineers, we were struck by two key points. First, that gender equity has become an accepted demand and resources have been allocated towards improving the proportion and standing of women engineers. Although such efforts have had limited success, they are met with resistance, hostility or indifference by both women and men engineers (Sharp et al., 2007). Second, gender as a factor was denied. Although each organisation endorsed gender equity policies, each was confronted by the apparent puzzle of the failure of engineering to attract and retain women. From senior management, to personnel managers, to newly fledged engineers, we repeatedly heard the phrase, “I don’t know” until we became convinced this itself may prove to be a clue. It appeared that not knowing, or ignorance, is a critical ingredient in the problem. This led us to the question: What are the knowledge and practices of ignorance, the epistemologies of ignorance, that account for the ways in which that not knowing is produced and sustained? This question formed the basis of a second successful Australian Research Council grant application for a study that is the focus of our current research Epistemologies of workplace change: transforming gender relations in engineering, which has been funded from 2009-2011 [16].

Establishing the collaboration
As mentioned above, our collaboration began when the engineering member of the team approached the then Director of the Research Centre for Gender Studies (RCGS) at the University of South Australia to see if any members of the centre would be interested in working with her, to undertake qualitative research to support the national qualitative study that she had just managed to explore the careers of women engineers in Australia. The Director (the education member of the team) then approached the sociologist and economist team members
and secured their initial interest. A key feature at the time was the existence of the Research Centre for Gender Studies which enabled cross campus and cross disciplinary work to be contemplated by providing a meeting ground where we could talk across our discipline and department boundaries. However, our collaboration at that time was definitely not the committed and well oiled machine that it now is! Although we were immediately successful in securing an internal collaborative grant with some external funding to support the initial qualitative study, our commitment to the initial research was patchy and less structured than it now is. The fundamental difficulty we faced was our geographic separation and the major demands that we all had on our time due to our various leadership roles. This meant that we met hurriedly and sporadically and that the day to day work of the initial project was primarily undertaken by a research assistant who was supervised by all of us at various times and in various ways – dependent on time, location and the nature of the current task. At the time we almost certainly varied in our commitment to the project – we were still determining whether it was something that really fitted with our interests and that we wanted to continue past the initial stage. But during this first year we were able to develop a sense of others’ potential contributions, an important element in beginning to think of ourselves as a team. It was not until we started to analyse the initial data, write some initial papers in our various fields, made the decision to seek a national competitive grant to further the research and then succeeded in that grant application, that we all became firmly committed to the project. At that time we began to seek ways and means of strengthening our collaboration and making it sustainably successful.

**The themes**
Reflecting on our experience of multidisciplinary and collaborative research, we have been able to identify several inter-connected aspects of the process which may prove useful to other multidisciplinary research groups, particularly those involved in gender related studies. We have distilled these into the four themes discussed below.

**Feminist commitment**

As a group we share a commitment to feminist principles and ways of working. Thus, the opportunity to conduct research that aligned feminist ideals of collectivity and an understanding of women’s inequality was very appealing. We were ready to undertake research which had the potential to advance the position of women engineers in their male dominated workplaces. However, collective work is not easily achieved, as feminists have known since Jo Freeman alerted us to the *tyranny of structurelessness* in 1970 [17]. At the same time, collaborative work among researchers is endorsed by the academy, but the messages are contradictory, since the outputs of research are ultimately assessed in individual terms. As researchers from four different paradigms, our feminist commitments provided the ground on which we built our multidisciplinary projects.

The issue of authorship, which can be a source of dispute, provides a tangible example of our feminist collaboration. We decided that any publications from our research would be co-authored by all four members of the team, sometimes also including a research assistant; however the process of writing has evolved during the course of our collaboration. Initially one member took the lead on a paper and the others were primarily involved as critical readers, but more recently our publications and grant applications have been co-authored word by word with all team
members robustly contributing. We have become adept at the use of a data projector in our meetings to facilitate this co-writing. However we are also constrained by our discipline bases insofar as most of the top journals maintain clear connections with discipline areas. This inevitably means that the person from the particular discipline area takes a larger responsibility in preparing a paper for publication that is aimed at a specific journal. At this point we are collaborating on a book which will present new opportunities and challenges for multidisciplinary work.

**Uneven paradigmatic engagement**

The problem of women’s inequality in engineering was neither new nor surprising to us, particularly for the engineer among us who had worked in the engineering industry for 15 years prior to joining the university. She brought a depth of knowledge about engineering education and training, the nature of the work, the details of the range of engineering workplaces and experience in the professional organizations. But, the key research question, *Why so few women engineers?* is not the kind of problem that the knowledge practices of engineering can address. Rather it is a question that is framed by social theory, which is open to concepts and knowledge of gender, social structures, culture, education, economic conditions, social policy and politics. At the same time, knowledge and understanding of engineering itself is essential to a research project that endeavours to tease out the multiple and complex strands that combine to produce the dilemma of the persistence of women’s inequality in engineering.

In tackling this problem, we have brought our various disciplinary paradigms to bear on the development of appropriate and viable methodologies. Reflecting on our experience, we see that our theoretical paradigms do not simply mesh together, but nor does any one paradigm predominate. Each of our social science fields (economics, education and sociology) has developed conceptual tools to research and analyse work and gender, although in each we draw on the work of feminist scholars, rather than mainstream work. As we have noted, we engaged in a series of studies that employed a range of research methods developed within the social sciences, but informed by feminist critiques of those methods.

We find that it is in the process of analysis and writing that we engage with a different and uneven paradigmatic matrix depending on the focus of the study. It is at this stage that the reality of a feminist multidisciplinary collaboration is most apparent. The language and concepts that we use have to be shared and interpreted at the same time as we are seeking to push the boundaries of the analysis of the research problem itself. Our discussions and analysis are also shaped by our need to be aware of the different audiences for our work. We share our knowledge and understandings in order to position our work in relation to funding bodies, academic or professional engineers, our own professional conferences, national and international journals.

**Negotiating knowledges**

We want to stress that collaborative approaches require a considerable investment of time. Agreements must be forged over the initial planning, the written applications and then the implementation of the methods outlined. Given our disparate discipline backgrounds it will come as no surprise to learn that outcomes often involved some degree of compromise. Gathering data
and having a group to de-brief with, comparing and contrasting initial responses, working
together on modification and clarification of the research instrument has proven to be
fascinating and has promised a much richer engagement than had we been individual researchers.
But the most time consuming part comes with the data analysis and the writing up, some of
which we have addressed in the themes above. This takes much longer in terms of both time and
energy than perhaps we had anticipated.

As we worked through this series of studies and progressively developed our research questions
and focus, we also had to develop our understandings of the epistemology of each of our
individual fields - how we know and understand the world from our discipline perspectives. Not
surprisingly this process generated many robust but fascinating debates about both theoretical
frameworks and methods. Each member has to be prepared to accept other views. We have
sometimes recorded and transcribed our debates so that we could revisit our discussions and
clarify our approaches. Having to explain our perspectives and positions has helped to deepen
our collective understanding. Whilst we have not attempted to become experts in each other’s
fields, we have all read key papers that each of us have recommended to improve our
understandings of each other’s paradigms, as well as the language of each discipline. It has also
been essential to have confidence and trust in each other to put out your ideas and be prepared to
accept criticism/discussion until you reach consensus.

Material conditions

The material conditions of university research and teaching have impacted on our collaboration.
Our work has also been affected by our professional and personal stages of life, which have
shaped our time commitments, emotional energies and experience and skills (particularly in
juggling!). We have found it necessary to strategise around these material conditions.

Collaborative, multidisciplinary research has been part of the discourse of the managerialist
research culture of Australian universities for the past decade. This rhetoric provided an
instrumentalist rationale for such research, arguing that complex problems can only be dealt with
by a multidisciplinary approach. Moreover, mutual advantages could be secured from increased
research reputation, new funding avenues and a reward structure within the university that gave
recognition to research collaboration. But multidisciplinary research was fraught with many
contradictions, including the countervailing and often predominant ethos of competitive
individualism and work intensification which precluded time to develop the more complex
multidisciplinary research approaches and the collaborative relationships that underpin it. The
British educational sociologist Reay [18, p.20] concludes that the forces of mutual
instrumentalism on one hand, and individual competitive self interest in academia on the other
hand, ‘lacks any intrinsic ethic of care’. While, in the main, we were confronted with material
conditions that did not support our collaboration, as feminist researchers we sought to pay
attention to an ethic of care which was essential to building the trust necessary to engage across
paradigms and disciplines.

The difficult material conditions were also exacerbated by our location in four different
departments and on several campuses, even though they were all in the same city. The lack of
priority given by the university to collaborative research space and time made collaboration
difficult. Our solution has been to have regular research workshops throughout the year which we hold at a town located 50 miles from our home city. By booking these 2-3 day workshops 4 times a year in our diaries and removing ourselves to a neutral space, away from the distractions (and emails) of our immediate workplaces we are able to focus on the research and achieve significant advances in a short time. We have funded the cost of the retreats by writing them into our grant applications.

Professionally we are four mid-career and mid-life women, all with partners and adolescent or adult children. We have each held senior roles within our departments at various times during our collaboration, such as Head of Department, Dean of Research, Director of Research Centre and Program Director. Increasingly long haul international travel has characterized our working lives. During the eight years of our collaboration we have each had to deal with significant health issues ourselves and/or of our partners, as well as the issues associated with children’s education and careers, personal relationships and so on. We have each faced the resultant pressures from work intensification and finding work-life balance. We have certainly all felt that the opportunity to discuss these difficulties with our collaborators and to exchange ideas about how to deal with them has been highly beneficial to each of us.

This research collaboration and the research area itself have not been seen as central to our mainstream discipline areas. It is an uncomfortable fit for our disciplines and departmental structures. Paradoxically we have won two highly competitive and peer reviewed national grants for this project. Importantly the collaboration has allowed us to effectively resist further erosion of the material conditions by finding other spaces, collectively accessing internal university grants and research resources to support our collaborations, prioritising external grants that give us reputation as well as resources. We are better equipped to navigate the managerialist research culture with its complex maze of unequal power relations that parallel the distribution of resources.

**Conclusion**

The sheer joy of winning a grant, of seeing a published product or even of clearing the ever higher hurdle of ethics approval is definitely one that is better shared. We continue to enjoy working together. While ever careful not to define one another in terms of particular backgrounds or personality types we think we have established a safe space in which to explore and exchange ideas. In the course of our collaborative work we have also been able to share knowledge about changes in structures and governance of our University which has been useful to each of us in our separate departments. Each member of the group has successfully continued her disciplinary research and provided significant peer mentoring and support for each other. Most importantly perhaps has been the way in which this joint work has enabled us to develop our own critical stance with respect to our own areas. Thus we have been able to develop ideas gleaned from the women and engineering project and apply them to issues arising within our own disciplines to good effect. Most importantly, we believe that we have also made significant contributions to moving forward the theoretical framework that might contribute to improving the number and position of women in the engineering profession.
There are some key ingredients of our successful collaboration that we believe can also be applied by other similar collaborations to make them successful. One is that it is a long-term commitment and should be viewed as having potential for multiple projects, grants and publications. Above all, recognising the value of a shared feminist commitment, awareness of the process of uneven paradigmatic engagement involving provisional knowledge settlements and negotiating around the material conditions, are essential to our continuing multidisciplinary collaboration. We have forged a collaboration that has been successful according to the extrinsic measures of grants and publications, but which has also been professionally beneficial to each member, whilst allowing each of us to hold true to our ideals and beliefs. What more could we want?

References


