

**Academic identity development of engineering
academics in the Australian engineering education
community**

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the Faculty of Engineering and Information Technology
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degree of Doctor of Philosophy
by
Anne Gardner

University of Technology Sydney

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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List of abbreviations

AAEE Australasian Association for Engineering Education
ACED Australian Council of Engineering Deans
ADTL Associate Dean Teaching and Learning
AJEE Australasian Journal of Engineering Education
ALTC Australian Learning and Teaching Council (superseded by OLT)
ANET Australian National Engineering Taskforce
AQF8 Australian Qualifications Framework Level 8
ARC Australian Research Council
ASCE American Society of Civil Engineers
ASEE American Society for Engineering Education
ATN Australian Technology Network
Curtin Curtin University
DEEWR Department of Education, Employment and Workplace Relations
DVC Deputy Vice Chancellor
EJEE European Journal of Engineering Education
ERA Excellence in Research for Australia
EU European Union
FEED Future Engineering Education Directions
FIE Frontiers in Education
FoR Field of Research code
Go8 Group of Eight
HE Higher Education
HILDA Household Income and Labour Dynamics in Australia survey
IJEE international Journal of Engineering Education
IRU Innovative Research Universities
JEE Journal of Engineering Education
L&T Learning and teaching
LSAY Longitudinal Survey of Australian Youth
NCVER National Centre for Vocational Education Research
NRC National Research Council
NSF National Science Foundation
NVivo proprietary software for analyzing text and video files

OLT Office of Learning and Teaching – part of the Australian Government Department
of Education and Training

PBL Project Based Learning

PhD Doctor of Philosophy

REES Research in Engineering Education Symposium

SEFI European Society for Engineering Education

SMEC Science and Mathematics Education Centre

SoTL Scholarship of Teaching and Learning

STEM Science, Technology, Engineering and Mathematics

STEMed Science, Technology, Engineering and Mathematics Education Centre

Swinburne Swinburne University of Technology

TAFE Technical and Further Education

RMIT Royal Melbourne Institute of Technology

US United States of America

USQ University of Southern Queensland

UTS University of Technology, Sydney

VC Vice Chancellor

VET Vocational Education and Training

Abstract

The field of research that an academic participates in is seen as central to the development of their academic identity. In the case of engineering academics that become engineering education researchers there are additional complications in reconciling this change with their academic identity. Part of the difficulty that engineering academics have with educational research paradigms is that they are so different to the typically positivistic perspective of most engineering epistemologies. A further complicating factor is that engineering education is an emerging research area in Australian universities and as such there are few formal training pathways into it and little consensus as to the standards and norms of practice. Yet engineering academics have and continue to make this transition - how they develop an academic identity in this research field is the focus of this study.

The research approach is interpretive using the identity-trajectory as a theoretical framework because it pays attention to the context-specific characteristics of working as an academic. Interviews with a range of engineering academics about preparing a conference paper and their response to the peer review process illustrated how various aspects of their research work contribute to the development of the intellectual and networking strands of their academic identity, the effect of their university environment on this development, and included the ways that engineering academics interpret how their past experiences contribute to their present situation and/or their future intentions. By focussing on the individual, this conceptualisation of academic identity aligns with the common experience of engineering education researchers and with the premise that development of the field is a function of the development of the individual researchers within it.

The engineering education research landscape model presented in this study was a successful stimulus for dialogue about the nature of the research field by allowing participants to identify where they belong on the landscape. Such discussions will help both the community and individuals to articulate and understand observed changes in their own and their peers' research as expertise is developed, as well as provide a language for researchers to plan, discuss and evaluate this development.

The continued importance of participation in engineering education conferences for the intellectual and networking strands of academic identity for members of this research community is apparent for researchers at all stages of development, although in different ways.

Chapter 1. Introduction

The main pathway to joining the engineering profession in Australia is by completing an undergraduate degree in engineering. Engineering academics at universities typically have research expertise in an engineering specialty and are expected to contribute to the development of new knowledge and innovation in that specialty area. As well as contributing through research to the learning in their specialty area, they are also generally expected to contribute to the learning of engineering students through formal subjects, courses and programs. Exploration of the theories, practices and innovations to most effectively facilitate student learning of engineering is referred to as engineering education research.

Engineering education research is still emerging as a recognised research area in Australian universities (King 2008, Kavanagh, O'Moore & Jolly 2012), and a similar situation exists in other parts of the world (Borrego & Streveler 2014). Apart from the difficulties commonly related to emerging research domains, a complicating issue is that most scholars who identify with this emerging field hold research qualifications and expertise in their own engineering field but are challenged to develop new perspectives and expertise when moving into educationally related research that requires them to work in interdisciplinary ways (Beddoes 2014, Borrego & Bernhard 2011).

Part of the difficulty engineering academics have with becoming interdisciplinary researchers is attributed to the ways that socially related research is different to typical engineering research (Taylor 2008, Smart, Feldman & Ethington 2000, Land 2008, Stierer 2008, Rowland 2009, Jones 2011). Engineering epistemologies were developed in response to the issues encountered in engineering research and to a lesser extent,

engineering practice. Formal undergraduate and postgraduate engineering studies socialise participants to the paradigm of engineering research, which is different from the paradigms of educational research. However, in Australia very few engineering education researchers undertake formal research study – including higher degrees – the traditional way of socialisation into a research domain (Thompson 2003, Weidman & Stein 2003, Hakala 2009). Those engineering academics wanting to change their practice to engineering education research have not only to negotiate the differences inherent in a different type of discipline, they also do it without the socialisation processes that come with related postgraduate study. The combination of the emerging nature of the field and this lack of formal training means that experience must be gained through intentional engagement with the engineering education research community.

In the Australian context a common form of this engagement is through contributing a paper to the annual conference of the Australasian Association for Engineering Education (AAEE). The aim of this association is to foster excellence and innovation in engineering education and it advertises itself on its website as relevant to the following groups of people:

Engineering academics, academics from other disciplines who teach engineering students, engineering support staff, postgraduate engineering students, engineering librarians, professional engineers, employers, and vocational educators (AAEE 2015).

For engineering academics, along with the engineering disciplinary norms that include expectations about research quality (Beddoes 2014), when we participate in engineering education research we also bring with us our engineering identities. The importance of identity in becoming an engineering education researcher is reflected in Wenger's (1998) comment about what it means to change practitioner identities:

[It] demands more than just learning the rules of what to do when. It requires the construction of an identity that can include these different meanings and forms of participation... The work of reconciliation [of differing identities] may be the most significant challenge faced by learners who move from one community of practice to another ... and is an on-going process (p. 160).

Yet for all its significance, Manthunga (2009) notes that “very little attention has been paid to the impact it has on researchers’ identities” (p. 132).

The research in this study is focussed on the development of academic identity for those engineering academics who work at different types of Australian universities and have a variety of experience in engineering education research. An identity-trajectory theory was used to frame and analyse interviews in which participants discussed the papers they presented to the 2012 AAEE conference and how they responded to the peer review process from the perspectives of both authors and reviewers. Analysis of their interviews illustrates how these individuals within the AAEE community are changing their academic identities as they develop expertise as engineering educational researchers. The implications of this development for the wider engineering education research community will be discussed.

The aim of this research is to help members of the engineering education community, and in particular the AAEE community, to better understand themselves and their peers as they transition to the unfamiliar ideas and methods associated with educational research. For most of them, it means loosening the ties they might have to the typically positivist perspective of most engineering research, with its “alleged objectivity of scientific knowledge” (Crotty 2007, p. 27). In the words of one of my research participants:

How do you navigate the path of not being ... an engineering academic, but also not being a higher education research academic? [Will].

At the 2012 AAEE conference, 53% of authors from the Australasian (Australia and New Zealand) engineering community had a first degree in engineering. This figure illustrates how examining the transition from engineering academic to engineering education researcher is relevant to the majority of stakeholders in this community. Other relevant stakeholders are universities, faculties of engineering, and professional associations. There are two reasons for the interest of universities and faculties of engineering, at which these academics are employed: the development of academics' skill and expertise in research; and the potential flow-on effect of a positive impact on teaching and learning. The findings from this study will also be useful to professional associations such as AAEE in the designing of activities and strategies that will support academics to become interdisciplinary researchers.

By investigating interdisciplinary academics, including experienced researchers, this research contributes to the body of literature demonstrating the applicability of identity-trajectory theory. The identity-trajectory theory was developed from data supplied by early career academics who were essentially involved in research aligned with their first degree – my application is with academics from a range of levels of experience who have changed their research trajectory, that is, their first degree is in engineering but their research is engineering education. It specifically addresses its value in analysing academics outside of the disciplinary and early career context in which it was developed. Finally, this research also responds to the call from Côté (2006) to move identity research from the “pure to the applied realm” (p. 17).

1.1 Overview of this study

This thesis consists of eleven chapters. Chapter 2 describes the context that engineering academics work in. This encompasses two broad areas: the increasing pressures on individuals in the Australian higher education sector to produce research outcomes; and the development of engineering education as a research field, both in Australia and overseas. Previous studies in engineering education research have identified a need for research on engineering academics and how they negotiate their development in this emergent and interdisciplinary field.

Barnacle and Mewburn (2010, p. 441) ask: “If scholarly identities are learnt, how can such learning be best supported?” To begin answering this question in relation to engineering education researchers, I need a way to conceptualise academic identity reconstruction. Chapter 3 includes an orientation to the conceptualisations of identity and a description of McAlpine and colleagues’ identity-trajectory theory, which is used to frame my research (McAlpine, Jazvac-Martek, & Gonsalves 2008, McAlpine, Amundsen, & Jazvac-Martek 2010, McAlpine & Lucas 2011, McAlpine & Amundsen 2011, McAlpine & Turner 2012, McAlpine, Amundsen & Turner 2013a,b, McAlpine & Emmioğlu 2014). The appeal of the identity-trajectory concept for this research is in the way it uses ‘stranding’ to foreground how individuals negotiate social, organisational, disciplinary structures in an academic context.

Chapter 4 includes a description and explanation of the interview protocols developed to generate this identity discourse, the identification and securing of appropriate subjects to interview, and the method used to analyse the data. Underpinned by the identity-trajectory theory, this analysis demonstrates changes in various strands of academic identity during the transition from emerging to established researcher.

Chapters 5, 6 and 7 describe the findings for emerging, intermediate level, and established researchers, respectively, from their discussion of their conference papers and the reviews on these papers. The data provide evidence that engineering academics' adoption of different research perspectives can be interpreted as the development of the various strands of identity-trajectory theory. These strands include intellectual, networking and institutional identity. Development of the intellectual strand is manifest in the artefacts of their research, which include conference papers, journal articles, books and book chapters. The networking strand includes both interpersonal networking, that is, who they personally know and interact with, and intertextual networking, whose texts they read. Institutional identity relates to the type of university they are employed at, along with their academic rank and the various roles they undertake at that university. Development along each of these strands is influenced by the individual's personal history and agency.

The roles an individual enacts become opportunities to express and develop their identity, in the same way; roles associated with research make an important contribution to academic identity. In Chapter 8 the academic strands of identity trajectory are used to frame the discussion of the roles nominated by participants as being most important to them, and the roles they perceived as most important to their university.

In Chapter 9 I use identity-trajectory to frame discussion of the findings from chapters, 5, 6, 7 and 8 to describe variations in academic identity with levels of expertise and types of university. The engineering education research landscape model facilitated discussion around locations in the proposed engineering education research landscape that researchers can relate to in discussing their research.

As a result of undertaking this research, I have recommendations for both practice and further research that are described in Chapter 10. The recommendations for practice have been classified by stakeholder, specifically, individual engineering academics, faculties of engineering and universities and professional associations such as AAEE. Finally, Chapter 11 provides a summary of the research undertaken and its findings.

1.2 Personal context

The need to research particular issues grows from the contexts in which the researcher operates (Clough & Nutbrown 2012, p. 11).

With a Bachelor of Civil Engineering degree and a Masters in Structural Engineering, and as an active member of the AAEE community, I am undergoing the transformation which is the focus of this study. In other words, I am doing identity work so that I can think of myself, and be thought of by others, as an engineering education researcher. This has the advantage that I am both familiar with many of the experiences described by the participants in this research and sensitive to many of the latent themes in their discourse. Or as Clegg and Stevenson (2013, p. 7) might put it: “She is a fish in the water, part of the habitus, with a feel for the rules of the game.”

Another advantage is that the participants have known me from my participation in the annual AAEE conferences since 2005 and from serving on the AAEE Executive Committee for three years. This familiarity and community service has generated a sufficient level of goodwill and trust in the engineering community to enable participants to be comfortable talking to me about their work in engineering education.

I am also aware of the potential disadvantage associated with being an ‘insider’ and hence perhaps not always able to discern aspects of this community that would be more

obvious to someone who is not a member of it. I have tried to reduce the effect of this by seeking feedback on my work from a member of the AAEE who has a social science background and from an academic who is not involved with engineering education.

Within the AAEE community I have disseminated the findings of this research through papers at its 2012 and 2013 annual conferences and by running workshops at the 2013 conference and the 2014 AAEE Winter School for researchers. Some of the research participants also took part in the workshop at the 2013 conference and, along with the other workshop participants, provided validation that my findings resonated with their experience and were useful in guiding their further personal development. Presentations of various parts of this research at international conferences such as the annual conference of the European Society for Engineering Education (SEFI) and the Research in Engineering Education Symposium (REES) also provided feedback that the experiences of engineering academics in Australia resonated with those from other parts of the world.

Through being involved in the peer review process for papers submitted to the annual AAEE conferences (Gardner, Willey, Jolly & Tibbits 2012, Jolly, Willey & Gardner 2012, Jolly, Willey, Tibbits & Gardner 2011, Willey, Jolly, Tibbits & Gardner 2011a,b), I came to see that not all academics respond the same way to peer review of their manuscripts and that discussion with them about the reviews they received made their thinking about research, particularly research methods, accessible. I also came to realise that the development of a research domain is inextricably linked to the development of the individuals in it. Using identity-theory, which foregrounds individual intention, allowed me to investigate the process of becoming an engineering education researcher in ways that were consistent with my previous experience.

In earlier research in structural engineering I was not aware that there were other ways of doing research than the 'engineering' way. In becoming a researcher in the area of engineering education I have come to realise that this way is typically associated with positivism, and that other epistemological perspectives can be equally as rigorous. In learning about these other perspectives I have come to recognise not only some of the limitations of positivistic research, but also some of its strengths, which I had previously just taken for granted.

I began this research with the objective of developing my own skills in qualitative research methods. I have come to understand why I need a theory to frame my thinking and to argue my position with respect to other theories and bodies of literature. I have strengthened my skills as an interviewer and used them to collect data. I have been able to view this data in an analytic sense and establish findings that relate to the theoretical framework chosen. Most of my challenges have involved arguing my research position with respect to other theories and using the interviews in an analytic way to come to the findings. I look forward to further developing my sensitivities as a researcher in future projects, much as described by Mason (1998):

It has been noted by almost everyone engaged in research that the person who learns the most is the researcher, no matter how well reports are written, how widely findings are communicated, or what other products produced. Questions that seem clear and focused are refined, changed, even transformed; conjectures are modified, sometimes confirmed, sometimes denied, and sometimes remain indeterminate. Throughout this process, the researchers' perspective develops, their sensitivities increase. They see more, make more and finer distinctions. They experience shifts in what they find fruitful to study, in the distinctions they are able to make, in their appreciation of the researched situation and of similar situations, and what constitutes a similar situation. In this sense, the researchers can be said to be learning about themselves as much as about the situation being

studied. Instead of thinking of the situation being studied as being acted upon by the researcher, there is a sense in which the studying of the situation performs an action upon the researcher (p. 369).

Chapter 2. Engineering education as a research field

Engineering academics who are members of the AAEE community are subject to both the general climate of the Australian tertiary education sector and the specific developments in engineering education as a research domain. This chapter summarises the current environment in the Australian tertiary education sector, taking special note of the changing nature of the sector and particular pressures on individual academics. Against this broad background I then trace the evolving nature of the engineering education research domain with reference to higher education research generally. This description of the Australian tertiary education sector and the engineering education research domain provides the background context to this study and supports the characterisation of academic identity development for those engineering academics who research in engineering education.

2.1 Australian tertiary education sector

Cretchley et al. (2014) list the following pressures on Australian universities and hence on academics:

- decreased government funding
- pressure to generate new income
- balancing work and family life
- continuous change
- dealing with slow and unresponsive administrative processes
- finding and retaining high quality staff, and
- increased government reporting and scrutiny. (p. 652)

The previous Australian government's Widening Participation strategy (Bradley et al. 2008) abolished the cap on the number of students enrolling in university programs.

This pressured universities to enrol more students and resulted in increased class sizes

and greater diversity in the skills students brought with them into the classroom, thereby effectively reducing the resources available per student. At the same time, the Excellence in Research for Australia (ERA) process was introduced to measure and rank university research by categorising it into predetermined Field of Research (FoR) codes. This has caused university administrators to intensify the pressure on academics to increase their research output. Hughes & Bennett (2013) explain it this way:

Although the ARC has strongly maintained that the ERA framework is not designed to rate individual performance, institutions expect academics to achieve 'high level' outputs as defined by the framework and often within FoR codes identified as institutional priorities. (p. 342)

This trend in the nature of university environments predates the latest ERA framework, with Fensham (2004) commenting negatively on the way research has been funded and assessed:

[It is] driven by the rather mindless way in which the funding of research in universities everywhere has become more and more driven by research indices that involve quantity of publication and citations rather than more valid measures of quality. (p. 92)

Dollery, Murray and Crase (2006) comment on how the language used in university policies and other documents illustrates a change in values in this new environment from 'collegiality' and 'freedom of thought' to 'accountability' and 'efficiency'.

Similarly, Churchman and King (2009) comment on the changed environment in Australian universities:

Academic work is becoming increasingly restrictive and controlled as tertiary institutions move towards a more corporate managerialistic mode of operating. (p. 507)

and

The work of individual staff has been increasingly subjected to the audit culture which is evident in managerialistic environments. (p. 509)

The result is an environment in which funded research is valued more than unfunded research and the autonomy of individual academics to decide what research they undertake has been severely restricted. McNay (2009) says: “What is clear is that control of the research agenda has shifted away from the individual doing the research” (p. 47).

In their study of the impact of change and the ERA on Australian researchers, Hughes and Bennet (2013) report:

[Research participants felt] frustration with inconsistent and patchy ERA information from otherwise reliable sources. This was seen to be a function of the rapidity of change between 2008 and 2011, which included changes to, and the eventual demise of, journal rankings, changes to assessment timeframes and changes in the FoR codes allocated to individual researchers. (p. 345)

Furthermore:

Respondents also felt that ERA discourages collaboration, multidisciplinary and applied research and certain types of publication and that ERA will narrow the focus of future research funding. (p. 350)

This last observation is particularly relevant to research areas such as engineering education because it is often collaborative, multidisciplinary and applied. A research study that displays these characteristics would generally be applauded by members of the research field but would be discouraged by individual institutions and funding body reviewers under the current metrics. Such mixed messages are likely to have negative stressful impacts on individual researchers.

The current (2015) Australian Government has intentions to deregulate the university

sector, thereby allowing the tertiary education sector to respond to market forces and universities to set their own fees. As government funding based on student numbers decreases further, the pressure on universities to increase funding through other means such as project funding and publication rates is likely to intensify.

These influences would seem to encourage activity in all research areas. However, not all areas of research are valued equally. Cretchley et al. (2014) suggest that universities in Australia do not reward higher education discourse and research into learning and teaching. They found that the professoriate in Australian science, technology, engineering and mathematics (STEM) faculties across a range of universities does not value the literature and conference participation that pertains to learning and teaching: “The low value these professors accord higher education as an area of research activity and academic discourse is clear” (p. 664). These researchers call for efforts to “support and reward academics across a range of disciplines to research in areas of higher education, and discourse on L&T, and strategies to ensure that higher education research brings the same professional rewards as research in other fields” (p. 665).

Krause (2014) reports similar findings in relation to history and mathematics academics, and notes:

[These academics have] limited avenues for informed debate on a range of epistemological issues that lie at the heart of how curricula are designed and how students learn in disciplinary settings. (p. 17)

She recommends

examining academic staff perceptions of how and what students learn in disciplinary settings. [This] also involves taking account of the complex factors influencing how academics define their work and their identity, including the

influence of disciplinary cultures and how to foster communities within and across disciplines. (p. 17)

Such discipline-based educational research has the potential to develop what Sadler (2011) described as a hybrid academic made up of two parts:

[One part is] constituted by expertise in the substantive field of scholarship, research and professional practice; the other part would be constituted by expertise as members of the guild of educators in that substantive field. The two parts together are constitutive of the academic as a distinct category or profession. The challenge is to further clarify and develop this identity. (p. 91)

Brew (2001, 2006) argues that the different ways that senior researchers talk about their research is strongly linked to their identity, and that while there are disciplinary influences in this discourse, the discipline does not completely define the variation in experience. She identified four variations in the way that senior researchers think about research: domino, trading, layer, and journey. The domino variation refers to thinking about research as a series of questions/tasks where “Solving one problem or finding an answer to one question can set up a chain reaction in regard to other problems or further questions” (Brew 2001, p. 24).

In the trading variation the focus is on the artefacts created from the research i.e. grants, and publications, which have value based on their ‘currency’ for promotion or other measures of status. Researchers dominating the layer variation talk about research “as a process of discovering, uncovering or creating underlying meanings” (Brew 2001, p. 25). The final variation, journey, is apparent when researchers interpret research as a process contributing to their personal development and possible transformation.

These research studies frame a role for the engineering education research community to explore perceptions of academic identity in that community. Some of the ways

particular academics think about and undertake their research can be attributed to disciplinary influences, but some influences are not tied to discipline and relate more to personal attributes. The next section of this chapter describes the development of engineering education specifically as a research domain.

2.2 Development of engineering education as a research domain

Engineering education is an emergent research area and as such the paths to gaining expertise are less clearly defined than in mature research domains. At the same time, the norms or standards relating to the practice are being negotiated within the community. For individual researchers this means there can be conflict over foundational knowledge such as the validity of using particular theories and methods. These difficulties are compounded by typical engineering education not generally preparing individuals to undertake the interpretive type of research which is more useful in educational contexts. This means we are trying to learn different ways of doing, talking and writing about research when the standards for our research area are still evolving. In addition, approaches to research vary according to their geographic locations. The next section explores these themes in an overview of the research field.

2.2.1 Disciplinary differences in research methods

Scholars in this emergent research field are continuously refining their vision and goals, bodies of knowledge, theoretical and methodological frameworks and standards that will develop the “shared theories, models, values ... and exemplars” (Haghighi 2005, p. 351) that characterise a disciplinary discourse. The most controversial issues they encounter deal with methods and educational research norms. In a paper titled “The Future of Engineering Education” for the 2002 Frontiers in Education (FIE) conference

(Schuman et al. 2002), Alisha Waller suggested there are three types of research happening in the community. These are classroom application research, evaluation research and discovery research (p. 10). She notes that “engineering education research often lacks explicit theoretical frameworks” and attributes this to engineers’ lack of training in educational research:

Within engineering education, many researchers use an experimental or quasiexperimental design because it is closely aligned to the "scientific method." In addition, surveys are the most prevalent method of data collection, perhaps because engineers generally are comfortable with the statistical analyses that can be applied. However, this focus on experimental designs and survey methods illustrates a larger concern for prevalence than for depth of understanding. Investigating student experiences via a Likert type survey for example, requires that the researchers "know" in advance what issues and ranges of experiences are possible. By definition of the instrument, students are restricted in their opportunities to describe their experiences; hence we lose depth of understanding to gain more confidence regarding prevalence. (Waller, in Schuman et al. 2002, p. 11)

Waller’s complaint is an example of the what Borrego (2007) describes as conceptual difficulties experienced by workshop participants in a 2005 study funded by the National Science Foundation (NSF) program Rigorous Research in Engineering Education. Her list has significant overlap with the “five difficulties encountered by engineering faculty learning to design rigorous education studies” mentioned by Stierer (2008):

1. framing research questions with broad appeal
2. grounding research in a theoretical framework
3. fully considering operationalisation and measurement of constructs
4. appreciating qualitative or mixed-methods approaches
5. pursuing interdisciplinary collaboration. (p. 100)

Borrego (2007) suggests these difficulties can be attributed to academics who have been trained in engineering disciplines that have high consensus of methods and standards moving to the emerging discipline of engineering education which has “far less consensus of methods and standards of rigor” (p. 101).

Jones (2011) notes that in consensus-based disciplinary classification schemes “high paradigmatic fields have high levels of agreement among their practitioners with regard to issues such as appropriate research topic and methods” (p. 11). An example of this type of field would be engineering. By contrast, “low paradigmatic fields have less agreement in relation to appropriate research questions and even less agreement on appropriate methodology for addressing these questions” (p. 11). An example of this would be the field of education.

The dominance of quantitative research perspectives and methods in engineering education has also been noted by Beddoes (2011):

Despite being an interdisciplinary research area ... positivist contributions from fields like psychology are ... more readily accepted without great effort on the part of authors than are critical qualitative approaches. (p. 8)

In this thesis, ‘interdisciplinary’ refers to work by an individual researcher on a study or in an area of research which combines two or more academic disciplines. This does not mean that researchers are working alone, but it distinguishes their situation from one where a group of researchers is working on a study and individuals in the group have a background in different single disciplines. While recognising that some researchers attach slightly different meanings to terms such as interdisciplinary, transdisciplinary and multidisciplinary, for the purposes of this study I mainly use the term interdisciplinary in line with Manathunga (2009):

There is a proliferation of terms such as multidisciplinary, interdisciplinarity and transdisciplinarity to choose from. Even after such a selection is made, very few people agree on precise definitions. I have chosen to use the term interdisciplinarity. (p. 131)

Land (2012) supports the idea that learning to be an interdisciplinary researcher is difficult, likening it to a ‘threshold concept’ for many academics:

The journey toward a more interdisciplinary mode of thinking and practising is likely to be instigated or provoked ... by an encounter in the preliminal state with a form of ‘troublesome knowledge’ ... the ontological shift experienced within the liminal space will also incur – and require – a loosening or weakening of disciplinary identity ... producing a postliminal state marked by a changed use of discourse. (p. 177)

McKenna, Yalvac and Light. (2009) highlight the importance of dialogue for constructing meaning. Their work suggests that critical dialogue could be a successful method for conceptual change amongst academics in regard to engineering education research, as it was in relation to approaches to teaching. They say: “Collaboratively reflective activities have been shown to impact faculty teaching” (p. 18).

Borrego, Streveler, Miller & Smith (2008) believe that it is imperative that community members engage in this type of discussion:

The development of engineering education as a field is likely to be impeded if alternative viewpoints are not resolved or at least framed with respect to one another and discussed openly. (p. 160)

Continuing this line of argument, Borrego, Douglas & Amelink (2009) contend that such discussions are particularly important in developing researchers’ expertise in understanding a range of research methods.

This focus on the need to discuss methods arises from the different research practices

needed for educational research compared to the typical research undertaken in engineering disciplines. As Clegg (2012) says:

Social science and humanities disciplines are more likely to share some of the same epistemological concerns as those of researchers into higher education in ways that science-based disciplines do not. (p. 673)

Stierer (2008) emphasises the influence of disciplinary characteristics:

Approaches to research design and reporting, the meaning and place of ‘theory’, implicit judgements as to what ‘counts’ as a researchable problem, issues that are foregrounded and backgrounded, and assumptions as to appropriate structure and ‘voice’ in scholarly writing, are all tinged to a greater or lesser extent by the norms and traditions of the discipline. (p. 6)

Rowland (2009) also comments on some of the disciplinary difficulties of engineering academics learning to be educational researchers:

There is perhaps a tendency for those in the natural sciences to have other things to think about than the epistemological basis of their enquiries. The acceptance of (and certainty about) epistemological matters is characteristic of what Kuhn (1962) called ‘normal science’ (as opposed to science which is undergoing ‘revolutionary’ change). In the critical social sciences, however, the epistemological basis of claims to knowledge has been a major preoccupation of many. (p. 584)

Winberg (2008) makes similar claims in reporting the changing identities of engineering academics from ‘engineer’ to ‘engineering educator’ as they undertook studies in education. She suggests that being an ‘engineering educator’ requires both high levels of engineering knowledge and pedagogical knowledge. She writes how her research participants found it difficult to reconcile the two fields:

Higher education studies and the engineering disciplines differ fundamentally in many ways: how knowledge is produced, what kind of knowledge is valued, as well as how one teaches or communicates this knowledge. (p. 365)

As noted above, this preference for quantitative research has been attributed to our formal training as engineers, which influences expectations and norms for engineering education publications in which quantitative and positivist research is generally dominant (Borrego 2007; Koro-Ljungberg & Douglas 2008; Borrego, Douglas & Amelink 2009; Douglas, Koro-Ljungberg & Borrego 2010; Borrego & Bernhard 2011).

However, although we engineers may start from a positivistic, quantitative perspective, there is evidence that engineers can learn to incorporate methods from other research traditions:

Research on primarily U.S. engineering education researchers indicates that they are more comfortable with quantitative research approaches, but are open to qualitative methods when faced with the complexity of studying human beings in classrooms and similar settings. (Borrego & Bernhard 2011, p. 23)

In Australia, while the dominant research paradigm has also been quantitative, some researchers are using qualitative methods. As Godfrey (2009) notes:

Qualitative research methodologies were the methods of choice in situations where local knowledge and interpretation were needed to assign meaning to words and actions consistent with the meanings assigned by members of the group under study. (p. 3)

Fensham's (2004) description of much of science education research is similar to how many engineering education papers could be characterised, reflecting the epistemological bias of our engineering background:

A lot of research in science education has been underpinned by a belief that can be stated as follows: Science learning ... is affected by factors, that students (or teachers) have in their person or that derive from the social milieu they are in, or have been in. Since it is not clear which of these factors are more significantly related, measures of a number of them that seem likely to be involved are sought, and appropriate statistical methods are then applied to show where the weight of

the relationships lie. This is a theoretical position that says that Xi is related to Yi, where Yi's are desirable educational outcomes and the Xi's are the possible factors, the influence of which can be determined ... In other words, although this position acknowledges the social complexity of education, it also believes that this social complexity can be unravelled in terms of factors that have stable definitions and are measurable, if sufficiently large samples of students are studied. (pp. 115–116)

Fensham (2004) found that as science education researchers gained experience they began using qualitative methods to “get at mechanisms of student thinking, rather than just the summative data before and after some treatment” (p. 125). These findings echo the comments of Borrego (2007) and Godfrey (2009) earlier in this section in relation to similar changes in engineering education researchers.

2.2.2 Model of individual researcher development

Streveler, Borrego & Smith (2007) (cited in Borrego et al. 2008 and Smith 2011) propose a developmental trajectory of engineering academics into engineering education research, as shown in Table 2.1. The different levels are characterised by the degree of engagement with theoretical frameworks, data collection and analysis methods and the anticipated audience for dissemination of results. Operating at Level 4 depends on having expertise with the framing of research questions, application of theoretical frameworks and relevant methods of data collection and analysis at the standard required to be recognised as contributing archival knowledge to the field. Awareness of publication standards at each level is required before an engineering academic can self-assess their current level of activity. There is no goal or expectation, however, that all engineering academics will move to Level 4. Smith (2011) suggests this “will likely be a small fraction of the entire community; however, those practicing

at Level 3 could be a large portion of the community” (p. 4).

Table 2.1: Levels of rigor in inquiry in engineering education (after Streveler, Borrego & Smith 2007)

Level of inquiry	Attributes of academic at that level
Level 0: Teacher	Teaches as taught
Level 1: Excellent teaching	Uses accepted teaching theories and practices
Level 2: Scholarly teaching	Assesses performance informed by best practice and makes improvements
Level 3: Scholarship of teaching and learning	Engages in educational experimentation and makes results public, open to critique and evaluation.
Level 4: Rigorous research in engineering education	Is public, open to critique, asks why or how questions about learning rather than what or how much, ties questions to learning, pedagogical, or social theory and interprets results of the research in light of that theory, pays attention to design of the study and methods used.

This hierarchial representation of levels of activity in engineering education has alienated many in the AAEE community who interpret it as meaning that there is only one pathway, that Level 4 activity is inherently more valuable than activities at other levels and is the only level of activity that can be regarded as ‘rigorous’. This is partly because in several publications the hierarchy has been labelled as “levels of rigour in inquiry” (Borrego 2007 p. 94). Tensions between theoretical and practice-based perspectives are also evident in the general higher education literature (Harland 2009, Rowland 2009).

The proponents of the hierarchy concede that this interpretation is not unusual and that “refinements are necessary” (Borrego et al. 2008, p. 155). In their latest explanation of this framework, Borrego and Streveler (2014) change their wording slightly by referring

to a “type of inquiry” rather than a “level of inquiry” and delete the numbering of levels in response to these arguments. They more fruitfully propose a cyclic process linking educational practice and educational research (p. 459).

Hubball, Clarke and Poole (2010) use a less judgemental term by referring to “scholarship of teaching and learning (SoTL) research”, which they differentiate from scholarly approaches to teaching and learning. For them,

[SoTL research is] shaped by multi-disciplinary research contexts and focuses on practice-driven institutional/curricula/classroom inquiries with particular epistemological ..., methodological ... and ethical ... considerations. SoTL internalizes theory and practice through a systematic and cyclical process of inquiry that may involve at various points hypothesis testing, planning, observing, analysis, and action, and includes the ... public dissemination of pedagogic research in peer-review contexts. (p. 118)

While very similar to Level 4 activity in Table 2.1, this description makes distinctions between processes without polarising people in discussions of theoretical research versus practice-based research.

Similar researcher development trajectories are mirrored in the general higher education literature (for example, Clegg 2012); and in the educational research literature of other disciplines such as mathematics (Mason 1998), science (Fensham 2004) and computer science (Fincher & Tenenbergs 2006).

2.2.3 Identity issues in the research field

Figure 2.1 shows the ‘general’ and ‘more specific’ research goals identified from discussions with delegates at a specially convened engineering education research conference in 2007 (Jesiek, Newswander & Borrego 2009). Examination of the ‘more

specific' goals shows that terminology and standards need to be negotiated, with calls for the community to establish "what counts as research", agree on "more consensus on what credible evidence means", "develop a common language for pursuing deeper and more progressive work" and agree on "fundamental knowledge". Jesiek et al. suggest that their data "reveals both an overall lack of clarity and continued sense of ambiguity about the identity and status of engineering education research" (p. 39). Their participants "generally agreed on the value of conferences and similar events as sites for learning, sharing results and collaborating" and that this learning was about "best practices and standards" (p. 46).

General	<ul style="list-style-type: none"> • "Sustain the innovation" • "Building depth" • "Cutting edge research"
More Specific	<p>Progression (Abbott, 2001; Adams et al., 2006)</p> <ul style="list-style-type: none"> • "Learn what others are doing and [build] on it." • "Pushing a research agenda forward from year to year." • "Keep advancing the body of knowledge." • "Build our expertise." <p>Research Agenda</p> <ul style="list-style-type: none"> • Identify "emerging needs for engineering education research." • "Uncover international fundamentals." <p>Standards of Quality and Evidence</p> <ul style="list-style-type: none"> • Establish "what counts as research." • "Rigorously peer-reviewed high-quality work." • "Do a more rigorous and scientific job." • "More consensus on what credible evidence means." <p>Terminology</p> <ul style="list-style-type: none"> • "Develop a common language for pursuing deeper and more progressive work." • Come to agreement about "fundamental knowledge" and "common language."

Figure 2.1: Research goals and objectives (Jesiek et al. 2009)

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In relation to reward structures, Jesiek et al. (2009) noted

[a] high level of consensus regarding a lack of recognition for engineering education researchers, especially for those in traditional departments ... [The] current structures of recognition handicapped those who did not fit the strictly defined values and reward systems of traditional disciplines (p. 46).

There were however disagreements about credible research methods, specifically between quantitative and qualitative research methods. These researchers suggest that their participants “demonstrated a preoccupation with their ambiguous status as participants in an emerging field” (p. 48) and that research-related goals are supported by “the cultivation of a disciplinary identity for engineering education researchers” (p. 49). This suggests that those engineering academics who think of themselves as (i.e. identify with) the research area of engineering education are more likely to achieve their ‘research-related goals’.

While most controversy surrounds methods and educational research norms, issues with audience and inclusivity, i.e. what work is classified as research, “remain a source of tension in the broader engineering education community” (Borrego et al. 2008). Issues with audience include questions of whether the research should be written for other researchers, or for practitioners – those in the classrooms teaching engineering.

At ten different engineering education conferences during 2007 and 2008, Jesiek, Borrego and Beddoes (2010) “observed generally high levels of agreement and consensus” (p. 125) on the importance of strong linkages between engineering education research and the practice of teaching engineering. These include issues of practice influencing the research agenda, research findings being disseminated to engineering educators and embedded in their teaching practice, and a cyclic relationship between the two. In other words, research generates innovative practice that is evaluated

and may lead to further research that is again implemented.

These findings do not align with the perceived USA-based push to privilege theoretical research over practice-based studies generated by the editorial agenda of the JEE, discussed in Section 2.2.4.1. and artefacts such as the Borrego researcher development model (see Table 2.1).

Workshop participants at these conferences valued efforts to build community and suggested that this could be achieved by

recruiting and supporting scholarly teachers and researchers, organising conferences and workshops and publishing results with practitioner audiences in mind. (Jesiek et al. 2010, p. 127)

In the area of mathematics education research there does not seem to be the same tension between theoretical and practice-based research that is evident in the engineering education community. Practice and sharing practice are both valued as contributing to a body of knowledge:

Where several colleagues find that they recognize each other's descriptions of incidents and phenomena, a body of shared experiences accumulates, which serves to enhance noticing in the future. By 'noticing the noticing', or in other words by labeling a collection of experiences with a descriptive term, that term can contribute to a framework that enhances noticing in the future. It is as if something inside generalizes from the particular, triggers the label, and so provides access to the collection of responses and comments on such situations which have been accumulated through collegial sharing. (Mason 1998, p. 367)

Interestingly, Jesiek et al. (2010) suggest that the people who typically attend engineering education conferences are:

staff/faculty interested in improving their teaching; staff/faculty presenting their scholarship of teaching and learning; engineering deans/heads of school and heads

of department; researchers and other scholars who study engineering education; and industry/government employees or similar stakeholders in engineering education. (p. 123)

They note the importance of engineering education conferences as times and places where dialogue occurs about engineering education, both its research and its practice. However, they refer to engineering education researchers and engineering educators as if they are two different groups of people, which seems to be the favoured model in the USA: “These ideas suggest, for example, that engineering instructors should be enrolled as equal and active partners in engineering education research” (p. 130).

At one of the European conference workshops, Jesiek et al’s (2010) participants suggested that engineering educators should be encouraged to become engineering education researchers, that is, researchers who are a subset of engineering educators, rather than a separate group. This would involve “giving engineering instructors the right knowledge, methods and tools so they could research their own questions and ‘solve their own problems” (p. 127), and would be more in line with the situation in Australia.

At most of their workshops Jesiek et al. (2010) found that professional development of engineering educators was identified as an important research area and “participants more generally indicated the desirability of conducting research on the beliefs, perspectives and/or behaviours of engineering faculty/staff” (p. 128).

In a continuation of their work exploring the nature and extent of engineering education as a research domain, Jesiek et al. (2011) refer to engineering education research as a “relatively young domain of research”, yet one that is “gaining global momentum and coherence as a field of academic activity” (p. 77). They identify the USA, the European

Union (EU), and Australia as particularly active regions for engineering education research. However, their participants “felt their home institutions were not providing adequate support for engineering education research” (p. 77). They report that “research activity in Australia has been bolstered by vibrant professional groups, conference, and publication outlets, the development of a cohesive and well-connected regional community of researchers” (p. 84). While most engineering education research relates to undergraduate education, they found:

A notable number of papers focused on other study contexts and populations, including professional practice and continuing education (profession with 48 articles), pre-college (k12 with 33 articles), faculty/staff characteristics and training (faculty with 23 articles), and (post)graduate engineering education (graduate with seven articles). (p. 87)

Jesiek et al. (2011) make three recommendations related to the creation and use of the outputs of research writing:

1. Journal editors and conference organisers ask for detailed abstracts of manuscripts for submission
2. Authors pay more attention to the keywords used to categorise their papers
3. Access to published literature in engineering education be improved.

Associated with such publication is the peer review process. Borrego et al. (2009) and Godfrey (2009) note dissatisfaction with the review process associated with engineering education conferences and journals, specifically in relation to an apparent bias for quantitative research methods over qualitative research methods:

The explanation offered for this perceived bias was the limited, traditional training and exposure of reviewers. Since peer reviewers are members of the community, conference presentations and discussions are an important means of exposure to difference methodological approaches. (Borrego et al. 2009, p. 62).

While issues with the peer review process are not limited to the engineering education research community (Rothwell & Martyn 2000, Peters & Ceci 2004), this is the community targeted by this research. Improvement would require not just researchers developing domain knowledge of theories and methods, but for novices in particular to develop judgement about what is acceptable practice in the field. This would require the negotiation of some consensus within the community of just what is the acceptable standard of practice in the field.

Weller (2011) argues that this need to discuss different methods is not just about understanding what the language of higher education means but also how it facilitates the necessary re-negotiation of academic identity by academics when first engaging with this different research paradigm. Comparing the way new lecturers read a research paper from their own discipline to how they read a research paper from higher education, Weller (2011) found that:

Where the new discourses they encounter position the readers as novices, the lecturers quickly resort to social and autobiographical notions of self as members of an expert community within the academy ... [When] academic reading in their disciplinary contexts is conceived of as a dialogic practice, the difficulty the readers in this study experience in entering into an analogous conversation with the higher education research texts implicitly undermines their perception of their agency as readers ... [They] respond by positioning the higher education research as non-academic texts as a strategy for reasserting the connection between their everyday academic practices and their academic identity. (p. 99)

Participants describe their sense of their insider relationships within their own discipline and comparative outsider identity in relation to the higher education research community ... [and] explicitly connect their perceived exclusion from the higher education research community to a threat to their academic identity. (p. 100)

In becoming engineering education researchers, engineering academics need opportunities for renegotiation of their academic identity, not just an explanation of different research methods. In other words, engineering academics need to do identity work as well as cognitive work to be able to engage at a deeper level with engineering education research.

2.2.4 Global overview of recent developments

2.2.4.1 USA-based development

In 2005, the journal of the American Society for Engineering Education (ASEE), the *Journal of Engineering Education* (JEE), took a strategic change of direction to disseminate the work of a particular group within the society:

What we are witnessing is the emerging discipline of engineering education, a discipline supported by a growing community of engineering scholars dedicated to the advancement of engineering education through research. (Lohmann 2005, p. 1).

Titles of editorials in the JEE since 2005 (see Table 2.2) give an indication of how the ASEE has seen the development of the discipline of engineering education occurring. However, references to a ‘discipline’ at the start of Table 2.2 contrast with the 2014 editorial reference to a ‘field’. Jesiek et al. (2009) titled their journal paper “Engineering education research: Discipline, community, or field?” and settle on ‘field’, backing away from the term ‘discipline’. This status and change of perception was reflected in a 2010 conference keynote address by the editor of JEE who stated that “by and large this is a community that still operates on the margins” (Lohmann, 2010), which is in contrast to his statement of five years earlier (quoted above) using the term ‘discipline’. More recently, Borrego and Streveler (2014) have supported the ‘field’ terminology:

We take the stance that engineering education is an emerging field, rather than a discipline, to emphasize its openness to interdisciplinary approaches and scholars. (p. 464).

Table 2.2: Titles of selected JEE editorials since 2005

January 2005	Building a community of scholars: The role of the Journal of Engineering Education as a research journal (Lohmann, 2005)
July 2005	Advancing engineering education in a flattened world (Gabriele, 2005)
October 2005	Quiet no longer: Birth of a new discipline (Haghighi, 2005)
April 2006	Conducting rigorous research in engineering education (Streveler & Smith, 2006)
October 2006	Shaping the discipline of engineering education (Radcliffe, 2006)
April 2008	The time is now: Are we ready for our role? (Haghighi et al., 2008)
July 2008	A rising global discipline (Lohmann, 2008)
April 2009	Useful sharing (Fincher, 2009)
October 2009	Engineering education research: Coming of age in Australia & New Zealand (Godfrey & Hadgraft, 2009)
October 2010	From the margins to the mainstream: The emerging landscape of engineering education research (Streveler & Smith, 2010)
April 2011	Sustaining and expanding engineering education research worldwide (Lohmann, 2011)
July 2013	Educational practice and educational research in engineering: Partners, antagonists or ships passing in the night? (Felder & Hadgraft 2013)
January 2014	Confusions and conventions: Qualitative research in engineering education (Baillie & Douglas 2014)
July 2014	<i>The Cambridge handbook of engineering education research and Reflections on the future of the field</i> (Johri & Olds, 2014)

In coming to this position, Borrego and Streveler (2014) were informed by the three categories of criteria Fensham (2004) used to define science education research as a discipline: structural, research, and outcomes. Borrego and Streveler (2014) support the view that the domain of engineering education research meets the structural criteria, which include academic recognition, research journals, professional associations,

research conferences, research centres, and research training. There are several engineering education specific journals such as JEE, EJEE, and IJEE that have an international readership.

Froyd and Lohmann (2014) report that there are approximately 20 centres in the USA where research in engineering education is conducted and that most of these have been established in the last decade. Most of these centres offer postgraduate studies in research training. Individual researchers also have the opportunity to apply for funding to support their research in engineering education through the National Science Foundation (NSF). The administration of discipline-based education grants and discipline-based grants by the same funding body has helped to improve the status of engineering education research in the USA.

Research criteria relate to the intellectual characteristics of work that identifies as science education research and include scientific knowledge, asking questions, conceptual and theoretical development, research methodologies, progression of research thinking, model publications, and seminal publications (Fensham 2004). In relation to research methodologies, Fensham is referring to those associated with a particular research area. Borrego and Streveler (2014) argue that in not having a 'signature' research methodology, engineering education research has not yet achieved the status of a discipline.

The final category of criteria relates to outcomes, and the single criterion listed under outcomes is that of developing implications for practice. While there are many implications for practice in the engineering education research literature, these implications do not yet seem to have significantly influenced mainstream practice

(Prince, Felder & Brent 2007).

Emergence of this research domain is not only evident in the USA. Many of these issues cross language/culture borders, with a report of a workshop in Mexico finding a high level of interest from engineering academics, a need for ongoing opportunities for discussions on the design and implementation of research studies, and a lack of recognition of engineering education as a legitimate field of engineering research (Guerra & Cox 2009).

2.2.4.2 European-based development

The European Society for Engineering Education (SEFI) established a Working Group on Engineering Education Research in 2008. While the USA approach has been to illustrate how typical engineering research is different from educational research, the Europeans have taken a more holistic and philosophical approach in exploring how engineering educational research is engineering. Bernhard (2013) refutes the claim by Borrego (2007) that engineering education research is fundamentally different from engineering and in doing so argues the importance of practice and the practical context for theory development in engineering education and engineering education research.

Bernhard and Baillie (2013) argue that no one research approach should dominate the engineering education research domain and hence assessment criteria, either for publications or grants, should not be written to privilege one type of research over another. Although they have a more holistic appreciation of what quality research is compared to the more atomistic USA perspective, they note that aspects of quality research that have largely been missing in the domain are methodological and epistemological awareness and consistency. These researchers see an understanding of

practice as an important aspect of theory development, as noted in their introduction to a special edition of the *European Journal of Engineering Education* (EJEE):

We have tried to make it clear, in this introduction, how different theories have been used as tools in different studies and how the authors by intertwining and making syntheses contribute to theory development as well to the development of engineering education. This is at the very heart of successful approaches in engineering where the development of theory and practice goes hand in hand. (Baillie & Bernhard 2009 p. 293)

The European perspective then is that research and practice should complement each other rather than compete with each other.

Also from Europe, Williams and colleagues (Neto & Williams 2012, Alias & Williams 2011, Williams, Wankat, Neto & Tiago 2014) have used bibliometric analyses to illustrate the range of disciplines referred to in engineering education publications and the range of geographic locations of authors, and they argue that engineering education research is not yet a global research domain, since publications from USA and Australia dominate the field. In particular, Williams et al. (2014) found that geographical location can strongly influence who scholars collaborate with.

Looking at strategic pathways that academics take to get into engineering education research, Alias and Williams (2011) analysed publications from Malaysian authors to demonstrate the effect of a top-down directive in increasing engineering education publications. They commented on the positive effect of institutional support in increasing the number of publications.

The strategic pathway labelled 'spontaneous generation' was explored by Williams and Figueiredo (2012) through interviews of scholars who were encouraged to tell their

stories of how they got into engineering education. The majority of scholars interviewed identified that others' views of engineering education research as 'not real research' was one of their major challenges and obstacles, which some overcame by securing research funding (because money implies legitimacy) or by their appointment to a senior position at their university.

2.2.4.3 Australian-based development

Like SEFI, in 2008 the Australasian Association for Engineering Education (AAEE) also established a Special Interest Group in Educational Research Methods to encourage the development of an engineering education research community in Australia and New Zealand. While the University of Southern Queensland hosted a Faculty-based engineering education research centre from 2007 (Brodie, Bullen & Gibbings 2011), sadly with a change in Dean this research group has since lost funding support. Other research groups active in engineering education are: the Science and Mathematics Education Centre (SMEC) at Curtin University (<https://smec.curtin.edu.au>), the Science Technology Engineering Mathematics Education Centre (STEMed) at Swinburne University of Technology (<http://www.swinburne.edu.au/science-engineering-technology/STEMed>), (Chang & Mann 2010, Mann, Chang & Mazzolini 2011, Mann & Chang 2012), and the Future Engineering Education Directions (FEED) special interest group of the Learning and Teaching Education Research Centre at Central Queensland University (<http://www.cqu.edu.au/research/research-organisations/institutes/education-research/learning-and-teaching-education-research-centre/special-interest-groups/sig-future-engineering-education-directions>).

These groups are affiliated with science education research centres or general higher education research centres, rather than being stand alone specialist engineering

education research groups. This supports the argument that engineering education research does not currently have the status of a discipline in the Australian context. In terms of Fensham's criteria for defining a discipline (see Section 2.2.4.1), engineering education research is still consolidating as a recognised research area. Referring to the Australian engineering education community (Kavanagh et al. 2012) report that "it is not even certain that educational research is counted in all engineering departments" (p. 6). They found further differences among types of Australian university:

While more junior respondents, especially those at newly created universities and ATNs, appeared to believe that educational research by engineers would be counted as research activity, this was denied by others especially those at Go8s.¹ (p. 7)

However, both the Europeans (see Williams et al. 2014) and the Americans (see Jesiek et al. 2011) comment on the volume of engineering education research publications from Australia, which they claim is second only to that of the USA. Jesiek et al. (2011) also highlight Australia's "cohesive and well-connected regional community of researchers" (p. 84). This suggests that even without significant institutional support or formal study pathways, some engineering academics in Australia have been able to transition to becoming engineering education researchers. The academic identity renegotiation required for this to occur is the subject of this research.

2.3 Summary

As members of an emerging research field, engineering educational researchers have noted that their community is still resolving issues such as: appropriate research

¹ ATN refers to the Australian Technology Network of five universities with a technological research focus (<https://www.atn.edu.au>)
Go8 refers to the Group of Eight, which are the older, more established Australian universities (<https://go8.edu.au>)

methods especially in relation to the need to use a theoretical framework; the benefits of using qualitative research methods; the intended audience for publication (should it be for other researchers, or for practitioners?) and how to link research to practice.

Researchers at universities across the globe report a lack of institutional recognition and reward for academics who undertake research in engineering education because it is often associated with the academic domain of teaching and learning, which is lower in status than the typical research that engineering academics carry out.

While Clegg (2012) would classify much of what is published in engineering education outlets as belonging to the field of “disciplinary teaching research”, she says, “It is difficult to analyse the emergence of research into higher education without also considering the trajectory of academic development” (p. 667). Researchers such as Jesiek, Borrego and Beddoes from the USA and Williams and colleagues from Europe have identified a need to investigate how engineering academics negotiate their development in the emergent and interdisciplinary field of engineering education research. Even if the developmental trajectory suggested in Table 2.1 is accepted, the movement of an individual from one level to another will require not only cognitive changes but also a renegotiation of their academic identity. Sadler (2011), Weller (2011) and Krause (2014) write that changes in modern university environments impact on academic identity, and Brew’s (2001, 2006) work highlights the importance of academic identity in framing how an academic thinks about their research.

A growing body of literature is shedding light on the mechanisms by which engineering students develop (or not) an engineering identity (Loui 2005, Tonso 2006, 2014, Allie et al. 2009, Eliot & Turns 2011). Tonso (2014) provides a particularly useful overview of this research. The professional identity constructs of professional engineers in practice

have also been studied (Jorgenson 2002, Faulkner 2007, Gouzevitch & Jones 2011, Hatmaker 2012). In addition, Jawitz (2007, 2009) and Winberg (2008) have each examined the academic identity negotiation of members in an engineering department in universities in South Africa. In a similar way this current research has turned to identity theory to explore how the development of academic identity, specifically for engineering education researchers, can be characterised and supported. The next chapter includes an orientation to the concept of academic identity and a description of the theory used to frame this research.

Chapter 3. Academic identity construction

The extensive literature in psychology and sociology relating to identity is essentially based on the premise that “people’s thoughts and feelings about themselves are important determinants of their behaviour” (Leary & Tangney 2012, p. vii). These disciplinary-based perspectives tend to focus on the individual (psychology) or the social (sociology) in studying identity. In this chapter I will discuss how these perspectives are related to the concept of identity-trajectory, which underpins my research framework. Identity-trajectory is concerned with the individual, specifically how the individual constructs their academic identity through interaction with various social and/or disciplinary groups and structures. The identity-trajectory framework was developed by McAlpine and colleagues (for example, McAlpine, Amundsen & Jazvac-Martek 2010).

In the first section of this chapter on academic identity construction I discuss a range of theories and conceptualisations of identity. In Sections 3.2 and 3.3, I describe the identity-trajectory framework and how I validated its use for my research. A summary completes the chapter.

3.1 Theories and conceptualisations of identity

Various literatures focus on either the effect of the external (social and/or structural environment) or the internal (e.g. personal agency) on an individual’s identity development (Trede, Macklin & Bridges 2012). Taylor (2008) summarises Hall’s (2004) historical overview of the development of the Western concept of identity as:

- ‘taken on’ through shared practices that demonstrate faithful acceptance of given truths

- constructed through individual thought and reflection based on doubt and scepticism, rather than uncontested dogma and tradition
- co-constructions, with an individual's 'traits, beliefs, and allegiances' reflecting non-rational processes and commitments
- continuously 'under construction' in contexts that are characterised by indeterminacy, partiality and complexity.

Hall also notes: “[The] postmodern perspective acknowledges that an individual can draw on all of these philosophical traditions in context-responsive ways” (Hall, cited in Taylor 2008, p. 29).

The importance of social and structural effects on identity construction is suggested by researchers such as Wenger (1998), for whom the idea of identity is linked to communities of practice: “Building an identity consists of negotiating the meanings of our experiences of membership in social communities” (p. 145). Handal (2008) also uses the metaphor of building when he writes:

We build our identities by participating in social communities where we ... enter into negotiations with the other members of our communities of practice about our common practices and the ways we understand them. In this way, we form our identity in interaction with a community of practice through a process of influencing and being influenced, or rather through a process of negotiation as Wenger would prefer to say. (p. 58)

This socialisation process involves developing the knowledge, skills and values that are common to one's own group, community or profession but likely to be different from those of other groups, communities and professions. In this way a person comes to identify with other members of their group through participation. Sfard and Prusak (2005) argue that the most important identity stories “are often those that imply one's memberships in, or exclusions from, various communities” (p. 17).

This view of identity development through participation is one of the central concepts of the situational perspective of learning (Johri, Olds & O'Connor 2014). Socialisation frameworks have been used to show how the social and disciplinary practices of a university department work to integrate postgraduate research students into the departmental community (Weidman & Stein 2003). Handal (2008), however, argues:

People who belong to a community of practice do not form their identities solely in negotiation with this community. They bring their 'luggage' from other communities to which they have historically belonged. (p. 59)

In the context of my study, some of the difficulties experienced by engineering academics in becoming engineering education researchers (see Section 2.2.1), are due to past engineering 'luggage' that hinders adoption of more relevant ways of investigating educationally related phenomena. Borden (2008) suggests that "structural characteristics of each of these environments shape these interactions, whether or not they are intentionally designed to do so" (p. 153).

While looking to belong to a particular community of scholars is part of identity development for academics, the privileging of social and structural aspects of identity construction downplays the effect of individual characteristics. Other researchers take the opposite view and suggest that identity is formed by the individual doing the work of internalising their experiences with others. Tonso (2006, p. 273) refers to "thinking about oneself, performing, and being thought of as a particular type of person". For Giddens (1991, pp. 53-54), "[Self-identity] sees the self as reflexively understood by the individual themselves in terms of a particular biographical narrative". And Geijsel and Meijers (2005), understand "identity" as:

the ever-changing configuration of interpretations that individuals attach to themselves, as related to the activities that they participate in ... This implies that

identity is a learning process: it is not something that happens to you, but something that you try to construct with the help of culturally available building materials. (pp. 423-424)

Handal's (2008, p. 58) comment "We form our identity", points to the effect of community on identity construction but acknowledges that it is the individual doing the work, not the community.

Another tension in the identity literature is between the views that individuals have multiple identities or that they have a 'core' identity (Trede, Macklin & Bridges 2012), the different aspects of which are enacted in various roles or contexts (Oyserman, Elmore & Smith 2012). Paterson et al. (2002) argue that a core identity is the starting point in developing as a professional. Hall (2004) also supports this view:

One's identity can be thought of as that particular set of traits, beliefs, and allegiances that, in short- or long-term ways, gives one a consistent personality and mode of social being. (2004 cited in Taylor 2008, p. 3)

However other researchers argue that people have "performances of identity, or multiple identities" (Land 2008, p. 141). Pearson et al. (2011, p. 539) recommend "recognising that people have multiple identities that may change over time". Barnacle and Mewburn (2010, p. 437) refer to "the multiple identities produced by the various actor-networks". And Walton, Paunesku and Dweck (2012) suggest, "Different contexts, roles and identities can evoke different working selves ... that in turn guide people's attitudes, judgements and behaviours" (p. 141).

Gee (2000) similarly argues that while multiple identities may arise from different contexts, or "performances in society", we still have a "core identity" which can be seen in discourse:

Discourses can give us one way to define ... a person's "core identity." Each person has had a unique trajectory ... That is, he or she has, through time, in a certain order, had specific experiences ... some recurring and others not. This trajectory and the person's own narrativization of it are what constitute his or her (never fully formed or always potentially changing) "core identity". (p. 111)

Evident in Gee's work is the reciprocal link between external and internal influences and the view that identity formation is negotiated "through dialogue, partly overt, partly internal, with others ... My own identity crucially depends on my dialogical relations with others" (Gee 2000, pp. 112–113).

The importance of these 'dialogical relations' to identity formation is a common theme in the various literatures related to identity. Bamber (2012) tells us, "Discourses and identities are intimately connected" (p. 159); and for Trede, Macklin and Bridges (2012), "Collaborative, dialogic learning from practice enables and facilitates professional identity development" (p. 378).

Dialogue and discourse also include the stories we tell about ourselves:

Over time, individuals weave together their autobiographical memories in stories they tell about themselves and their lives. They construct these self-narratives subjectively and selectively to make meaning out of the events they experience, integrate their goals, make sense of conflict, and explain how and why they change over time. (Morf & Mischel 2012, p. 34)

Links between types of data and the discourse they capture are noted by Taylor (2008):

Interview transcripts and oral histories provide contexts within which identities are rehearsed ... remembering and sharing aspects of personal experience and perspective are themselves creative, rather than objective acts. (p. 29)

Interviewing engineering academics who participate in engineering education research is a way to engage them in self-narrative with the potential to demonstrate aspects of

their academic identity.

For many identity researchers this dialogue or discourse occurs when individuals enact a particular role since “roles give rise to context-specific opportunities to express, and even to develop, personal identity” (Taylor 2008, p. 29). When the roles relate to academic work and contexts, they provide opportunity for development of an academic identity (Fitzmaurice 2013). According to Taylor (2008, p. 39), “Research has often been seen as central to academic identities”. The role of researcher is “key to identity, learning and belonging for most academics” (McAlpine, Jazvac-Martek & Gonsalves 2008, p. 122). These roles make an important contribution to the disciplinary identity of academics, for whom writing is also “the key site of contemporary scholarly practice and the performance of scholarly identity” (Barnacle & Mewburn 2010, p. 434).

As well as the various roles that academics may enact, the disciplinary frameworks in which they enact them have also been found to be important to identity issues (Trowler 2012; Barnacle & Mewburn 2010; Strathern 2008). In the academic context this can be indicative of the types of academic activity we engage in and the academic communities we look to for underpinning recognition of our developing academic identities (McAlpine, Jazvac-Martek & Gonsalves 2008). According to Manathunga (2009), when we choose to work as an interdisciplinary researcher, our disciplinary identity is liable to change. She writes:

When you engage in interdisciplinary research you are located in that liminal space between and across diverse disciplinary cultures. The disciplinary identity that you may have originally formed becomes challenged and changed by your engagement with different disciplinary discourse and practices. (p. 133)

Fitzmaurice’s (2013) study of early career academics shows that they are “critically

influenced by the institution and their international peers in the discipline. However, the values, virtues and beliefs of the individual have emerged as a significant influence on identity construction” (p. 621).

An individual’s values influence the choices they make about where, how and with whom they spend their time and energy. Borden (2008) sees this as the mechanism that links the reciprocal nature of the relationship between internal (individual) and external (social and structural) influences on identity:

The influence of interactions within communities of practice on professional identity development can be viewed entirely as a function of the time and attention that an individual directs towards these experiences relative to other experiences that can influence professional identity development ... I am both an institutional researcher and a member of the psychology faculty, but I identify more with the former than the latter. I have attended two conferences of the American Psychological Association ... I have attended the last 19 consecutive national fora of the Association for Institutional Research and more than twice as many state, regional and international conferences of affiliated groups. Do I self-identify as an institutional researcher because of all my experiences within the profession, or did I pursue those experiences because of my identity? The causality is inexorably intertwined. (p. 153)

Brew (2001, 2006) supports the idea that the way academics conceptualise their research is strongly linked to their identity. Dressen-Hammouda (2008) explicitly links the development of disciplinary identity to being able to write as experts in the discipline do. Lea and Stierer (2011) also explored how “identity work is being enacted in day-to-day professional practice” (p. 610) through interviews with academics in which they discussed participants’ texts and the significance of these texts for their academic practice.

Continuing in an academic literacies thread, Weller (2011) followed new lecturers as they began to read higher education research, as distinct from their disciplinary research, and reported that the difficulties these academics had with this research were “more complex than the overcoming of linguistic differences in an unfamiliar discipline but relate to lecturers’ wider conceptions of their academic identity” (p. 93).

Much of the literature on academic identity focuses on doctoral students and early career academics (e.g. Taylor 2008, Jazvac-Martek 2009, Turner & McAlpine 2011, McAlpine & Turner 2012, Fitzmaurice 2013) since this is typically when people are establishing their academic identities, that is, learning to be the type of academic they aim to become. This literature is also relevant to our engineering academics because the process of change that they undergo in becoming engineering education researchers involves a re-construction of their academic identity in what is, for them, a new field, one they must learn about it by participating in its discourses and practices.

In their study of 5395 doctoral students, Pearson et al. (2011) report:

Individual candidates bring varying combinations of goals, expectations, career histories and family and community responsibilities within and beyond the academy. While there is a commonality of the doctoral experience overall, the individual experience is singular and particular. (p. 530)

I suggest this finding also applies to engineering academics in disciplinary transition and supports the use of an identity framework that focuses on the individual experience.

The idea that identity construction is an ongoing process that takes time is picked up by Di Napoli and Barnett’s (2008) comment: “We see identities ... as a historical process of construction, deconstruction and reconstruction” (p. 6). Taylor (2008) also says: “Identity work is ongoing work. It is work that is constituted by history and by the

conditions within which we live and work” (p. 27). For Geijsel and Meijers (2005): “Identity is a configuration of meanings. But this configuration will change constantly when new elements are given a place and are related to experiences” (p. 425).

In this ongoing process, priorities also change over time (McAlpine, Amundsen & Turner 2013a). The idea of ‘trajectories’, that is,. changes over time and/or location (both intellectual and geographic), align strongly with identity development as “‘becoming’ and ‘belonging’, instead of simply ‘being’” (Tonso 2014, p. 270). In engaging in a dialogue with academics about work with which they identify (such as their research) we are, as researchers, participating in the co-construction of their academic identity:

When informants share their sense of who they are and what their current experiences mean to them, they do so in ways that are collaborative acts of identity formation, involving both the researcher(s) and the respondent(s). (Taylor 2008, p. 30)

In summary, the stance on identity used in this study is that there is a reciprocal relationship between the individual/agentive and the social/structural in forming an identity. This identity can be enacted in multiple ways through the various roles an individual plays. However, it is a continuous process of reconstruction by the individual. For academics, their field of research is strongly linked to their disciplinary identity, which is not only “dialogic and emerging through interaction” (Miller 2008, p. 104), but also influenced by their institution. All of these aspects of identity development are included in the identity-trajectory framework described in the next section.

3.2 Identity-trajectory framework

The identity-trajectory framework for describing the development of academic identity has been proposed by McAlpine and colleagues, who examined the longitudinal narratives of early career academics (McAlpine, Amundsen & Jazvac-Martek 2010; McAlpine & Lucas 2011; McAlpine & Amundsen 2011; McAlpine & Turner 2012; McAlpine, Amundsen & Turner 2013a,b). For these researchers,

Identity-trajectory emphasizes the desire to enact personal intentions and hopes over time; to maintain a momentum in constructing identity despite challenges and detours; and to imagine possible futures. (McAlpine, Amundsen & Jazvac-Martek 2010, p. 139)

This conceptualisation of identity acknowledges the central nature of individual agency and the influence of personal circumstances to the decisions people make about their academic work in the structured environment of the university. Clegg (2008) also reports on the interweaving of the personal self and the academic or intellectual self. Her research participants experienced enacting the latter in their reading and writing, and expressed an “overwhelming sense of self in the act of writing” (p. 334).

Personal agency relates to an individual’s ability to set a goal and intentionally move towards it despite any institutional or personal constraints, and “attending to individual agency is essential in understanding academic practice” (McAlpine & Lucas 2011, p. 705). A sense of personal agency and resilience is needed in academia to respond to reviews and funding applications, especially rejections (Baruch & Hall 2004). The decisions each individual makes about their academic work are the results of their past and current personal context, agency and academic development, all of which interact to create their ‘horizons for action’. These are defined by what each person regards as possible and desirable. Horizons for action encompass how an individual negotiates

what Hodkinson and Sparkes (1997) call ‘opportunity structures’, which include “organisational hierarchies, employment possibilities, government regulations, workplace networks, etc.” (McAlpine & Turner 2012, p. 538). While engineering Faculties in the field of higher education in Australia may have common or similar opportunity structures, horizons for action are personal since they are particular to that individual’s circumstances and agency. Horizons for action are a useful aspect of a framing of identity development since they imply that an individual may see a number of options as possible and desirable, and that horizons may change with time (McAlpine & Turner 2012).

Personal history, agency, and context are the overarching influences within which the academic elements of the identity-trajectory develop. These elements consist of three intertwined strands: intellectual, networking, and institutional. As modelled in Figure 3.1, these strands interact asynchronously such that each trajectory will vary “individually in length size and impact, and will change over time” (McAlpine, Amundsen & Jazvec-Martek 2010, p. 139).

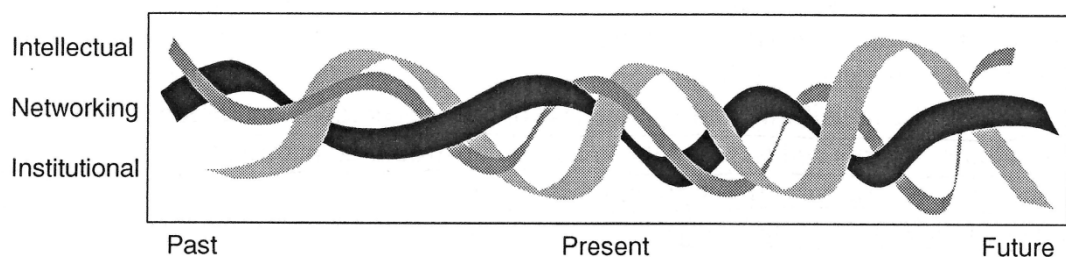


Figure 3.1: The interweaving of strands of academic identity (McAlpine & Amundsen 2011, p. 178)

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For McAlpine and Amundsen (2011), the intellectual strand represents “contributions to

one's disciplinary specialism or field [and] leaves a trail of artefacts, e.g. publications, citations, papers, course/curriculum design" (p. 179). As such, the intellectual strand is related to thinking and writing "and subsequently making writing public [which] is a core activity in academic work" (McAlpine 2012a, p. 351). The inclusion of the intellectual strand is also supported by Fensham's (2004) research, which identified "growth through writing" (p. 40) as being developmentally significant.

The networking strand encompasses the academic community beyond the participant's university. In the organisational behaviour literature this strand aligns with extra-organisational support (Arthur, Khapova & Wilderom 2005), which is important for academics (Baruch & Hall 2004). The networking strand includes both 'interpersonal' and 'intertextual' elements. Interpersonal elements of networking include interactions with colleagues either face-to-face or through personal communication channels e.g. email, Skype. The importance of significant others in the academic identity development of science education researchers was reported by Fensham (2004):

A joy of research for some comes from the opportunity it offers for establishing collegial contacts with other researchers. Often these contacts influence the directions and manner of one's future research, as well as providing rich personal friendships that extend in the future. (p. 44)

For the participants in this study, the intertextual element of networking includes the AAEE community and reviewers, as well as the authors of the literature they read and cite. It represents:

[the range of] local, national, and international networks one has been and is connected to, and ... includes (a) research and publication collaborations with others; (b) cross-institutional course/curriculum design; (c) work with professionals ... and (d) membership of disciplinary organizations [such as AAEE] and on journal boards. (McAlpine & Amundsen 2011, p. 179)

Fensham (2004) writes about the value of the intertextual network as a means of communication between researchers and the significance of both the interpersonal and intertextual networks for a researcher's practice. He foreshadows:

Science education researchers [will communicate] personally, face-to-face as colleagues or at conferences, and impersonally, through published materials such as research papers in refereed journals, handbooks of research, edited books and occasional monographs. Either the personal or the written word can be the source of powerful influences on what researchers choose to study and how they go about it. (p. 47)

Intertextual elements of networking include interactions with various texts especially reading to create "links between papers which 'spoke' to each other and to their own research" (McAlpine, Amundsen & Turner 2013b, p. 11). The intertextual network is populated by the authors of the journal and conference papers that academics read and also by their peers who review these texts. As McAlpine (2012a) puts it:

Learning through reading involved understanding how scholars in the field communicate through varied genres, e.g. papers, manuscript reviews and funding proposals. Learning the discourse was essential (e.g. how claims are made or the positioning of the researcher/author), but also how textual practices are tied to actual research practices (e.g. what is an appropriate question in a field, what is considered appropriate or essential evidence) ... Learning to read–understand in the chosen field is necessary to interacting within the field. (p. 356)

Beddoes (2014) also illustrates that reviewers play a part in an author's intertextual network:

Numerous individuals are involved in bringing an article to its published version [and] articles are often the result of multiple and competing deliberations and negotiations. They contain knowledge and opinions not only of the authors, but also of reviewers and editors. (p. 8)

McAlpine, Amundsen and Turner (2013b) note that most of their research participants,

who were PhD students, early career researchers or non-academic post-PhD professionals, did not appear to understand either the “reciprocal nature of reading and writing in advancing an individual’s thinking and contribution to the chosen field” (p. 12) or the importance of both reading and writing to academic progress. McAlpine and Lucas (2011) also comment that “peer review is a core element of academia in recognition of one’s intellectual contribution” (p. 703), and their research participants therefore needed to learn how to separate their manuscripts from their academic identity, especially when reading reviewers’ feedback on their manuscripts..

In relation to the intertextual network, McAlpine (2012b) comments on the different motivations for reading that were demonstrated by science and social science research students:

In the social sciences, individuals’ were reading to find epistemological links that might underpin their work ... In the sciences, rather than epistemological links, reading related to empirical findings in recently published paper representing the most up-to-date experimental results. (p. 42)

This difference in reading practice is part of the different research paradigm that engineering academics need to adjust to as they become engineering education researchers, and it illustrates that changing a research paradigm involves more than just changing research methods.

Analysis of early career academics’ narratives illustrates the challenges of re-establishing an intertextual network when academics engage in interdisciplinary research (McAlpine 2012c, McAlpine, Amundsen & Turner 2013b). McAlpine and Emmioglu (2014) also found that participants in science-related disciplines were constrained to positions in their own specific discipline when seeking post-PhD

employment, in contrast to the experience of social sciences participants who could move beyond their specialisation in finding a position. This suggests there is a lack of respect for other disciplines in the science-related world. Both of these findings add to the differences and difficulties that engineering academics find in becoming engineering education researchers.

While the networking strand “[establishes] the intellectual location for one’s contributions” (McAlpine & Amundsen 2011, p. 180), both the intellectual and networking strands strongly interact with each other, and so are largely focussed beyond the individual institution where an academic may be employed. McAlpine and Amundsen frame interpersonal networks as sources of feedback on participants’ texts and thinking, which are situated in frameworks created by their intertextual network. The two networks (intertextual and interpersonal) tended to merge as their participants gained experience.

In contrast, the institutional strand represents the interactions of the academic in their institutional workplaces, which McAlpine and Amundsen (2011) suggest can “support or constrain an individual’s networking and intellectual strands” (p. 180). The institutional strand also accounts for “how the structural features of the workplace mediate, positively as well as negatively, the development of the networking and intellectual strands of academic work” (McAlpine, Amundsen & Turner 2013b, p. 966). For academics at an Australian university, these networking interactions include teaching activities, serving on various faculty- and university-wide committees, as well as other administrative functions.

The importance of institutional support in regard to researcher productivity is reported

by Wood (1990), Bailey (1999), McGrail, Rickard and Jones (2006) and Hardre et al. (2011). Wood (1990) found that departmental support was consistently and strongly predictive of an academic's efficacy in respect of their research:

Departmental support was ... an important factor in predicating efficacy, which further underscores the implication that faculty members need to see their departments and institutions as supportive of their efforts and development of research skills and tools. (p. 60)

Bailey (1999) argues that "because institutions gain from productive faculty, it follows that institutions will benefit from investing resources to give faculty the tools they need to be efficacious in doing research" (p. 60), such as training in technology tools and methods. McGrail et al. (2006) also report that regular, ongoing meetings of a writing group were more effective at increasing publication rates than a training course on writing. McGrail et al. (2006), Hardre et al. (2011) and Bailey (1999) report that efficacy is an important factor in faculty productivity, although McGrail et al. (2006) refer to this as "motivation and confidence" (p. 34). In the context of my study, an example of institutional support for the networking and intellectual strands would be the provision of funding to attend the annual AAEE conferences.

However, even within the institutional strand there is variation in individual experience. McAlpine and Lucas (2011) note that even though the students in their study were in the same department at the same time "nothing in their accounts signalled similarity of departmental experience" (p. 705). This supports the focus on the individual's experience, which is an essential feature of the identity-trajectory framework. Brew and Lucas (2009) comment on the importance of institutional context for academic identity, but they link this to the ideas of personal agency and horizons for action:

Considerable differences exist in the ways people respond to, and work within, their context. The meanings they attach to research depend on their responses to these contexts. Their responses also depend on the meanings these contexts make possible. (p. 9)

The three strands acknowledge the influence in developing identity of the interplay between the individual (both cognitive and metacognitive processes and the importance of agency in the intellectual strand), the social (the networking strand), and the structural (the institutional strand and the structures of knowledge). However, the identity-trajectory concept does not explicitly acknowledge differences such as ethnicity, cultural background or gender in academic identity development. Gender differences in academic identity development would be particularly interesting to explore since there is significant gender disparity in most sectors of engineering practice and education in many English-speaking contexts (see, for example, Walker 2001). In identity-trajectory terms these factors would be included in an individual's personal values and history and, as such, may influence their horizons for action. However, McAlpine and Turner (2012) explicitly argue against such characterisation of groups of research participants "in order not to lose the importance of individual variation ... what the individual understands to be possible" (p. 538).

Various dimensions of identity-trajectory are reflected in Fensham's (2004) description of the science education researcher as a person:

The conduct of research involves a sequence of decisions underlying each stage of the study, and these decisions ... belong very personally to the researcher(s). These decisions are important reflections of the researcher's personal state and situation at the time. They are influenced by the researcher's confidence and experience, his/her personal conceptions of what the issue is, and what researcher is needed, which dimensions of the issues are of interest, and which

methodological competencies are possessed or can be readily acquired. All of these aspects ... have then, in some way, to be combined with the support that will be available from others, and from the institutional infrastructure, so that the chosen study will be possible ... These aspects can change as a personal stays actively engaged in the interactions of research. (p. 37)

Identity-trajectory provides a framework for all the dimensions mentioned in this description – the personal history and values, agency, intellectual, networking and institutional strands, and the sense that these dimensions change over time. Fensham's work further supports my position that the identity-trajectory framework will offer insights into exploring the academic identity of engineering education researchers.

3.3 Summary

An investigation of engineering academics' development as educational researchers needs a model that acknowledges the changing and discursive nature of identity construction. This is accounted for by the identity-trajectory concept, which pays attention to the context-specific characteristics of working as an academic and includes the ways that engineering academics interpret how their past experiences contribute to their present situation and/or their future intentions. By focussing on the individual, this conceptualisation of academic identity aligns with the common experience of engineering education researchers, which is one of developing expertise outside of the typical socialisation/inculcation process that is part of the experience of undertaking a PhD in a particular discipline.

The appeal of the identity-trajectory concept for this research is that its three strands foreground the individual and how they negotiate the social, organisational, disciplinary structures in an academic context. The identity-trajectory framework is built around the

concept that the journey of each academic is just that – their individual trajectory, the details of which will be unique. As Taylor (2008) reminds us: “There is no such thing as a standard academic career” (p. 30). Even so, there are sufficient commonalities in the stages of progress of every engineering education researcher to warrant some generalised observations.

In subsequent chapters I describe the ways that engineering education researchers with different levels of expertise discuss their research and what this reveals about their academic identity development in terms of the identity-trajectory framework.

Chapter 4. Research Method

This chapter includes a description and explanation of the specific research methods used in this study. The research approach is interpretive, that is it is based in an epistemology that “looks for culturally derived and historically situated interpretations of the social life-world” (Crotty 2007, p.67). This approach thus relates to the socially constructed concepts of university, discipline, research field and academic identity which define this research. Furthermore, the nature of this study requires qualitative methods of data collection and analysis because:

Qualitative research focuses on smaller groups in order to examine a particular context in great detail ... [and] seeks to generalize through thick description of a specific context, allowing the reader to make connections between the study and his or her own situation. (Borrego et al. 2009, p. 57)

As well,

As an aspect of the social world, it is most appropriate to research higher education using social research methods and methodologies. (Tight, 2013, p. 149)

Included in this chapter are explanations of the interview protocol that was developed to engage the participants in identity discourse, the process of identifying and securing appropriate participants to interview, and the methods used to analyse this data. The research approach is interpretive, with the identity-trajectory concept used as a framework or ‘lens’ through which to view the data. The framework is used to ‘frame’ that is to direct the analysis in interpreting the research participants’ meanings.

4.1 Interview protocol

4.1.1 Development of the interview protocol

Clegg and Stevenson (2013) tell us that the reason for conducting an interview is to “explicitly explore the understandings, reflexivity and potential agency that participants

experience in relation to the practice under investigation” (p. 12). The interview context was selected as a means of engaging in a dialogue with appropriate engineering academics about their research and hence generating data which could be analysed for aspects of academic identity. Taylor (2008) specifically mentions interview transcripts as a source of identity discourse:

Interview transcripts and oral histories provide contexts within which identities are rehearsed ... [and] remembering and sharing aspects of personal experience and perspective are themselves creative, rather than objective acts. (p. 29)

Furthermore, in engaging in a dialogue with academics about work with which they identify (such as their research) we, as researchers, are participating in the co-construction of their academic identities. Taylor (2008) puts it this way:

When informants share their sense of who they are and what their current experiences mean to them, they do so in ways that are collaborative acts of identity formation, involving both the researcher(s) and the respondent(s). (p. 30)

With regard to this study, the interviewing was specifically related to how participants view themselves as researchers and how they view their research, that is, their practice as educational researchers. This method is supported by Fensham (2004), who commented: “This is what interpretive research is all about – how to convey to the outside world the beliefs and understandings of people on the inside” (p. 129). Lea and Stierer (2009, 2011) explored academic identity through interviews with academics about various texts they had produced in the course of their everyday academic practices. Other identity researchers, for example, McLean and Pasupathi (2012) and Taylor (2008), argue that in narrating both everyday and important events identity is developed and sustained. In line with these research methods, this study is focused on engineering academics identifying as engineering education researchers, and it

combines the approach of Stierer (2009, 2011) by focusing on an example of text produced by each participant with the approach of McLean and Pasupathi (2012) and Taylor (2008) in exploring an event in relation to that text. The texts examined and discussed were specifically produced for that research domain, namely an AAEE conference, and the contextual event is receiving reviews on a conference paper.

Each interview was planned for a timeframe of approximately one hour because this was likely to be the most time that busy academics would spare to participate in someone else's research. Given the time constraint and because their academic identity is not generally something that engineering academics would reflect on, I planned the interviews to include some activities that would help to focus participants' thinking about their research and themes around identity. The first activity was based on an exercise in a workshop for research students cited in Ferdman (2004) (See Figure 4.1).

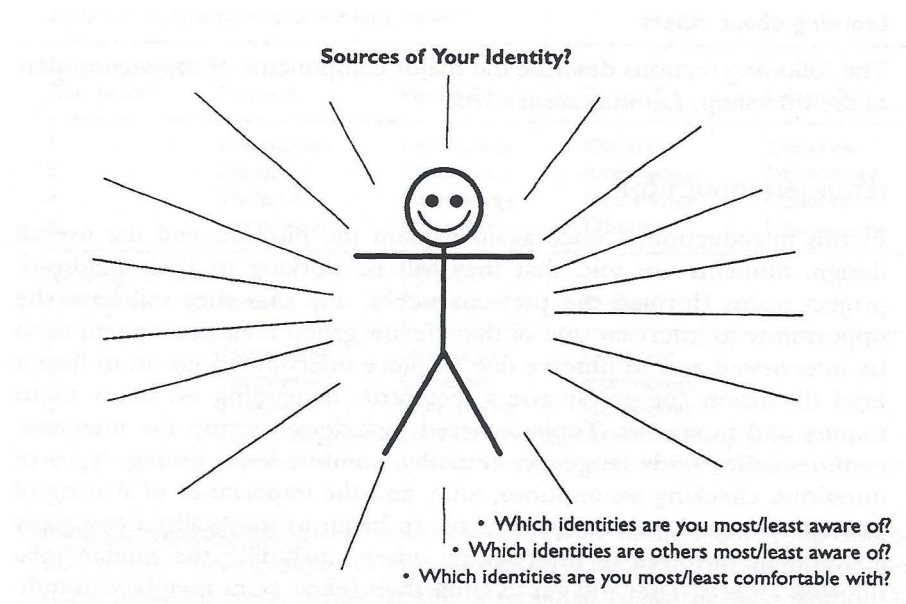


Figure 4.1: Sources of your identity (Ferdman 2004, p. 53)

The aim of the workshop exercise is for students to learn “how individuals typically derive much of their identity from group memberships and, at the same time, how there

is a great deal of diversity within such identity groups” (Ferdman 2004 p. 50). Ideas that underlie the exercise include:

- the role of the individual in constructing and interpreting cultural identity (p. 56)
- the key role of dialogue in the process of knowing about our own self-identities (p. 56)
- membership in the same identity group can be experienced in a variety of ways (even by the same individual over time and across settings) (p. 57).

The exercise thus seemed appropriate for stimulating thinking about academic identity and the extent to which participants identify themselves as engineering education researchers. To focus thinking on aspects of academic identity associated with writing about research, I substituted the Ferdman stick figure with the figure holding a pencil, shown in Figure 4.2. Gilbert, Osborne and Fensham (1982) similarly use stick figure drawings to explore students’ understandings of scientific concepts in what they call an “interview-about-instances” (p. 624).

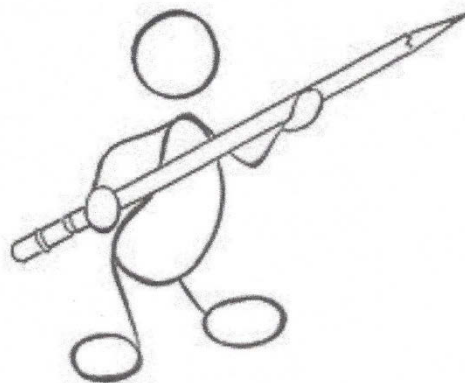


Figure 4.2: Graphic used in interviews to stimulate thinking about roles associated with writing about research

For many identity researchers, relevant dialogue or discourse occurs when individuals

enact a particular role since “roles give rise to context-specific opportunities to express, and even to develop, personal identity” (Taylor 2008, p. 29). Hatmaker (2012) found that professional engineers moved across different roles that together create their professional identity. When the roles relate to academic work and contexts, they provide opportunity for development of an academic identity (Fitzmaurice 2013, Taylor 2008, McAlpine et al. 2008). While I acknowledge that for most academics their academic practice includes activities other than research, such as teaching, in this study I am particularly focusing on their academic identity as a researcher. With this in mind participants were asked to think of what roles they perform in the process of carrying out their research and writing about it, and to write these around the stick figure (see Appendix II for further details). They were then asked to list the three roles that were most important to them and the three roles that they perceived as being most important to their university. A comparison of these two lists was used to indicate any tension between the individual’s research identity and the goals of the university where they work.

With their researcher roles in mind, each participant was asked to re-read the reviews of the conference papers they submitted to the 2012 AAEE conference and explain any changes they made to their conference paper as a result of the reviewers’ comments. This was aimed at stimulating a discussion about the research described in their conference paper and how they responded to the reviews. It was anticipated that this discussion would illustrate various aspects of how participants think about their research, about themselves as researchers, and about the area of engineering education research.

The final activity planned for the interview was for participants to use an adhesive

sticker of a coloured star to indicate where their 2012 AAEE conference paper ‘belonged’ on the engineering education research landscape model shown in Figure 4.3.

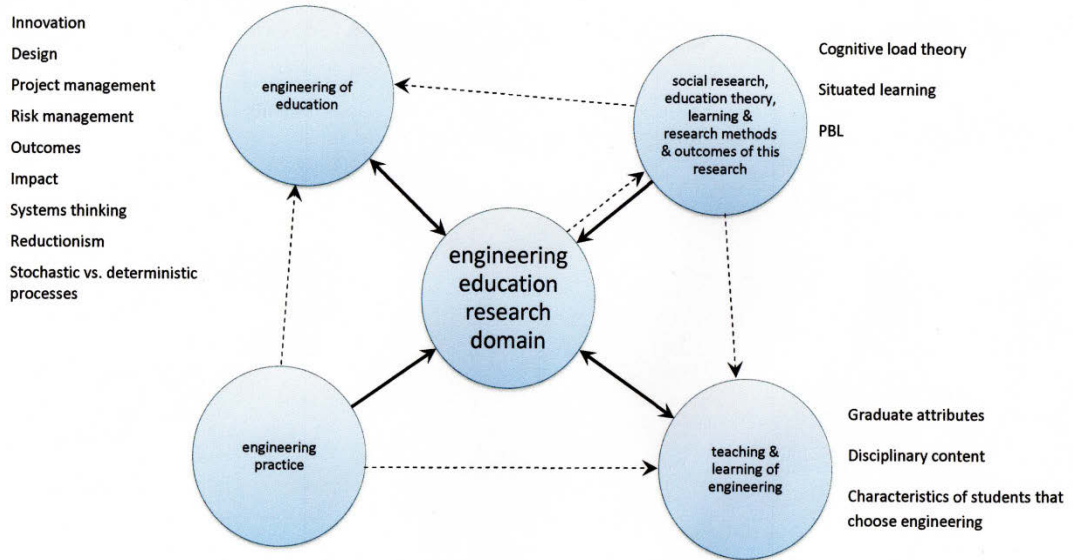


Figure 4.3: Engineering education landscape model

I developed this model by allocating the range of papers submitted to the 2010, 2011 and 2012 AAEE conferences into broad categories. One ‘neighbourhood’ in this landscape is the teaching and learning of engineering. This encompasses what engineering academics do in classrooms and workshops, and at university generally with engineering students enrolled in their subject/s. Another neighbourhood is engineering practice, which encompasses professional engineers practising their profession in industry. Conference papers also referred to the methods and outcomes from social research, particularly learning theories, so this forms another neighbourhood on the landscape. The final area on the landscape model is the engineering of education (after Dewey 2009). This is where engineering academics tend to use in their subjects and in research on their subjects the same skills, approaches and ways of thinking and looking at phenomena that they've adopted or learned in their engineering training. This

might be, for example, treating issues in subjects as problems to ‘solve’, or designing an activity, product or artefact to promote a desired outcome then evaluating its application and subsequently refining its design (Smith 2011, Bernhard 2013). Solid and dashed lines in the model indicate relationships between neighbourhoods in the landscape with solid lines indicating a stronger relationship than dashed lines.

This model is not meant to describe definitively the landscape of the engineering education research community. Rather, it was devised to provide a basis for members of the community to articulate their area/s of activity. This information is intended to be used in two ways. The first way is to use responses from individual participants to provide additional information about their academic identity because “the need to research particular issues grows from the contexts in which the researcher operates” (Clough & Nutbrown, 2012, p. 11), and so the area they publish in is likely to be one they identify with. The second way is to use responses from all the participants to investigate the characteristics of AAEE researchers who have different levels of expertise and the various areas they are working in.

Academics are all time poor so the various stimuli for use in the interviews (stick figure, different version of a participant’s conference paper, peer reviews, and the landscape model) are all intended to generate responses relating to how the participant thinks of their academic identity as a researcher and what this means for them in the relatively short timeframe of the interview. Furthermore they are designed to generate these identity-related responses from academics generally not familiar with the concept of academic identity.

4.1.2 Ethical Considerations

The research involved in this study was approved by the UTS Human Research Ethics

Committee. Although academics are not usually considered a ‘vulnerable’ group in society, as a researcher I still had ethical issues to consider, mainly in terms of identifying individuals. While most academics would not mind being considered ‘expert’, the same is not necessarily true in regards to being considered a ‘novice’. To prevent potential embarrassment from possible inferences about participants’ expertise, and to otherwise protect their identities, each participant has a pseudonym. I did not identify the specific university where they work, just the type of university (see Table 4.1). Since I am operating in a small(ish) national community I felt it necessary to pay particular attention to maintaining the confidentiality of the participants.

Draft copies of conference papers and reviews on these papers were obtained directly from participants so that they had control over this information and the sharing of it. Their final papers though were available through the conference proceedings.

As a researcher I feel another ethical issue is to represent as faithfully as possible what the participants have said, and acknowledge the work of other researchers, especially the conceptual framework of McAlpine and colleagues.

4.1.3 Piloting of the interview protocol

The aim of trialling the interview process was to practise asking the questions and rehearsing the participant instructions. The interview process was trialled with four research academics at my own university. Two of these are researchers with a social science background (one in education and one in sociology), so they are not part of the target group I was looking to interview, but are experienced in using interviews in their own research. Interviews with these researchers gave me an opportunity to practice asking questions and giving instructions, but I also took the opportunity to elicit

feedback on my interviewing skills from these more experienced colleagues.

The other two academics I interviewed in the pilot process are engineering academics who have published at the AAEE conference and would have been part of the target group were they not at my university. These colleagues gave me feedback on the difficulty/ease with which they could answer the questions and complete the activities. As a result of their feedback, I used some of the keywords from the pilot interviews to include under the stick figure shown in Figure 4.2 a list of roles that an academic might typically undertake in writing a conference paper. This was intended to give participants a clearer idea of what they were being asked to do.

4.2 Sampling

This study focuses on engineering academics with engineering qualifications who are also 'active' members of AAEE. I am defining engineering academics as 'active' members of AAEE if they authored a paper for the 2012 AAEE conference AND at least one of the three previous years' AAEE conferences. The author lists from these conferences (available in the proceedings) were used to identify potential participants. At the 2012 AAEE conference, 53% of authors were from the Australasian community and have a first degree in engineering, so studying the transition from engineering academic to engineering education researcher is relevant to a major group of stakeholders in AAEE.

I excluded universities in my own city (Sydney) in deference to those academics who see universities as being in competition with each other. After excluding non-engineering academics and all engineering academics based in Sydney, the remaining 38 eligible academics were invited to participate in the research project. Nineteen of these accepted the invitation. Suzuki et al. (2007) suggest that for interview studies such

as this one is, the “number of participants tends to be around 15 ± 10 ” (p. 298). The academics who chose to participate came from a variety of university types spread around Australia and had a mixture of levels of experience as educational researchers.

Being an active member of AAEE, participants knew me from my participation in all the annual conferences since 2005 and from serving on the AAEE Executive Committee for a three-year term. I thought that this would help me with the two aspects of successful data collection by interview, namely gaining entry and establishing rapport (Suzuki et al. 2007). As DeWalt and DeWalt (2002) suggest:

Rapport is essential to gain and sustain entry and connotes the quality of the relationship between researcher and participant. Rapport is facilitated when researchers and informants share common goals – this is when participants understand the study’s purposes and agree to help in the research process and when the investigator learns about and accepts “the goals of the community”. (p. 44)

As a member of the community I felt that the academics invited to participate would already know that I was familiar with the goals of the community, and that this would help towards building the rapport necessary for them to feel comfortable talking to me about their work in engineering education. While I could speculate on the reasons that invited academics did not participate, one reason Clegg and Stevenson (2013) suggest for lack of participation could be that the “sheer day-to-day pressure and the structural constraints of everyday work militate against ... engagement with research” (p. 14).

As shown in Table 4.1, participants were classified according to what type of university they work for. Quiddington (2010) describes the four main groups of Australian universities as

the more dominant Group of Eight (Go8) and Innovative Research Universities (IRU), which are the ‘sandstones’ and the well established research universities; and the Australian Technology Network (ATN) and the unaligned universities, mostly comprising the newer universities. (p. 476)

Only one of my participants came from a university aligned with the IRU, but several came from regional universities which are important centres for educating local engineers. This consideration led me to categorise the university types as Go8, ATN, regional, and metropolitan unaligned.

A participant’s level of expertise as an engineering education researcher was determined by the number of specific types of research publications they had written in the previous four years (national and/or international conference papers, journal papers, and/or book chapters). Any of these types of publications were counted twice if the participant was listed as the first author. Other indicators of research activity were also included such as being the project leader of a grant with funding awarded through a nationally competitive process, supervising research students working on educationally related topics, and serving in an editorial role for an educationally related journal. Using this system, participants fell into three broad groups: emerging, intermediate, and established researchers. Appendix I illustrates the categorisation of each participant for these research expertise categories. This categorisation was used for initial grouping of the research participants only with confirmation and clarification of a participant’s level of expertise generally demonstrated in their responses to the interview questions and activities.

The pseudonym for each of the 19 participants is listed in Table 4.1, along with their designated level of experience, and an outline of the type of university where they were

employed at the time of the interview.

Fourteen participants have a PhD in an engineering disciplinary area such as structures, hydraulics, control theory, combustion, mechanical design, control systems, and environmental engineering. Of the remaining five, at the time of the interviews, three (two at the emerging level and one at the intermediate level) were undertaking a PhD in an engineering education-related topic, one established researcher had completed a PhD in an engineering education-related topic and one established researcher had been able to argue that the engineering education research he had undertaken was equivalent to a PhD in his successful promotion to professor.

Table 4.1: Participants’ pseudonyms, levels of experience and types of university

Pseudonym	Level of experience	Type of university	Description
Adele Evan Mark Tom	emerging	Group of Eight [Go8]	The ‘Group of Eight’ (http://www.go8.edu.au/home) is a coalition of eight research-intensive universities located in state capital cities, which tend to be the oldest universities in Australia. .
Neil	intermediate		
Stuart	established		
Therese	intermediate	Australian Technology Network [ATN]	The ATN is an alliance of five universities, each located in the capital city of a mainland state of Australia. These universities badge themselves as practice-based and their research is focused on the needs of industry and the community.
Rob Steve	established		
Alex Wayne	emerging	Regional	Regional universities are those with their main campus in a regional city or town rather than a state capital city. As well as on-campus students, these universities are characterised by significant numbers of external/distance students.
Sam	intermediate		
Dennis Erica	established		
Terry Mike Ian	emerging	Metropolitan unaligned	The metropolitan unaligned universities are those based in a state capital city, but not included in the Go8 or the ATN.
Nathan	intermediate		
Will	established		

4.2.1 Interviewing participants

Semi-structured interviews were conducted with each participant in their campus office, or at an alternative location nominated by them. From the perspective of the study, the campus office was the preferred location since participants would be surrounded by artefacts related to their academic identity and it was also likely to be an environment within which they felt comfortable and hence likely to talk. Two participants were

interviewed in a meeting room in their building on campus because each shared an office with colleagues. In this situation the interview would have disturbed their colleagues and the participant may have felt more constrained in their responses since they could be overheard. Only one participant chose to be interviewed off campus because the location was convenient to the other meetings that he had that day.

Each interview took approximately an hour and occurred between three weeks and five months after the deadline for submission of the final versions of their paper to the 2012 conference. The intention was to interview participants as soon as possible after submission of their final paper so that the process was fresh in their memory. However, the summer break in the academic year limited the availability of many participants.

A document analysis comparing the reviewed version of their paper with the final submitted version and both of these documents with the reviews they received on their draft paper provided me with issues to ask about in the interview if the participant did not raise these issues themselves. Having their reviews on hand during the interview was useful in reminding participants of how they changed or resisted change to their final submission.

During the interview participants were asked to explain the various roles they enact in bringing their research to publication (e.g. learner, collaborator, editor). They were asked to re-read the reviews they received on their paper, comment on how helpful they had found these reviews in preparing the final version of their paper, and explain any changes they had made between the draft and final versions. This generated discussion about their research and about how they write about their research. In answering the questions and talking about their conference papers and the reviews, participants would

often tell short stories that were drawn from their personal history or would illustrate their institutional standing or personal agency. This confirmed my judgement that identity trajectory would be a valuable frame in analysing the interview transcripts.

Participants were also presented with the engineering education research landscape model shown in Figure 4.3. They used a coloured adhesive star to locate their paper on this model and then explained why they had stuck their star or stars in the position they did. The interview protocol is included in Appendix II.

4.3 Data analysis

Four sources of data were used in this project. The major data source is transcripts from audio recordings of interviews with participants. These were supported by draft and final versions of each participant's conference paper, the peer reviews of each draft conference paper, and my researcher notes written immediately after each interview.

Transcripts were created from interview audio recordings. I checked the accuracy of each transcript by simultaneously reading it and listening to the audio recording from which it was created. Transcripts were manually coded in NVivo 10 for *a priori* themes relating to the identity-trajectory model (intellectual, networking and institutional strands, personal context, time-related narrative, evidence of agency, and horizons for action). For example, the intellectual strand is referenced in participants' comments relating to research perspectives, methods, data collection, analysis and tools.

Comments relating to interactions with other people about research were coded as demonstrating that participant's interpersonal networking strand while comments relating to publications were coded as illustrations of their intertextual networking strand. When participants referred to how some aspect of institutional operation

impacted on their ability to undertake engineering education research, this was categorised under their institutional strand. This process involved repeated reading of the transcripts and the descriptions of the academic identity strands. Personal communication with Professor McAlpine to benchmark interpretation of examples of the data contributed to the validity of the data analysis process.

I also took care to base the participant narratives and other findings on the interactions that arose during the interviews and not on my prior experience of that participant at workshops or conferences that we may have both attended. As a member of the engineering education community in Australia I used my knowledge of the community in interpreting the data generated in the interviews, not to add to it.

This analysis began with the transcript of the first interview and continued as each interview was conducted. It was through this parallel interview/analysis method that I noticed the frequency that participants mentioned 'quality assurance' as a reason for having peer reviews of conference papers. This prompted me to specifically ask in the remaining interviews what the participant meant by 'quality' in a conference paper.

In the following chapters quotes from participants are followed by their pseudonym and the type of university at which they are employed. Some quotes were edited slightly to preserve the anonymity of participants, while still maintaining the integrity of meaning.

A document analysis was conducted to compare each participant's draft paper submitted for review for the 2012 AAEE conference with the final version of their paper prior to interview. The two reviews of each paper were also examined to determine what the reviewers thought the major issues were in that paper. This provided me with specific prompts, if needed, in the interviews and also provided a context for participants'

comments.

Immediately after each interview I wrote a memo about that participant in my research journal. These memos record similarities and differences among participant's responses and anything in the interviews that particularly made an impression. During the analysis the memos were useful for constructing the participant narratives.

4.4 Summary

Nineteen members of AAEE who had submitted a paper to the 2012 conference agreed to be interviewed for this research. The dialogue generated in the semi-structured interviews, along with the documentary data collected through the interview activities was analysed for aspects of academic identity that form the identity-trajectory framework.

Chapter 5. Emerging researchers

The nine participants who are classified as emerging researchers are those participants who had the least experience in engineering education research. These participants had co-authored less than ten AAEE conference papers each, authored no more than two journal papers and no books in the period from 2009 to 2012, were not the project leader for any externally funded projects, not supervising PhD students in educationally related topics and not serving as editor or associate editor for any educationally related journals.

The researcher classification system was supported by responses from participants where they self-identified as being emerging researchers in the field of engineering education:

I'm really, really out of my depth, but that's okay ... There's something there for me to learn, and that will be great. [Adele, Go8]

[I'm] trying to identify whether or not I'm doing it correctly ... I also haven't been teaching for very long so I need to learn more about all the different fields. [Evan, Go8]

In that paradigm, I very much class myself as a beginner. [Tom, Go8]

My background is not as a researcher, it's something I'm just learning to do [Alex, regional].

The next section summarises each emerging researcher's interview, highlighting how their explanations of their conference paper and responses to the peer reviews of their paper illustrate the various aspects of identity-trajectory. Aspects of their research practice that either enable or constrain their development as engineering education

researchers are also discussed.

5.1 Emerging researcher summaries

The summary of each participant was developed from their interview transcript and responses to the interview activities, the document analysis of their conference paper and the researcher notes concerning that participant.

Adele

Adele has a fractional appointment at a Go8 university, which she began after significant experience in industry. She nominated learner and teacher as her most valued roles (it is interesting that she sees these as so intertwined), then initiated a discussion that was closely aligned with her third most valued role of communicator/disseminator. In line with her extrovert personality, the roles that Adele values the most are all associated with communicating with other people. The roles that she sees the university as valuing are academic, peer review, and dissemination. Adele acknowledges the tensions between the personal and institutional values and says she has resolved these by giving up on promotion: “I think you learn to accept that you never make professor.” Adele’s paper was accepted subject to minor changes, and there were very minor changes between the reviewed version and the published version of her paper. These changes related to formatting, abbreviating terms and numbering tables. There are slight differences in the Background section of the reviewed and published versions of the paper but these amounted to tightening the writing rather than any change of ideas. Both reviews of this paper were overwhelmingly positive and pointed to the need for minor abbreviation and table numbering changes, which were made for the final published version. One reviewer did attempt to engage at a deeper level by asking questions about

the categories in the survey, but there was no response to this in the final paper. While the positive reviews reflected the high quality of the originally submitted paper, for many of the review criteria the only response from the reviewers was one word: “Excellent”. While positive, this did not assist the author in further improving her paper, and Adele commented she would have appreciated some elaboration on this one word to find out what was ‘Excellent’ about it so that she could do it again:

I actually find, sometimes, excellent, as the sole comment ... more frustrating. Because you think, well, could you actually tell me why it was excellent so that I know what I did well? ... so that I can do it again?

Adele also mentioned that if reviewers have difficulties with something in her paper, she would appreciate knowing exactly where in the paper the problem is. In other words, the more specific reviewers can be, the better:

A particular comment – where is that relevant? Which section? ... is it there, or is it two pages over that really needed that clarification? That's what I find frustrating ... knowing exactly where their particular comments are relevant to.

In Adele’s view, reviews are for “adding value” to the paper. To make the paper “better” and for quality control, papers should meet a minimum standard (however that is defined) for the reputation of engineering education as a field of research. Adele strongly identifies as a teacher/disseminator, which encompasses the teaching function for her students and also passing information to her colleagues. She sees this as her “responsibility” and an “obligation” that academics have towards each other. Adele talked about how her new Head of School learned about her teaching practices from her students at “college” dinners. This relates to her institutional identity. There is significant tension between her roles/objectives and what she sees as the university expectations of academics, but she is exploring this tension in her research. Adele

placed her star on the arrow pointing to the social research neighbourhood (see Figure 5.1) on the landscape model. She commented that this was an unusual area for her, with her previous educational papers fitting between teaching and learning and engineering of education.

Alex

Alex also placed her star in the social research neighbourhood of the landscape model “because it's very much looking at social research theory and how can we put it into that educational domain.” Her paper is related to her PhD, which she began 12 months prior to the interview. Previous to that her publications were more aligned with the teaching and learning area. Enrolling in a PhD has changed Alex’s outlook on engineering education research and what the characteristics of research are; she is working now with theoretical frameworks rather than reporting practice. Like Adele, Alex came to academia from industry, but without research experience in her engineering speciality, and is now working at a regional university. Alex listed her most important roles as reader, writer, and person with a question, and acknowledges that these are interconnected. Her most important roles from the university perspective are researcher, writer then educator:

I've got researcher and sort of in inverted commas. It's very important to the university that we are researchers and that we have research publications and reportable research publications, whatever that means. It continually frustrates me how much emphasis is put on having reportable publications to prove that you're a real researcher ... Being a researcher is so important ... more important than being an educator.

She suggests that she resolved tension between these two lists of values by doing research that aligns with her teaching. Alex began a PhD “because I decided I'd

probably be sticking around academia for a little while and if you're going to do that you need to have a PhD”, but only after finding a research area that she was interested in and colleagues that she felt she could work with as research mentors. Brew and Lucas (2009) comment on the relative importance of mentors for female academics, compared to male academics.

Both reviews of Alex’s paper have a generally positive tone, even though the theoretical nature of the paper and the theory discussed are not commonly found in AAEE conference papers: “It's a funny paper because it's a discussion paper or a theoretical background paper ... It's not a collect some data and analyse it and here's my results type paper.” Both reviewers asked for an illustration of how the theory could be applied to the engineering education domain. This prompted what I regard as substantial changes to the last page and a half of Alex’s paper, where she completely deleted a table and its explanatory paragraphs and replaced them with suggested ways of using the theory in engineering education. Alex found suggestions from the reviewers helpful in improving the paper:

So what I did do, and what the reviewer suggested was outline how I would apply this theoretical background to a project ... Which makes a lot more sense when you're then reading the paper ... So yeah, it certainly did give me the direction that I needed to complete the paper the way I wanted to.

It is interesting that for Alex the only role for peer review she mentioned was for feedback to the author. The research group at Alex’s university has been of support to her efforts to move into educational research. The multidisciplinary ‘mini’ research group seems to have practical benefits, for example, “brainstorming the research question”. Alex’s husband recently finished his PhD in a typical engineering field and so she can now start hers. With three primary school-aged children they had decided

that one parent doing a PhD at a time was enough of a strain on the family.

Evan

Evan had recently (in the previous six months) changed from being a part-time tutor to a full-time academic at a Go8 university, so had not been an academic for very long. This change coincided with enrolling in a PhD because “I’ll need to do a PhD to progress.”

Evan listed teacher, researcher and then student as his most important roles, and teacher, researcher and then academic as the roles most valued by his institution. Evan explained ‘academic’ as:

I guess particularly with the university culture you have your academic staff and your professional staff and because I am an academic then I must publish. So in many ways they’re all tied together.

He feels little tension between these two perspectives. Evan made minimal changes to his draft paper – two instances where a short phrase was added to clarify the rest of the information in that sentence, as requested by his Reviewer 1 – before final submission stage. He conceded in his interview that he did not address most issues raised by the reviewers: “I think I made a few tweaks and just read over it, but I don’t think I made huge changes.” This behaviour is consistent with his comments that his main reason for publishing was to meet the expectations of being an academic: “Because I am an academic then I must publish.” Evan raised the issue of transparency of the review process, asking how a reviewer knows what standard to apply? His comments show that he values quantitative data over qualitative data and has a view that for most things there is a “right” answer. He is looking for reviewers to tell him that his research is “right”, and looks to the conference committee to tell him his review of other papers is “right”. He feels that good teaching is valued by his university, which contrasts with the perception of Mark and Tom who work at the same university, and with most other

engineering academics I interviewed. He placed his star in the teaching and learning area of the landscape (see Figure 5.1) since his paper describes a teaching and learning project Evan was involved in: “It's a project I ran, just one where it was my responsibility and I figured I need it published.”

Mike

Like Evan, Mike placed his star in the teaching and learning area of the landscape (see Figure 5.1). He locates his educational research there because:

It informs my practice. I don't like the idea of educational research for its own sake ... if engineering education and research doesn't inform practice in Australian universities, then it's missed the point.

Mike is an academic of approximately 20 years standing, currently working at a metropolitan unaligned university. For Mike, the personally valued aspects of writing a conference paper are reviewee (i.e. someone who receives peer feedback on their work), formal record of research work, and education researcher. His university values identification of his performance, record of research output, and disseminator of research findings. Mike acknowledges the tension between the personal and institutional values and resolves that tensions by “trying not to worry about it. By trying to be true to what I believe in.” The reviews on Mike's paper were contradictory, for example, one reviewer expressed reservations about the methodology while the other reviewer commented “the methodology strikes me as rock solid”. Changes to the final version of the paper include short responses to some of the issues/questions raised by the reviewers. However, many of Reviewer 1's concerns remain unaddressed. This may be in part because of the difficulty in addressing issues of methodology after a study has taken place or because they are out of the control of the author. As Mike said: “The first [review] I wasn't so happy about, possibly because he brought out things which I think

were separate to what I could control here.”

Wayne

Wayne’s reviews were very brief, mainly mentioning typographical errors and data presentation issues such as the possibility of changing the graphs to tables.

Consequently, Wayne’s response to the reviewers’ comments in his final submission was to reformat some graphs into a table. Considering the reviewers’ lack of engagement with the ideas in his paper, I can understand that Wayne did not find his reviews very helpful. Wayne’s experience raises questions in regard to the level of expertise of reviewers in the AAEE community:

Thinking of my experiences of publishing in the education conferences, as opposed to the [typical engineering research field] papers ... I've had 100 per cent success with getting things accepted in the education conferences.

The decision of ‘accept with minor changes’ and the comments Wayne’s paper received, combined with his previous ‘success’ at educational conferences, contribute to his perception that he is a competent educational researcher. This prompts some questions: Is engineering education less judgemental than other areas and more tolerant because it is prepared to be more developmental in nature? Or are the criteria less stringently applied partly because there is less consensus in the standard expected and therefore poorer papers are accepted? Interestingly despite the positive reviews, the changes to Wayne’s paper from the reviewed to the final version were more substantial than the changes made by Adele, Evan and Mike on their papers. Wayne wrote his paper with another engineering academic, and his interview suggests that the changes in the final paper came more from his co-author (an ‘established’ engineering education researcher at another Australian university) than the reviews: “Certainly [the co-author] and I had a bit of back and forth.” His previous educational papers would fit in the

teaching and learning area but this current paper sees him starting to move towards the social research vicinity (see Figure 5.1), a move he said is largely driven by his co-author mentor. Wayne thinks of himself as an engineer working in education and also regards himself as an experienced researcher, even though that experience is not in education. He seems to have a very traditional engineering view of research: “Do something, evaluate it, change practice as a result, evaluate that, etc.”; and he characterised being a researcher as asking a good question, collecting data as evidence and analysing that data. He did not mention engaging with the literature, either in relation to his own paper or as a more general characteristic of research, so he would be unlikely to explore the social science literature and apply a theoretical framework to his research, especially since he regarded talking to mathematics academics as a multidisciplinary experience. His view of research would fit with Brew’s category of a ‘domino’ view of research and is linked to Wayne’s identification as a disciplinary researcher.

Wayne had been on sabbatical shortly before his interview, but this was in relation to his typical engineering research rather than his educationally related work. Although there is a research group at Wayne’s university he has more conversations with a particular subset of members of the research group (colleagues who think like he does) rather than engaging with the broader membership, and this influences his view of education and educational research. Wayne listed data analyst as the role he most values, then questioner and writer. These roles are all related to Wayne’s intellectual strand and the intrinsic value he places on his academic work, and contrast with the university-valued roles of publisher, reviewer and collaborator. These roles that Wayne sees as valued by the university all involve interaction with others and contrast with the

roles that he values, which involve his individual work. Wayne acknowledges that there is tension between the two lists of valued roles, but articulates the relationships between some of the roles on the two lists.

Ian

Ian only listed one role as important for him in relation to writing conference papers and that is track record. From his university's perspective he listed project output and staff performance in teaching and learning as important. For Ian there is little tension between personal and institutional objectives for writing conference papers. He wrote his paper to comply with dissemination requirements associated with project funding from his university and volunteered that writing conference papers was for him all about building a "track record". The review decision of Ian's paper was 'accept with major changes'. Both reviewers called attention to grammatical, punctuation and formatting errors, which were addressed in the final version of the paper. Ian said that he appreciated this feedback – possibly because English is a second language for him – and that he learns from reviewers and also from other authors when he reviews their papers. Reviewer 1 commented on two other aspects of the paper, which Ian addressed by deleting one phrase from a sentence in one part of the paper and adding some proposals for future work. Reviewer 2 provided a much more detailed and useful review than Reviewer 1. This reviewer challenged some of the conclusions in the reviewed paper, which Ian dealt with by removing the unjustified conclusions from the final submission. Reviewer 2 mentioned ten issues in relation to the argument of the paper – three of these issues were addressed in the final paper, one issue was addressed by removing the phrase in question, but there did not appear to be a response in the final paper to the remaining issues mentioned by this reviewer, and hence I would not say that the 'major

changes' asked for were actually delivered.

Ian sees the purpose of reviews to make sure the reviewers can “feel the quality of the paper”. He characterises quality as no assertions without evidence, “carefully crafted and polished language”, and referring to literature – not just listing other studies but explaining how they relate to the paper and using them to identify a ‘hole’ in the literature. Ian located his paper in the teaching and learning part of the landscape model (Figure 5.1). Ian completed his PhD in a typical engineering research area and teaches in this area at his university. He aligns strongly with Brew’s description of ‘trading’ category of researcher, that is, “building track record” is the main reason for him to write, hence there is no tension between personal and institutional objectives for writing conference papers. He has recently completed a Graduate Diploma in Higher Education, which would help to build his institutional strand of identity and hopefully have some impact on his intellectual strand as well. As a result of his work in completing the Graduate Diploma, he asserts that his conference paper is an artefact of his scholarship rather than research. He presented the results of a locally funded teaching and learning project in the previous year at his university’s School research seminar series and in the current year at the university-wide teaching and learning forum. This further consolidates his institutional strand of academic identity, especially since he acknowledges that the dissemination of project results is undertaken to comply with project funding conditions.

Mark

As in Ian’s case, Mark’s paper describes work undertaken with a small internal university teaching and learning grant. He commented that Australian Government–sponsored Office of Learning and Teaching (OLT) grants were not regarded as research

at his university and there was no recognised process for authorising OLT grant applications. Furthermore, there is no category in his Department's publication record collection process for engineering education, so publications in this area don't get 'counted'. While Mark acknowledges the usefulness of a conference paper as "something you put on your CV", the paper helped to clarify ideas and insights into the project. He said:

We didn't set out to write a conference paper. We set out to try and think about how do we solve this problem? Then the conference gets announced and you say oh yeah, we can tell people about what we're doing on that particular problem.

Mark's paper was accepted subject to minor changes. Reviewer 1 wrote that "the results are of importance to any engineering educator dealing with reflective practice". This positive tone contrasts with that of Reviewer 2, who wrote a short paragraph concluding that the paper was not really relevant in an engineering education conference and suggested a general learning conference might be more appropriate. Reviewer 2's other main criticism was with the "careless" English expression of the reviewed paper. The only changes made for the final version of the paper were the typographical errors mentioned by Reviewer 1, and Mark conceded that "the extent to which the paper was revised in view of the review was quite small". On the landscape diagram he placed his star on the trajectory heading towards the social research circle. Mark has many years of experience as an engineering academic and has had a management role in the past in his Faculty. As his personally valued roles Mark listed discussant in reflective practice meetings with other academics, discussant of evolution of research direction, and author. From his university's perspective he sees that the most valued roles are successful grant applicant, author, and presenter. He indicated that in his future work he is aiming to do more of the three areas of teaching and learning, engineering of

education, and social research; and less of engineering practice. However, he complained that teaching practice papers did not seem welcome at the AAEE conference anymore and that papers that he had rejected as reviewer were still accepted at the conference.

Terry

Terry's area of teaching and mainstream engineering research is a practice-oriented aspect of engineering and his identification with this area is illustrated by his locating his star on the engineering practice trajectory (see Figure 5.1), even though his paper is essentially about evaluating practice and improving quality in the subject that he teaches. Terry has significant experience teaching in this area and works at a metropolitan unaligned university. As the roles he most values that relate to his writing in engineering education he listed researcher, interpreter and team member in that order. He perceives that the roles his university most values are researcher, team member and administrator. Terry does not feel there is much tension between these two sets of roles, except in relation to administration: "I'm not a big fan of administration." Although Terry identified roles such as 'researcher' in both lists, his description of what that means differs between the personal and the institutional. What Terry personally values about being a researcher is the chance to satisfy his intellectual curiosity. This is different from the university's perspective, which values him as a researcher for the publications they can count. There is general alignment between what Terry personally values in his educational research publications and what is valued by his university.

Substantial changes were expected in Terry's paper since the decision was 'accept with major changes'. Reviewer 1 expressed serious misgivings with the methodology and its description. His final paper did include a fuller description of the details of the method

used but did not address a major questioning of the appropriateness of the data collection method, or the English expression and formatting deficiencies noted by reviewers. For a paper with a 'major changes' decision, it is noteworthy that much of the reviewed version remains unchanged in the final version. This may come down to Terry's attitude that: "Whether they say major changes or minor changes, to me I don't think it's a huge difference." Similar to other participants at institutions with an engineering education research group, he feels supported in doing engineering education-related research. Terry is still finding his feet in engineering education research and taking care to articulate the rigour in his method. He emphasised that he is looking for reviews that expand on the judgement, that is, not just have a rating but explain why it is rated that way.

Tom

Tom had not previously published an educationally related paper but has significant research and publication experience in his own engineering speciality. On the landscape diagram Tom placed one star in the teaching and learning vicinity with a value of 80% and one star in the vicinity of engineering practice with a value of 20% (see Figure 5.1). Tom's paper for the 2012 AAEE conference was rated 'accept with major changes', which was in contrast to the 'reject' decision his paper received in 2011. Tom's final paper had substantial changes compared to the reviewed version, including a change in structure to improve the description of the event which was the focus of his paper. The detailed discussion and reformatting were in response to reviewers' comments that suggested more detail of the evaluation evidence was required. It is evident that Tom did make major changes to his paper, but most of these changes were Tom's ideas: "I actually think it's a more interesting paper as a result of that re-organisation, but that

was my idea. Didn't come from the reviewers.”

He lamented that papers about educational practice no longer seemed welcome at AAEE conferences. While his view is that practice papers should still be accepted for the conference, this does not mean that poor quality papers should be accepted. He was frustrated that papers he had reviewed and rejected were still accepted at the conference. Tom has no aspirations about being an engineering education researcher, but he does want to be able to contribute practice papers that would be ‘counted’ at his university. He commented that papers are counted as long as they were peer reviewed. Tom values having original ideas relevant to the discipline, well-written and technically sound publications, and good scholarship. For his university, the most-valued aspects are peer review of papers, the international standing of the conference, and original content. Tom sees little tension between his personally valued roles and the aspects valued by his university:

There is no actual tension, although they view it differently. Yeah, they view the outputs differently. Mine is an input focused perspective. Did I think I put good content into the paper? ... But then those outputs are output focused.

5.2 Academic identity-trajectories

As described in the theoretical framework (Section 3.3), the academic elements of identity-trajectory consist of three interweaving strands: intellectual development, networking, and the institutional. In discussing their conference papers and responses to peer review of their conference papers, participants exemplify aspects of these strands. The following sections will explore each strand in some detail.

5.2.1 Intellectual strand

The intellectual strand is referenced by the comments that many participants made about research perspectives, methodologies and tools. It is perhaps not surprising that these issues are of concern to a group transitioning to a different research paradigm.

The dominant view among these emerging researchers is that the only really ‘rigorous’ way to conduct research is to use quantitative methods. They then experience difficulties when they realise the limitations of quantitative methods in helping them to understand the types of phenomena they want to investigate. As may be seen in these comments from Wayne and Evan, there remains strong connection in their minds between evidence and quantitative data:

So you've got numbers, whatever, you've got the raw data that is there and you've got to look through it and, ultimately, what you're trying to do is identify patterns ... how you can compare one variable versus another and ultimately then see if you can find a pattern which then explains the overlying thing that you are investigating. [Wayne, regional]

I think it's important. It's very hard to make conclusions otherwise. There's a lot of things within education which feel right but may not be right and without some sort of evidence to back it up then it's hard to know which way you should really act ... I think generally though that it [statistical analysis] is needed. [Evan, Go8]

These quotes point to the participants’ conceptual difficulties in their transitions from engineering researcher to engineering education researcher. The predominance of quantitative research perspectives and methods has been noted by Beddoes (2011) and Godfrey (2009) with respect to engineering academics, and Fensham (2004) in relation to science education researchers (see Section 2.2).

However, Mike’s comment shows he is developing an awareness of some of the

limitations of statistically analysing survey results while looking to “measure something real”:

If you look at my surveys here, the mean is always bigger than three, maybe sometimes it's up to four, which is sort of agree. So it's always above neutral... So you've got this mean around 3.6, around four, but it's a standard deviation of one, which means that there is a big spread... and I don't know how you get around that kind of thing. So that's a problem when you come to numerical stuff. If this was an experiment it wouldn't be a very good experiment, because it's sort of telling you a trend, but there is a lot of noise ... it all comes down to their perception. It's nothing real. But I don't know how you measure something real. [Mike, metropolitan unaligned]

Alex and Terry, who both work at universities with engineering education research centres, are deviant cases in that they are using qualitative research methods on a regular basis. Alex knows this is different from the standard paper submitted to an AAEE conference:

It's a funny paper because it's a discussion paper or a theoretical background paper and again, it's coming from the PhD work that I'm looking at. It's not a collect some data and analyse it and here's my results type paper. [Alex, regional]

As suggested by Borrego (2007), to assist the development of emerging researchers making the transition to engineering education research, reviewers and mentors need to focus on their understanding of methodology, especially data collection and data analysis. Terry and Evan commented on reviews for the papers they had written, which asked for issues of methodology to be addressed, especially in relation to type of data collected and how it was analysed:

They were saying that there's an unacknowledged possibility of the Hawthorne effect. [Evan, Go8]

There was one comment here about the use of the extracts from focus groups. They [the reviewer] weren't convinced that that was a way to show results. [Terry, metropolitan unaligned].

For these emerging researchers, whose identities have been shaped by the need to measure and gauge multiple subjects and variables, the dominant aspects of the intellectual strand revolve around unfamiliar research methods, data collection and analysis. However, as Wenger (1998) noted, changing identity is not just about knowing what to do when. So I turn now to the other strands of identity-trajectory.

5.2.2 Networking strand

As mentioned in Section 3.3, the networking strand has both *interpersonal* and *intertextual* elements. It encompasses the academic community beyond the participant's university, with the interpersonal element including the AAEE community and reviewers and the intertextual element including the authors of the literature they read and cite. Alex and Terry referred to elements of their intertextual network this way:

I've also just recently enrolled in a PhD so reading more literature and trying to absorb it and understand what it means and analyse it. It is something I'm trying to get better at and become better at. [Alex, regional]

I found a textbook that was Methods in Qualitative Research or something like that. [Terry, metropolitan unaligned]

Beddoes (2014) describes how peer review can impact the literature that researchers read and cite. As such, it is a facet of this 'intertextual networking' that has contributed to the intellectual development of the emerging researchers. The following quotes from participants highlight how interaction with the peer review has resulted in a change in their thinking or practice, with resulting change to their intellectual strands. For Alex

the impact of one of the reviews was quite specific, while for Mark the effect of reviews is more general:

The reviewers picked up on things, weaknesses that I already knew were in the paper ... There was one comment in particular ... I thought that ... useful, and actually it changed the way I thought about it ... It gave me the, 'Oh now I know what I'm going to do with this paper'. So it certainly did give me the direction that I needed to complete the paper the way I wanted to. [Alex, regional]

Look, having other people's views on what you've written is useful. Whether it be agree or disagree or otherwise, it provides some level of providing another perspective ... or an idea that you really should be thinking about something else. [Mark, Go8]

Another way that peer reviews extend an author's intertextual networking strand is through the process of reviewing other authors' conference papers. Several participants commented that they learn from not only the reviews of their own papers, but also the papers they are asked to review. This type of intertextual networking contributes to the development of their intellectual strand. Alex and Evan's comments illustrate the potential learning benefit for an emerging researcher of reviewing other papers:

It's good ... to read other people's work to get an idea of what's out there ... Also to get an idea of how other people write ... I'll criticise something then realise I've done it myself in my own paper. [Evan, Go8]

In fact reviewing other peoples' papers is very useful when you come back to your own paper. You then go and put the same hat on and look at it from that perspective, yeah. So actually yeah, you learn both ways. What you apply to your own work you can then apply to other people's and vice versa. What you learn by reviewing other people's work comes back to what you do with your own. [Alex, regional]

Peer review for the conference is not the only aspect of the networking strand illustrated

by these emerging researchers; the interpersonal element of the networking strand was also evident. Wayne brings attention to his interpersonal network by conceding that the changes in his final paper came more from his co-author (an experienced engineering academic at another university) than the reviews:

Certainly [the co-author] and I had a bit of back and forth ... If I was the sole author I would not have done that because I thought the graphs told the story, but I guess this is why you share with other people and they have different perspectives. [Wayne, regional]

Many participants could articulate the links for them between participating in the conference, a significant networking event, and the development of their research. For Evan and Adele this is mainly about learning about the research domain:

I also learn about what others do and I guess that's by attending conferences and not just about the writing. [Evan, Go8]

So, the stuff I do with the [named learning space], that came out of reading someone's paper. I thought, that's interesting, and then they came here and I heard them speak, and I thought, that's interesting. I was able to quiz them ... about how that really worked – because you said this in your paper, but come on, tell me how that really worked. You think, okay, I can work with that, that's translatable to ... and that's what I like about conferences, is that you have the ability to quiz people about what they've written, and try and pick out what's really, really relevant to you, which is easier to do verbally. [Adele, Go8].

Emerging researchers commented much more on the intertextual element of their networking strand than the interpersonal. I suggest this is a reflection of their status as emerging researchers, which may change as their expertise develops and they participate more in the research domain and meet more fellow researchers at other universities both in Australia and overseas. Following the development of these particular researchers would be an interesting exercise, but is beyond the scope of the

current research.

5.2.3 Institutional strand

Institutionally related comments overwhelmingly referred to the pressure to write papers that 'count' towards the university's ERA ranking. The following quotations illustrate the view of most participants that this pressure is not a positive influence, particularly in the changing environment in which academics' work is dictated more by administrators than by the needs of research or teaching:

But I think the university really values numbers. It's again, another issue that [has] always struck me – centres of higher learning use the most base measure to measure their quality. The number of publications and the amount of dollars that you've put in grants ... because it's easy to do. [Mike, metropolitan unaligned]

It's very important to the university that we are researchers and that we have research publications and reportable research publications ... Being a researcher is so important ... It seems to me to be a lot more emphasis is put on the research outputs than the teaching outputs. Again probably because it's more easily measurable and easy to quantify ... It's interesting because being a regional university with a focus on teaching, you would think we'd have found a better way of doing it by now. Yet there's still this emphasis on research. If you want to be promoted you need to research. [Alex, regional]

Well, essentially, the university values academic publications ... The number count, the quality count. They actually don't care about...dissemination...I actually don't think the university cares too much about the impact that we make on engineering education. I think they just care – well, they just care about the metrics ... it's the how many people, how'd you get cited, was it peer reviewed ... it's more to do with what we call the administrivia of the university these days. [Adele, Go8]

Most participants commented that despite producing publications that the university can count towards its research output for ERA purposes, engineering education-related publications were seen to be second-class and in some places not considered as ‘real’ research, which aligns with findings from Kavanagh et al. (2012) in Australia and Jesiek et al. (2009) and Guerra and Cox (2009) overseas. This is similar to the experience of other interdisciplinary researchers; Manathunga (2009) talks of “disciplinary chauvinism” (p. 139) and likens it to racism. This perception of the educational research area as not real research means that authors in that area are also looked down on as not being capable researchers, which may impact on identity constructs as well. In Alex’s case there is a hierarchy of research areas, and educational research is regarded as lower down the hierarchy than technical research, while in Mark’s department publications on educational research were not even considered:

We get presentations from our Office of Higher Degrees in Research about what is a reportable ... Anything that has learning or teaching associated with it, they tend to view fairly cynically when they're trying to determine whether it's real research. If you were testing concrete beams or something, it must be real research. But if you're not they seem to apply almost different standards because they can't quite cope with qualitative and the quantitative difference, I suspect ... this seems to be a common thing. Maybe we see it in Engineering Education because we see both sides of the coin. We see the technical researchers and what they do, and say well we're just as rigorous, but we seem to have different standards applied to us [and] we have to justify our status much more strongly. [Alex, regional]

The school operates a sort of database for research categories and for collecting information and whatever. Engineering education is not one of the options for recording information – or recording – research performance on that ... It's more through ignorance rather than design. They're not saying oh well, we've thought about engineering education and we're not going to do it. Or we're not going to

put it on our list of important things. It's just that it never even crossed their mind in the first place. [Mark, Go8]

Some universities do actively support engineering education-related research, with two universities at the time of the interviews having established a discipline-specific educational research group. In Mike's case, this institutional support had benefits for both the development of his networking strands (supporting him to attend the conference) and/or his intellectual strands (providing resources at his university to support developing expertise):

The school will fund you to go to AAEE conference, at the moment ... [Head of School] funds four to five people every year to go to AAEE, which he doesn't fund any other conferences. We all got \$2000 this year. [Mike, metropolitan unaligned]

Alex's developing identity as an engineering education researcher is supported at the departmental level where there is a named research group for disciplinary education research. The research group gives some institutional authority to the development of Alex's intellectual and networking strands. Alex acknowledges her development as a researcher, which includes a better appreciation of what reviewers are saying: "I've improved myself as a writer and researcher." However, her earlier comment describing presentations from the Office of Higher Degrees in Research demonstrates that support for her area of research is not shared throughout the general university, resulting in tension about its value.

Similarly to Alex, Wayne and Terry also made major changes for their final paper.

Wayne works at the same regional university as Alex, and Terry works at a metropolitan unaligned university that also has a disciplinary-specific educational research group. Even though Wayne and Terry's interaction with these research groups

may be different to Alex's, having an active research group on campus provides them with institutional authority while they develop their intellectual and networking strands of identity in engineering education. In Terry's case,

The previous discipline leader was actively encouraging people to do research into education. Our previous Dean was quite keen on it as well ... So I guess you do have support because (a) there's people here I can talk to about it and (b) it is actually encouraged by people at senior levels. [Terry, metropolitan unaligned]

For Terry, wanting to be seen as an active member of the research group provided some of the motivation he needed to write his paper for the AAEE conference: "I've explicitly been told if you're a part of a research group you're going to find it easier to get promotions." The closer alignment between local departmental values and university-wide values that are apparent at Terry's university means that there is strong institutional support for the development of his intellectual and networking strands. In other words, his intellectual, networking and institutional strands would be mutually supportive. Similar arguments are reported in studies into the institutionally supported identities of engineering students (Tonso 2006) and the institutionally supported (or not) interdisciplinary identities of engineering students and academics (McNair et al. 2011).

The other individuals who work at an institution can also influence whether academics might engage in engineering education there. This is demonstrated by Alex's choice of research area for her PhD:

I guess when I started as an academic it was clear that I had to develop a research area ... I've got a construction background so I thought about construction type research. It came down to who I wanted to work with I think, as well as my interest ... I became quite passionate about my teaching and wanted to improve it. So that stemmed an interest in what's going on in the research area. But then also I get on very well with [engineering colleague at the same university] who's

running the [engineering education research group] ... So I was very happy to work with all those people as well as it follows my interest as well. Construction interested me as well but there was no one I wanted to work with at this university in the construction area. Which was a big disincentive for a long time until I discovered this whole engineering education thing. So yeah, that was a big factor. Being a novice researcher I obviously had to have a mentor of some sort to get into the whole research thing. The construction mentors just didn't – or I didn't see eye to eye with them so I couldn't see myself working with them. [Alex, regional]

Mark made a similar comment that the type of research he is doing now is a function of his collaborator, who also works at his university:

It's partly to do with the particular research collaborations that I've got at the moment. [Mark, Go8]

For Evan and Mike, their educational research is inextricably linked to their practice of teaching engineering students. This is illustrated on the engineering education research landscape (see Figure 5.1) where they both placed their stars in the 'teaching and learning of engineering' circle. The final papers from both did not address all the issues raised by their respective reviewers. I also note that these academics work at universities without disciplinary educational research groups, and neither seems to have a strong mentor, as Wayne does.

However, the institutional influence is not necessarily uniform even within the one institution, with a local departmental-level environment sometimes having a stronger influence over an individual academic than the university-wide environment (if there is one). For example, while Alex may benefit from the local Faculty-based research group, she still feels her work is under-appreciated by the university-wide structures such as the Office of Higher Degrees in Research. The following three comments are from different academics in different engineering departments at the same university. Tom

appears to have no trouble having his engineering education research accounted for, while Evan and Mark, in different Departments, struggle to find validation of their publications or grant proposals:

The only question my university asks in relation to a paper – if you want to have it counted by the bean counters – was it peer reviewed or not? That's the only question they ask ... So, in that sense, yeah, the bean counters are counting AAEE papers for the University. In terms of telling the world this is what our academics have done, yeah, they [count them]. They're peer reviewed ... The other reason is that the government actually gives a small amount of funding to the universities for each paper that they publish [and] that's what the University cares about.
[Tom, Go8]

Evan is in a specific unit at the same university with “primarily education specialists so their research requirements are less, but their teaching ones are higher”. He commented that in regard to the work of the unit being valued “some is, some isn't; probably not so much the research at this point”.

Mark at the same university commented:

One of the issues that's faced is this thing about the importance or role of engineering education ... the legitimacy of engineering education as something worth researching. Which arises in various aspects from whether there is somewhere to record your efforts ... where you might seek research funds, so for example, if you seek research funds from ... the Office of Teaching and Learning or its predecessor ... the University's Research Office refuses to deal with those submissions, because it's not research. So you float around the University looking for someone important to sign your application [but] they haven't got a mechanism for receiving your application, signing it and then passing it on ... The Research Office have got a very good means of putting things in front of someone important to sign off as a university signatory. But it's not research like ARC or ... industry funding sources. So that's a bit of a battle. I don't know if other universities are similar. [Mark, Go8]

Tom has a different view from Evan and Mark. This may be due to him having a different sense of agency in regard to academic practice, that is, the ability to leverage institutional structures in one's favour. Or it may be due to Tom not having worked in this field as long as Mark and Evan, and so has not met the same barriers yet. These different attitudes reinforce the value of the personal focus of identity-trajectory as an identity theory.

Many emerging researchers are continuing their activity in the domain of engineering education despite the lack of support from their universities, rather than because of it. This causes tension for many of them as they learn to negotiate university structures. At the same time it motivates their involvement in the AAEE conferences, where the opportunity to meet similar researchers from other universities serves as an alternate source of support.

5.3 Temporal references

The previous comments from participants show that the intellectual, networking and institutional strands are interdependent. Another aspect of the identity-trajectory framework is the temporal frame of reference, that is, the development of the academic strands occurs over time. The emerging researchers make apparent the importance of a timeframe by the use of past events in framing their current situations. Interpreting past events and experience and incorporating them into their personal narrative is demonstrated by researchers from all university types. Alex, Evan and Mike refer to a history of experience in industry prior to entering academia:

I came from industry before I came here so I had no research background when I came here. So I'm developing it through engineering education. [Alex, regional]

I worked in industry before coming back to uni. Only over the last few years have I been teaching. [Evan, Go8]

But I know that one thing that I have struggled with in the last 15 years is that when I was at university, I was very, very good at knowing what to do and I did it ... I'd left school at Year 10 and done TAFE and then ... where I worked put me through university. [Mike, metropolitan unaligned]

Whereas Wayne and Terry refer to their previous research experience:

I've had a strong research background before coming here where I've been doing research only for over a decade, doing nothing but research ... so my introduction was down in the practice side of things. Well it was just I guess welcome to education research kind of thing ... I did a little bit of research and got a little bit of evidence to go with it so it wasn't just a show and tell paper. But that's where I started.[Wayne, regional]

Actually, I don't know if this is of any use to you but my PhD was actually in probabilistic design, which is where you treat all of your variables as distributions, and that's to design quality products and things like that. So quality control is something that's in my mind and so I guess I just think a bit that way. [Terry, metropolitan unaligned]

As well as looking back, emerging researchers look forward to what they plan for the future:

I've done largely quantitative and a smattering of qualitative and it's really necessary at some point I've got to force myself to use a much more purely qualitative method to collect some information. [Wayne, regional];

Where I've come from what I was doing previously, dabbling. I shudder when I think back to like the Adelaide AAEE Conference [2009] ... I'm trying to think what I was writing about ... It was very much a show and tell ... It's been an interesting progression since then. One of these days I'll line up the papers and go,

yeah. To be able to see the progression ... To say well I have moved on ... sometimes you think, Oh I'm not where I want to be. But then I am closer than I used to be. [Alex, regional]

I mean next year I might put something into the conference. I remember, what's his name, [academic consultant], he's a guy who runs consulting courses on academic success; I think he gave a ratio of one journal paper for every three conference papers or something like that. So I might review that at the end of this year and think about what I want to do next year. [Terry, metropolitan unaligned]

These comments referring to the future are also relevant to each participant's horizons for action that are discussed in Section 5.6.

5.4 Agency

Another important aspect of identity-trajectory is an individual's agency. This relates to their ability to set a goal and intentionally move towards it, despite institutional or personal constraints. In relation to their academic practice, participants demonstrated agency in a variety of areas within the structures of their universities,.

One argument could be that simply choosing to site their academic practice in engineering education demonstrates agency since it is not a mainstream research area for engineering academics. Evan and Alex have recently enrolled in PhDs in this research domain. Both refer to the need to have a PhD to progress in academia and identified engineering education as an area aligned to their interests:

I started doing some casual tutoring ... and then I just enjoyed it and felt that there was room for improvement, so I thought I could contribute to the area. So I started getting more involved in different projects, found a niche and then I'll need to do a PhD to progress. [Evan, Go8]

I've sort of said, Okay I'll play the game, I'll enrol in a PhD. But I'm going to do something I'm interested in and aligns with the teaching I'm doing ... I decided I'd probably be sticking around academia for a little while and if you're going to do that you need to have a PhD. I get sick of people ... who look down their nose at you somehow. You're somehow inferior because you don't have that PhD. Somehow you can't be as good. So if nothing else I want to be able to say, look I've got the piece of paper, go away. Obviously it's something you have to do if you're going to be in this industry. It took me a while, I resisted doing it for a whole lot of personal reasons for a long time. It just wasn't the right time ... Now is the right time – well is it ever the right time? But it's a better time than it was. I'm interested in engineering education, hence now let's enrol in the engineering education PhD if that makes sense. [Alex, regional]

While Evan and Alex are both enrolled in PhDs in engineering education, their different responses to the reviews of their papers (Alex making major changes and Evan minimal changes) may be explained by the way they see themselves. Both reported undertaking their postgraduate program because it is expected that an academic has a PhD. While compliance with this expectation seems to be the main issue for Evan, Alex sees her PhD as intentional development of a “possible self” identity (Markus & Nurius 1986, p. 954) as an engineering education researcher, which aligns with where she located her star in Figure 5.1. Alex’s process of choosing research area and collaborators demonstrates her agency.

For others their agency is enacted by prioritising their teaching or administrative role over their research since, as Alex said, “If you want to be promoted you have to research”. This type of agency reflects the finding that “managing one’s own and others’ competing intentions occasionally involved resisting work practices as well as the expectations of others” (McAlpine et al. 2013b, p. 958). Mike demonstrates this:

I do what I think is the right thing to do. Not necessarily the thing I should do. So I don't necessarily get ahead because I don't publish, because I don't do all the things that I know I should be doing ... I'm not sure why now my attitude has changed, that I do what I think is the right thing to do ... and I look for reasons to justify why that's the right thing to do. Rather than doing the things that I really know I should be doing. [Mike, metropolitan unaligned]

Adele exhibits agency in a different way by intentionally working with people from different backgrounds on projects that will stretch her knowledge and skills:

I work with people who often have quite different views on the world, so you get really different perspectives. That's actually something I find – like [engineering colleague] and I ... teach in completely different parts of the curriculum, but that's actually really powerful, because ... when we do work together, we have quite different views on it, so often that means I get forced to look at things differently. Whereas if I was just doing my own thing, I think you sort of get – that's what I'm going to do and I'm going to be comfortable. But working with other people can really sort of challenge you and take you out of your comfort zone. [Adele, Go8]

Wayne demonstrated agency by finding an experienced researcher at another university to co-author his paper and in doing so act as a research mentor. Other participants demonstrated agency in the way they responded to the reviewers' comments:

We ignored that review, because it was of no help whatsoever. [Mark, Go8]

I probably would have thought differently if the second person said very much the same thing. [Terry, metropolitan unaligned]

There was one comment in particular ... It gave me the, 'Oh now I know what I'm going to do with this paper'. So it certainly did give me the direction that I needed to complete the paper the way I wanted to. [Alex, regional]

Variation in the quality of reviews can elicit a range of responses from authors.

Contradictory comments from reviewers may start authors thinking more deeply or

from a different perspective and hence develop their intellectual strand, a process that is assisted by they have a colleague to discuss it with (see Erica's comments in Chapter 7 regarding helping authors to interpret their reviews). Isolated or unmotivated authors can use the positive review to justify ignoring the negative one, as in Terry's comment above.

Tom's experience was interesting as his paper was rejected for the 2011 AAEE conference. He demonstrates agency by reworking it for the 2012 conference, for which it was accepted, rather than accepting the initial rejection. His reasoning for resubmitting the paper was:

As an author, I rejected the reviewers. That's not unusual for me. I've routinely rejected the reviewers' recommendations. I've numerous times written to editors-in-chief, and had reject recommendations turned into publish ... I go right to the top. I tell the Editor-in-Chief, this decision is wrong. This is why it's wrong. You should publish me. I've had numerous reversals of decisions. I was writing one this morning actually before you came. So I'm a person who has a fair amount of confidence, and value my own opinions. I'm not bashful. So when I got 2011, I thought you ... You are just thinking research, research, research. Research is fine. I want this other category; I insist there is this other category. So I resubmitted, and I was quite willing to spin the paper the way it needed to be, to fit the criteria. That's how determined I was to present the paper ... I'm being evaluated on a playing field that I don't wish to enter. I want to compete on a different playing field, please. [Tom, Go8]

While these participants may still be emerging as researchers, they have demonstrated agency in various ways in line with their personal intentions for their academic practice.

5.5 Personal context

McAlpine, Amundsen and Turner (2013a,b) suggest that attention to personal contexts

is essential to understanding the academic experience. Personally related stories were often intertwined with references to the past, since it's their own histories participants are talking about. Personal circumstances influenced some participants' decisions to pursue an academic career and when to do it. For example, Alex waited until her husband had finished his PhD before she began hers, and then chose to work in an area of interest with someone that she wanted to work with. Adele's fractional appointment at her university was in response to her significant leadership role in a national professional association. For other participants their personal relationships were evident in comments such as Wayne's describing a competition between himself and his wife, and Tom commenting that his daughter would like the coloured stars used in the landscape model:

I've always been excellent at English and my wife and I have competitions. We're both really good at our grammar and spelling and all those things that make up correct writing [Wayne, regional]

Should get my daughter to do this for me. She'd be right into the coloured stickers [Tom, Go8].

It was difficult to separate the personal comments because they were usually intertwined with other aspects of the model such as referencing the past, agency or horizons for action. This reinforces how pervasive the personal aspects of our academic life are.

5.6 Horizons for action

Horizons for action are generated through personal agency and based on past experiences and the intertwining of the personal and the academic strands. For most participants the horizon for action relates to their envisaged participation in engineering education as a researcher and author. The limit/s they impose on themselves as

researchers are based on how they view themselves as engineering academics within the engineering research paradigm, and are strongly linked to the development of the intellectual strand of their identity-trajectory. Here are examples:

I don't know where AAEE is going in future. I don't know where I'm going in terms of contributing to it ... I think if it was going to become a significant part of my research effort, I would have to go into this sort of field, and become some sort of expert in engineering education research, which involves the sort of methodologies that I can see that you are using. Which I respect – I have friends who have got PhDs in Sociology and Philosophy and other areas. So I respect those methodologies, I just don't happen to know too much about them myself. So I would need to go in that sort of area to become a more deeply engaged engineer education researcher. But I'm probably not going to. [Tom, Go8]

Probably, only because I think it's too difficult for me to go into that area. I'm not sure that I could go into that area. I could say I'd like to go into this [and] use some of the same modeling and simulation type stuff to be able to inform. But ... the problem I see with modeling, when you get into this area, is the non-modelists say well, this is a model. It's not real. The problem with the model is it will only ever tell you what you've told it. [Mike, metropolitan unaligned]

If I was moving to education research in general I'd probably feel as though I need to have a high level of qualifications in education to understand the theoretical background of things like that. So although there is the opportunity there, I don't necessarily know if I'm likely to take it, simply because I'd say, well, where am I going to publish. If there was a journal of interdisciplinary education research then I'd say, Oh okay, that's the area. But to publish a paper like that in just a generic education research journal it would just be a lot of work to make sure I'm familiar with the theories within that journal and stuff like that. [Terry, metropolitan unaligned]

It is interesting that these three participants argue that they intend to stay in engineering education because if they were to move into general education research they would have

to learn about learning theories and different methodologies. This implies that they think they don't need to be familiar with broader research perspectives to undertake research in engineering education. For Tom, Mike, and Terry, above, as well as Ian and Evan, their educational research is inextricably linked to their practice of teaching engineering students. The final conference papers from these participants did not address all the issues raised by their respective reviewers. Terry is the only one of these academics who works at a university with a disciplinary educational research group, and none of them seems to have an experienced researcher to mentor him.

Contrasting with these five participants are Alex, Adele, Mark and Wayne, all of whom located their stars on the trajectory towards the social research vicinity on the landscape model (see Figure 5.1). Alex, Adele and Mark were each collaborating with a colleague outside their own university who had some type of social science discipline background and Wayne was working with and being mentored by an established researcher within his university. Working with these colleagues has broadened their horizons from the engineering disciplinary base. This reinforces the potential of the networking and institutional strands to impact the intellectual strand.

Another horizon referred to by Adele and Mike relates to their perception of how being identified as active in the engineering education field will impact on their chances for promotion:

I have accepted that I will not ever be a professor, and I'm actually okay with that ... I don't know whether [new Head of School] actually understands the reality, because you know, I've been a 60 per cent fraction with a full-time teaching load for 10 years, who never had any protected teaching time ... I would be better off being a crappy teacher, because I would get less teaching. So, I'm now 80 per cent and I'm teaching two courses full-time. So, I will have taught 1,000 students this

year, and I'll teach the same next year – more than that. I'll teach probably 800 in the first semester and 500 in the second semester. So, the reality is, I'm effectively now teaching focused without being called teaching focused, and my Head of School is okay with that. But I think he still thinks I can get promoted ... I don't know, I think women are actually better at saying, you know what, stuff it, I like it [teaching] – which is really good until they go through a School restructure and then you're vulnerable. [Adele, Go8]

The Head of School in my performance review said that I should focus on one thing or the other, either in my [typical engineering] research or in my education and that that would allow me to strengthen my position. So not in the school, but strengthen my research ... So now it's making me think well, I don't think I should be putting all my eggs in the education basket because if they make me redundant then I've got no [typical engineering research area]. I may not be able to get an education research role at my age now at somewhere else. [Mike, metropolitan unaligned]

Both Adele and Mike believe that being identified as active in engineering education will impact negatively on their chances of promotion and security of employment. For Mike this perception tends to limit his activity in engineering education as a research area. Similar perceptions are described by Manathunga (2009), who reported one of her interdisciplinary participants being called a “butterfly” by a promotions committee:

In many senses, interdisciplinary researchers are always in-between, flitting here and there, never settling for long, but the productive aspect of this liminality lies in its potential for creating new identities and new knowledge (p. 138).

5.7 Response to the landscape model

After nominating the roles they enact in being a researcher, and discussing the reviews they received in response to their 2012 AAEE conference paper, participants were asked to locate their paper on the engineering education landscape model shown in Figure 4.3

and discussed in Section 4.1.1. These self-identified locations are shown in Figure 5.1.

All emerging researchers were able to locate their paper on the landscape model and were able to locate it with one star, except for Tom, who used two stars to indicate that his paper was mainly about teaching and learning of engineering, but related to practice since practitioners were involved.

These participants typically wrote about the subject they were teaching or managing and so their stars are clustered in the ‘teaching and learning of engineering’ vicinity, except for Adele, Alex, Mark and Terry. The papers written by Adele and Alex were concerned with questions that did not specifically relate to any one subject but instead were general sector-wide questions. Because of the questions they were addressing and, in Alex’s case, the theoretical positioning of the paper, they located their stars in the ‘social research’ vicinity. These participants were working closely with researchers from a disciplinary background in the social sciences and I suggest this interaction influenced the way they carried out their research as well as the way they thought about it.

Mark also located his paper in the ‘social research’ vicinity, even though he is concerned with students’ development of a particular skill. Like Alex and Adele, he is collaborating with a social scientist in this work and he is drawing heavily from theories of learning. In my view, the nature of the question he is addressing would site his paper in the ‘teaching and learning of engineering’ vicinity. In locating his paper closer to social research, Mark is indicating that because of the theoretical positioning of the work, he views it as something more than simply reporting a teaching innovation.

Terry’s area of teaching and mainstream engineering research is a practice-oriented

aspect of the university course and his identification with this area is illustrated in locating his star on the ‘engineering practice’ trajectory, even though his paper is essentially about evaluating practice in the subject he teaches. Mark and Terry both located their papers in a different vicinity than I would have, that is, in or close to the teaching and learning of engineering circle. Paying attention to where they located their paper has demonstrated that Terry thinks of his work as strongly aligned to engineering practice and that Mark recognises the strong social science influence in his work.

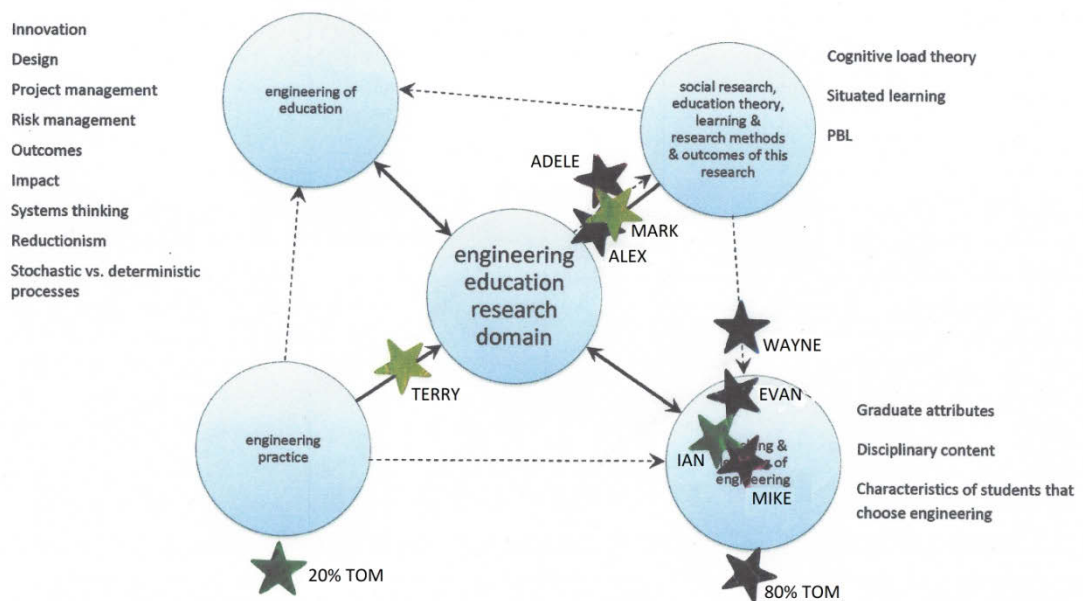


Figure 5.1: Emerging researchers' self-location of their 2012 AAEE conference paper on the engineering education landscape model

Also worth remembering in relation to Figure 5.1 is that Alex and Wayne work at the same university, and Tom works at the same university as Mark. The various locations of their stars demonstrates that individuals react to an environment in differently, for example, by interacting more closely with particular people at that university, or by the ways they negotiate institutional structures. This further substantiates the value of using

a theoretical framework based on the individual such as identity-trajectory.

5.8 Summary of findings for emerging researchers

The identity-trajectory concept has provided a valuable framework to analyse the various elements of academic identity development for emerging researchers. For this group of participants the dominant aspects of the intellectual strand revolve around the initial reliance on, and later dissatisfaction with, quantitative research methods. They commented much more on the intertextual element of their networking strand than the interpersonal. Yet the interpersonal support available at the annual conference is an important alternative for those without institutional support for their research area – this is the case at most universities in Australia. Many emerging researchers are continuing their activity in the domain of engineering education despite the lack of support from their universities, rather than because of it.

Emerging researchers illustrate the importance of a timeframe by their use of past events to frame their current situations. They also demonstrated agency in various ways that align with their personal intentions. I found it analytically difficult to separate out the personal comments because they were usually intertwined with another aspect of the model such as referencing the past, agency or horizons for action. This reinforces how pervasive the personal aspects of our academic life are.

For most participants the horizon for action they mentioned relates to their envisaged participation in engineering education as a researcher and author. The limits they impose on themselves as researchers are based on and in their view of themselves as engineering academics working within the engineering research paradigm and are strongly linked to the intellectual strand of their identity-trajectory.

Most of the emerging researchers located their paper for the 2012 AAEE conference in the ‘teaching and learning of engineering’ area of the model of the engineering education landscape. The exceptions were participants who identified strongly with a particular region or were working closely with colleagues who had a disciplinary background in the social sciences.

Chapter 6. Intermediate researchers

For the purposes of this study, intermediate researchers are characterised by comparison with the emerging researchers and the established researchers. Typically, between 2009 and 2012 they wrote more AAEE conference papers than the emerging researchers yet fewer international conference papers and other types of publications than the established researchers. Three of the intermediate researcher participants had authored or co-authored one international conference paper, while the fourth had been a first author on several. Two of them had published one journal paper or book chapter, and the other two had published several journal papers. One had edited a book and another had led a competitively funded project. None of the intermediate researchers was supervising PhD students in engineering education or acting as editor or associate editor for any engineering education journals.

This system of classifying researchers was supported by responses such as the following from participants who self-identified as having progressed beyond the emerging phase in their transition to working within the engineering education research paradigm:

So I'm in the midpoint of my transition from one to the other. Not generating too many new ideas in the technical research area anymore.[Therese, ATN]

I'm probably going to start digging deeper into getting a better understanding of cognitive development, psychological aspects. These are areas that I haven't delved into at the moment ... I'd like it to be based more in theory. [Neil, Go8]

I'm part of the go-to group. I'm not an expert in anything – yet. If I don't know I may know a colleague of mine who knows what's going on. [Nathan, metropolitan unaligned].

In this chapter, I analyse the intermediate researchers' interviews and discuss how the

various aspects of identity-trajectory are illustrated by their explanations of their conference papers and their responses to the peer reviews of these papers. I also highlight aspects of practice that characterise participants in this category.

6.1 Intermediate researcher summaries

These summaries were developed from the intermediate researchers' interview transcripts and activities, document analyses of their conference papers, and my researcher notes concerning each participant.

Sam

Sam works at a regional university. As the role of most importance to him, he listed being a member of the engineering education community. This was followed by educator/teacher: "As in educating ... about new things" – in his case mainly engineering academics involved in teaching. Part of his reason for writing conference papers is to let others know what resources he has created for academics to use, or what he has found in his research. His third most important personal role is that of researcher.

As aspects of most importance to his university, he listed, first, active researcher: "[The] university with the publication drive wants you to be active and disseminating information regularly"; second, project leader: "The university wants you to be the leader of things, not a collaborator in everything"; and third, academic. Sam identifies as a learner, that is, as someone who continues to learn and has an attitude that no matter how much you know you can always learn more. He talks to a range of professionals about education, which suggests that he doesn't think engineers have a monopoly on good ideas. The reviewers' decision on Sam's paper was 'accept with major changes', which was largely due to the reviewers' interpretation of the structured

abstract and review criteria for the 2012 AAEE conference that all papers should have a theoretical research focus and format. The reviewer response form required for papers with major changes demonstrates Sam's personal agency:

The authors acknowledge that this does not conform with the research paper-only format of this year's conference. We request that the conference chair consider this position and decide whether this paper is a useful contribution to this conference or not.

Obviously the conference chair had considered it a useful contribution, since it was accepted for presentation at the conference. The substantial changes to the final paper were in response to the substantive issues of focus and structure raised by the reviewers. Sam placed his star in the teaching and learning of engineering circle (see Figure 6.1) with a link to engineering practice:

What we're trying to do in this project is informed by engineering practice, so it's about what graduates are going to have to do. It's probably in this teaching and learning bit ... it's driven a lot by modern engineering practice.

He also indicated that some of his papers are in the vicinity of the social research neighbourhood: "There's a little bit in research. Probably a third of the papers are attempting to be in research."

Neil

Neil identifies strongly as an engineer. This became apparent when he listed the roles that he values: researcher, communicator, and project manager:

One of the things that's helped me through every aspect of my work is trying to equate nearly anything and everything I do to a design challenge ... For me, it becomes an engineering problem.

As the three most important aspects for his university, which is a member of the Go8,

he listed, first, automated publication machine: “Being an automated paper-producing machine would be important to the university, to basically get the publications up”; second, submissive employee: “There's an expectation, for what would have been and should have been creative academics to be more submissive and just do as they're told”; and third, ‘kudos’ builder: “So there's these pressures for pushing stuff out like a machine, but at the same time, particularly the sandstone universities, they want to retain this kudos”.

Neil’s research is bound up with his practice of teaching. As Associate Dean Teaching and Learning (ADTL) in his Faculty, he has a role of authority and leadership in his university. Neil used three stars to locate his paper: one star for method, which was in the engineering of education circle, and two stars for content – one of these was 60% in the social research/education theory circle and the remaining 40% was located in the teaching and learning of engineering circle (see Figure 6.1). Neil’s paper was accepted subject to minor changes. He comments that there was a “cull” of material to reduce the repetition noted by one of the reviewers. Both reviews were positive overall – one focussed on the structure and repetitive nature of some material, the other engaged with the stated purpose of Neil’s paper. Neil addressed this question in the paper, so it’s unclear why the second reviewer focused on this so much. In regard to the reviewer’s comment on his paper’s structure Neil responded:

Organising and structure is fairly important to me and I probably would have taken that initial comment and been a bit defensive about it ... We might have chosen not to follow the reviewer's recommendations on changing the organisation there.

Nathan

Nathan works at a metropolitan unaligned university and likes to talk to people, to learn

new things and to think. As his three most valued roles he listed, first, collaborator; second, editor: “I actually enjoy editing a paper very much; just putting it together, getting the right format, making sure that the flow's correct, making sure that it makes sense, the logic is there.” and third, researcher. He listed “the count”, “the journal rating” and the number of publications as the most important aspects for his university. He is a member of a writing group that is part of a research centre in his Faculty. Being part of the writing group helped Nathan to complete the conference paper, and having a research centre helps with not only the practical aspects of being a researcher, but also with the credibility of the research area in the university. Like Sam, Nathan collaborates with people outside of engineering. The review decision on Nathan’s paper was ‘accept with minor changes’ and there were very few comments made or changes requested. A concern was expressed about receiving ethics approval (prompted by a comment in one of the reviews); the tense of one word was changed; and two sentences were slightly reworded. One reviewer said the paper “makes little new contributions”. In a manuscript about referencing and research, there were apparently very few references to journal papers dealing with strategies for developing literacy skills, and most citations were from conferences. Nathan’s paper used a Likert scale on a survey and then quantified the results, which some would argue is questionable analysis practice. One reviewer did question the methodology, but this had more to do with the word choice in the questions. Nathan located one star in engineering of education and one star in engineering practice on the landscape model (see Figure 6.1).

Therese

Therese works at a university which is a member of the ATN. There is little tension between Therese’s personal goals and university priorities. She listed author, grant

applicant and research supervisor as the three roles most important to her as she is intent on increasing her research outcomes in engineering education:

If I'm to develop a track record in that then I have to write the papers ... the purpose of having a track record is to be able to win grants ... it's probably easier to generate a track record in a field where you've got a number of PhD students or post docs writing than when you're writing everything yourself.

Although she has no engineering education graduate students at the moment, she is actively looking to get some. As Discipline Head in her Faculty she also sees being a mentor to other academics as an important role. She noted that what was important to her university was that she was awarded grants and had PhD completions and journal papers published. Therese commented that the two lists are closely aligned:

That matches quite well. So I have to write grants and what the university needs is for me to be successful. I want to supervise research students and the university wants me to have completions. University supports me to author conference papers but expects them to be turned into journal papers ... So there's a strong congruence between what's important to me and what's important to the university.

After the first two reviews of Therese's paper, the initial decision on was 'accept with major changes'. This was followed by the final editorial review, which was 'accept with further minor changes'. The editorial review mainly contained suggestions to improve the written expression and formatting of the paper, for example, "Fonts should follow the template", "The acronym for ... should be written out in full on the first occasion the phrase is used." Both of the peer reviews raised questions of clarity of the methodology and the resulting argument, which made claims about student learning that resulted from the particular intervention that was the topic of Therese's paper. Reviewer 2 specifically referred to relevant literature. Therese's responses to reviewer comments

were brief, and she did not fully explain her editing of the final version; she just stated whether changes were made or not. Comparing the reviewed version and the final version of Therese's paper, I can see major differences between them, mostly in response to reviewer comments. Changes include scaling back of claims made about the extent of student learning, and the identification of further research. As suggested by the reviewers, she also added or reworded comments to improve the description of the background literature and clarify the methodology. Therese used two stars to locate her paper on the landscape – one in 'engineering of education' and one in 'teaching and learning of engineering' (see Figure 6.1). She commented that most of her research is closer to the educational theory and social science part of the landscape:

It's quite rare that I do this. I think this is probably the first research area where I've done this. The research that I do is more in this area ... Whereas if I'm doing teaching innovation – which I do some of – then it's over here [in the landscape].

6.2 Academic identity-trajectories

The academic elements of identity-trajectory are the three intertwining strands – intellectual, networking, and institutional (see Figure 3.1). These elements become apparent when these intermediate researcher participants talk about their research, especially their 2012 AAEE conference paper and responses to its peer review. Intermediate researchers are becoming intellectually open to different ways of doing research, and they are widening their personal networks beyond their own institution and their intertextual networks beyond AAEE. Two participants in this category have leadership roles in their Faculty and their strong institutional profile has developed in advance of their intellectual strand.

6.2.1 Intellectual strand

The intellectual strand is referenced by the comments participants made that relate to research perspectives, methodologies and tools. Comments from intermediate researchers show that there has been some progression in familiarity with qualitative research methods compared to most of the emerging researchers. Therese makes a comment that “proper” research is done outside the classroom, and Nathan talks about both “numerical” and “non-numerical” data.

Upon examining the reviews for these researchers’ papers, it is apparent that reviewers often asked for issues of methodology to be addressed. In one case this was in relation to type of data collected and how it is analysed, and in another the reviewer asked for a clearer description of the methodology used. Reviewers were still suggesting relevant literature to researchers in this category and asking authors to pay attention to the structure of their papers. The decision on two intermediate researchers’ papers was ‘accept with major changes’. For one of these papers, this decision was because the reviewer was strictly interpreting the 2012 AAEE conference criteria to mean that only research type papers would be accepted. In discussing the reviews of their papers with these participants, various aspects of their thinking about their research methods were revealed.

Nathan seems to be still developing skills in writing survey questions since one of his reviewers commented that the survey questions in his paper were “loaded”. Writing low-inference questions for a survey is a skill that engineers are not trained in, as Nathan commented: “Most of us who wrote aren't educationally trained. So to write to education type criteria is not always easy.”

One of Nathan's reviewers asked for an explicit statement in his paper confirming ethics approval for the research they reported. Securing ethics approval before undertaking research about students or other staff is another difference between typical engineering research and educational research, and is comparable with completing a risk assessment before laboratory work starts.

Neil's main method of data collection is still surveys with statistical analysis, but he has progressed to linking his findings to theory. Neil also explicitly bases the motivation for empirical research on an engineering background:

The fact that I suppose we're out of the engineers' mould, there's the experimental aspect of it as well, where we actually do the tests. We do the laboratory experiments and nine times out of 10 these days it involves ... surveys, or we start questioning students or staff or whatever to see what their thoughts are. A statistical approach to interpreting those results and see whether it backs up the findings of other academics and, I suppose, not just the findings of other academics, but the fundamental theory that goes behind it. Comparing your experimental findings with the theory and with what other people have done and being able to use your expertise to come to a logical conclusion. Yeah, so that's what's really important to me ... and that's what I mean by research. [Neil, Go8]

Sam submitted a second paper to the 2012 AAEE conference and it had positive reviews. He commented that he thinks this is because engineering reviewers more readily accept papers with statistical analysis, which is in line with the findings of Beddoes (2011), Godfrey (2009) and Fensham (2004), as described in Section 5.2.1. Sam said that just because a paper includes a statistical analysis does not mean that it actually says anything useful, implying he has a critical approach to deciding on research methodology based on what is appropriate to the question:

It had statistics in it, so I don't know if that gets through easier ... you do see that a lot in journal papers, that you see a lot of very heavily statistical papers, and

they've been published. They've got this really rigorous statistical analysis, but they still don't say anything. But, they've been published anyway, and if I was reading it, I'd think that that doesn't give me anything to work with ... I think you can often get a lot more out of – more so than not out of qualitative, because people are qualitative and education is all about people. You don't weigh up percentages when you're making a choice about whether you study for this or not. [Sam, regional]

Even though intermediate researchers are becoming more comfortable with qualitative research methods, their range of research perspectives is still a restricted one. Neil's unfamiliarity with some established social science research theory was demonstrated in his description of a workshop that he attended at the 2012 AAEE conference:

I walked in there accidentally. I thought it was just an engineering research methods type. I didn't read it properly. I just rushed in. But, I don't know, it's – see, for me ... these are social science type subjects. So it just surprised me a little bit. I can't see too many of our community saying that, okay, the research that I've conducted on this particular paper has been based on a feminist perspective. I just can't see that happening. I really can't ... But for me, the naming of that was divisive. It probably should have been gender-balanced research methods ... I mean, I think the minute you talk about feminism, you think, okay, well, I'm a guy, so that doesn't include me, and it should do, because really, for all things to be equal, guys need to be able to empathise more with that. You're not going to get that while you've got these divisive type titles. [Neil, Go8]

He does not seem to be aware that feminist theory is a recognised research perspective and he refers to feminism with the popular meaning of the word. However, he does seem to understand the purpose of using a theoretical perspective and hence his intellectual strand is further developed than that of many of the emerging researchers who are yet to recognise that they can use a range of research perspectives:

My interpretation from that was that there's different ways of looking at issues and if you take your normal – say I've got my pragmatic engineering approach hat on

and I take that off. I now put my feminist hat on. My eyes will open – will be opened differently to the problem and I will come up with probably a different solution. So that's what I took away from that. [Neil, Go8]

Both Sam and Therese demonstrated that they have started to develop multiple areas of activity within the engineering education research domain. Sam placed his star in the teaching and learning of engineering circle with a link to engineering practice:

What we're trying to do in this project is informed by engineering practice, so it's about what graduates are going to have to do ... It's probably in this teaching and learning bit ... it's driven a lot by modern engineering practice. [Sam, regional]

He also indicated that some of his papers are in the vicinity of the social research neighbourhood: “There's a little bit in research. Probably a third of the papers are attempting to be in research.”

Therese said she is not only starting to work in multiple research areas, she is also using qualitative research methods in these areas rather than the quantitative methods favoured by most emerging researchers:

It's quite rare that I do this. I think this is probably the first research area where I've done this. The research that I do is more in this area. So when I'm working in sustainability, it's more like this and when I'm looking at the graduate attributes then we're doing interviews and focus groups and trying to develop a framework. Also I've got a research project in gender where we're doing focus groups. So I think it's more like this ... Yeah, so it's proper, proper research outside the classroom. Whereas if I'm doing teaching innovation – which I do some of – then it's over here. So this would be my teaching innovations, and this the research to try and understand what motivates learners and you know with interviews. This bit is pretty novel for us. [Therese, ATN]

While these researchers were conscious of needing research publications to build or maintain a track record, they also referred to their research as a way of understanding

what they do. Neil was specifically looking to understand blended learning:

Blended learning is exciting me. I want to add value when 200 students go out of their time to face up to me in a class, I want to add value and I want to give them something that they can't get online. I want to know what that is. I'll be honest with you. I don't really know what it is yet. I know I can entertain. I can be a clown. I know I can do that. I can capture an audience, but it's not what it's about. I want to use that time to embed the ideas that need to be embedded and I want to understand that. When do I need to be a clown? When do I need to make it light-hearted? When do I need to make it serious? ... I don't understand it yet, but I want to. [Neil, Go8]

Therese commented more generally about the link between understanding and writing:

So I'm looking at what works for me and my theory is – this applies to everybody – is that to get into education research, to understand your teaching, there is only one way to do it and that is you have to write papers. You have to do little research projects. You have to grapple with evaluating your research otherwise you can never teach well I think. I think that's the only way to do it. [Therese, ATN]

Therese and Sam's also reported on how they link writing and learning, in their case learning about research methods and research writing:

Writing literature reviews [is] one of the things I love about writing papers ... it means I'm now reading and then writing it down. So I love reading other people's ideas. But best of all I like remembering their ideas. If I write them down, then it goes into long term memory and so then I feel I've learnt it. So that's something I really enjoy about being an author. PhD students writing papers for you can develop a track record faster, but those papers are never as deep ... But where there's so much new to learn in education research, then to actually be the one who's writing the literature review and be the one who's analysing the results and developing the framework and doing it myself I find ... that learning is much deeper because I've written it myself ... The first paper that [two collaborators] and I wrote, I – and at the same time was learning education research

methodology. Having been to four of [experienced researcher]'s seminars ... On the fourth one I had started writing the paper on our project and I heard so much in that seminar. Exactly the same seminar that I attended for the fourth time and finally I was going oh, that's what she means, oh that's what she means ... I heard those words - they echoed in my brain – I knew I'd heard them before but I'd never understood them because I hadn't got the experience of struggling with a data set and trying to turn it into something that makes sense. But doing the education research has really facilitated my learning about methodology and about the field. But for me and others like me there is no substitute for actually doing it. [Therese, ATN]

I don't think you can progress to knowing everything and then only teaching everybody else. You've got to keep learning the whole way through ... and in writing conference papers, particularly collaborating with other people, I've learned a lot about writing itself, and researching and creating arguments, just through comments of co-authors, and then again, through the review process. I've learned a lot about researching and writing. [Sam, regional]

While the emerging researchers commented positively on the reviews they received, some of the intermediate researchers said the reviews they received were not of a high quality. For example, Sam commented that the reviews on his second paper for the 2012 AAEE conference were not very critical, and Neil said the reviews for his paper were not constructive:

I didn't know if they were critical enough. There were questions I had about the research that weren't asked by the reviewers, so I'm hoping they'll be brought up at the conference to discuss in more detail. [Sam, regional]

The key thing I'm getting from those two reviewers there, and this is the crucial thing, is it's typical of the sort of contradictory feedback that you can get ... when you get reviews that just say, this is bad, this should be better, this is bad, this bit

here should be better, this doesn't do this, and point out the problems ... without suggesting any solutions, then that's not very constructive. [Neil, Go8]

Nevertheless, they were still using the reviews to learn how to fully participate in the academic community:

Compared to the first review, [this one] was a much more supportive approach to writing it, and it's something I'll learn from when I'm giving other people reviews. [Sam, regional].

Another issue that arose when talking to these researchers about their reviews was a tension between 'research' and 'practice' conference papers and their perceived relative value. Some reviewers seemed to have interpreted the 2012 AAEE conference review criteria to mean that only theoretical-type research papers would be accepted at the conference. This generated negative reactions amongst the intermediate researchers, as it did with the emerging researchers, who perceived that AAEE was trying to become an exclusive research community. However, the intermediate researchers were not just expressing negative feelings, they were also able to draw on their experiences of the broader engineering education community to make their case. For example, Sam referred to REES as an available research forum, and Neil argued for the use of the term "scholarly practitioner":

For this review ... it got my back-up a bit about the research focus, because I've always seen engineering education as not about doing all new and original research, it's about taking existing ideas and refining them and making them effective for engineering. So, you don't have to be doing fundamental research to be doing something worth publishing and worth telling people about ... A few of these comments in this first review gave me the impression that there's a real expectation of research, when it's not a research conference. The second review is very much oh, this is really interesting stuff and they made some useful recommendations for refining the way the paper was written, but accepted the

nature of it. Whereas the other one seemed to be saying, no, it needs to be researched. We have a forum for that; it's REES. We don't need to do it twice. I think your original question was about how we've taken this and refined the paper. I think, certainly, from reading the one that was reviewed to the latest one, it's definitely improved it and clarified it. It's, now, got a more consistent story through it, but it's still not, by any means, a research paper. [Sam, regional]

I do like the term scholarly practitioner compared to a researcher. For me, the difference there is that you could spend 100 per cent of your time in pure research. For example – okay, take philosophy, you could spend a lot of time coming up with theories about philosophy and ideas and concepts, blah, blah, blah, but perhaps never, ever put them into practice. To me, a scholarly practitioner – for me, it's a more valuable commodity, because it's somebody who actually puts into practice and turns ideas ... Makes ideas valuable to people, makes them useful. But at the same time, it's not somebody who's just practising, I suppose – naively practising, or practising in ignorance. So it's that good hybrid mix, I think, of somebody who engages in research and then applies that research in practice ... There's always been this idea that there's fundamentally two types of papers we see at the conference. What they call the show and tell paper and the research papers – the engineering research papers ... Well, but the worry of that has been that it would divide the camp into the elitists and the, if you like, the apprentices, the people that aren't quite there yet, but let's patronise them for a while. I don't think it needs to be like that at all. I was so encouraged when I heard this term scholarly practitioner at last year's conference ... I would hate to divide the community. I would hate to be perceived as becoming more elite. [Neil, Go8]

It is difficult to see how this misinterpretation of the review criteria became so pervasive. The review criteria were never meant to exclude practice-based papers; they specifically included practice: “The text clearly ... explains the implications of the project for engineering education research or practice” (see Appendix C for the full review criteria).

6.2.2 Networking strand

6.2.2.1 Personal networks

Intermediate researchers were developing personal networks outside of their own institution and outside of their own discipline. All the researchers in this category mentioned educational researchers from other universities whom they know personally.

Therese and Neil said:

I had a very pleasant breakfast this morning with [experienced researcher] from Curtin and a colleague from RMIT. But [experienced researcher] is Curtin's expert at doing peer learning. She has an ALTC grant. [Therese, ATN]

I'd like to be on the receiving end of [AAEE reviewer]'s reviews. I mean, she picked up the prize. But what I can anticipate she probably did, just knowing the sort of lady she is, I would imagine that she probably went in and gave specific advice on what to do regarding specific problems. [Neil, Go8]

All researchers in this category reported interactions with academics outside of their own discipline: Therese working with a criminal psychologist, Neil discussing practice with academics in dentistry, Sam working with educational developers and an indigenous academic, and Nathan working with a librarian:

If I'm to develop a track record in [research] then I have to write the papers or collaborate with other peers, which we do. So about half of my engineering education papers I write, and the other half are written by colleagues ... about half my co-authors have been in my discipline and half have been outside. [Therese, ATN]

[There is] a lot of the online stuff, there's a couple of ladies that I speak to in dentistry that have done a lot of stuff on online resources and blended learning. [Neil, Go8]

It's been mostly through the academic development unit ... a few random people you just find around, like [experienced researcher]. She was hired on this project; she had a lot of great ideas. I talked to her about this and also other stuff. A guy I know, [indigenous academic], who I talked to a lot about indigenous engagement and indigenous issues, he's just got a different perspective on everything. It's really good to talk to people who don't think like you and don't have the same social and family structures, just to make sure you get a fresh perspective on everything. [Sam, regional]

I like working with a team of people. Exchanging ideas and information - finding out new things. Because in this case I work with two people who aren't quite in my field so it's very enjoyable. They have different slants and viewpoints. I really enjoy that. We have a sit down, regular meeting once a week. Lunch for five minutes over a cup of coffee – or for an hour or two, just to keep in touch – rather than by email or by phone. We like to see each other in person and exchange information. [Nathan, metropolitan unaligned]

The value of interacting with academics in other disciplines is to get “ideas and information” and a “different perspective”, or to access specific expertise. An example of this is Nathan asking staff in the Mathematics Department to do the statistical analysis for his project: “In statistics I go to somebody in the Maths Department and I know that they'll do all the stats for me.”

These participants show how the personal network can support the intellectual strand. Therese said she uses her personal network developed at conferences to learn new ideas, build project teams for grant applications and secure postgraduate students:

So why do I go to conferences? Because it's important to me to be an author. So I get new ideas at conferences. Grant applicants – I find my collaborators, and research supervisors – that I meet people who've got students and I say how did you get students? Have you got any students who want to come to my team?
[Therese, ATN]

For Sam, his personal network also sustains his intellectual strand. As well, the demands of the artefacts in the intellectual strand generate interaction with other academics:

I think AAEE you leave with a big grin on your face thinking, I've met all these nice people and they're all doing work and if I want to run a workshop down here, I can call that person. You get some good ideas, but it's a good supportive community as well ... That's where I think conference papers are really useful ... You write it to participate in the discourse and also get participation from other people in what you're doing. I like to look at conference papers as a way of inviting people to get involved in your work and seeing if other people can tell you about theirs and collaborate in the future ... it's just a good way of engaging with the community... to be involved with something, or to give someone new ideas, or to get new ideas from somebody ... it's dialogue. As a researcher, you write the paper with the methods you've used and, first up, you get your co-authors' comments on them, and then you get the reviewers' comments on them, and then you get the conference participants' comments. So, it's an important way of seeing that what you're doing is valid and reasonable and you're taking the right approach, or if you're not, where to go next. [Sam, regional].

With his comment of “the” right approach, this response from Sam’s demonstrates some similarities with the emerging researcher dialogue, and suggests that in relation to his intellectual strand he has not fully transitioned to the education research paradigm.

Sam’s personal network has also grown through the projects he has been involved with.

He said:

A few of the people have been through contacts that are suggested as part of project teams. That's how I know you and [engineering academics] down in Tasmania ... A few others that have been not through AAEE, but through other reasons, like [experienced researcher]. When we put in the application for this project, I looked on the ALTC website and it had just announced she had a very similar project. That's when I got in touch with her to say, I think we might be

doing the same thing, but I want to make sure we're not, because I'd like the grant. That's how we started talking about this, that and the other. Again, she's got a very high standing in the field, but that's not the reason I got in touch with her; it was about something else. So, most of the people I work with in the field are just the ones I get along with. [Sam, regional]

As shown by Sam's comments, in addition to establishing a personal network outside of their own institution, these intermediate researchers are developing a network outside of the national community context provided by the AAEE conference. For example, Sam has attended REES twice and is aware of SEFI and ASEE conferences:

I've been to REES twice; they're the only other ones. I didn't get to SEFI and I've never been to ASEE, or any of the ones around Asia. But, REES is a different game again. I find that a mentally challenging conference to be at. You pick up a lot of new ideas and a lot of really challenging stuff. It's about research and about really out-there ideas and big grants and all that sort of thing. So, it's a different community, definitely not as tight-knit. It's not as supportive. It's more like this is the top level. It's kind of, comparing it to AAEE ... whereas REES is more just about the ideas. [Sam, regional]

The interlinking of the interpersonal network and the intellectual strand can be further strengthened by the impact of the intertextual network.

6.2.2.2 *Intertextual networks*

The intertextual network is evidenced by the link these researchers make between academic reading and writing. Therese, for example, said:

Writing literature reviews [is] one of the things I love about writing papers ... it means I'm now reading and then writing it down. So I love reading other people's ideas. But best of all I like remembering their ideas. If I write them down, then it goes into long term memory and so then I feel I've learnt it. So that's something I really enjoy about being an author. [Therese, ATN]

Therese's case is typical of, how reviewers' comments can prompt these researchers to go back to their readings and re-engage with their intertextual networks when revising their papers for the 2012 AAEE conference:

So this one was more referenced to literature on teaching sustainability and the illustrating concept would be helpful. So I thought I thought I'd done that, dug into the paper, couldn't find it anywhere. Thought yeah, I can see that. So that was readily addressed and led me to reading in a more deep way some of the literature that I've already read. But you know once you've read a paper three times you don't read it again. But when you're writing about it, then you're reading it in a new way. So that got me deeper into some of the relevant literature and ... changed my perception. [Therese, ATN]

Therese and Sam spoke about how the AAEE conference also provides an opportunity for researchers to meet with authors in their intertextual network and hence they can become members of their interpersonal network, or vice versa:

Well at the conference next week we're going to be talking about other people's papers. So there'll be an opportunity in the discussion of papers to critique the work ... working with my peers, there have been times where the quality of the research work you think yeah, if they take that direction then they're really missing an opportunity, if they take this direction and so that might be a bit of mentoring but a bit of critiquing. But mentoring might be well have you thought about this? Whereas critiquing we'll be saying you know I think there's really an area of weakness in your argument there, have you thought about that? So a combination of the two to try and get them to think a bit more openly about their research goals or their research questions. [Therese, ATN]

You get to chat with people at conferences, or you see their paper and they present something interesting, and you have a chat to them about it and see where it goes from there. [Sam, regional].

Intermediate researchers have started to develop their networks with academics outside

their own discipline and outside their own institution. In the next section I look at their practices inside their own university.

6.2.3 Institutional strand

The institutional identity of these intermediate researchers is demonstrated in the roles they have at their own university and the people they commonly interact with there.

Both Therese and Neil have established research records in their typical engineering research areas before developing a profile in engineering education research. They are both Associate Professors at their university and in formal positions of authority, which they see includes a mentoring role:

So I'm taking over ... Deputy Head Teaching and Learning for this school... responsibility for teaching across three disciplines. So where as Discipline Head I've had a very hands on day to day tactical approach to teaching ... My role as Discipline Head, then I have 12 or 13 direct reports. But most of those staff don't need mentoring but a couple of the younger early career researchers, I work with them and there's some mentoring involved there. [Therese, ATN]

Just in the context of learning and teaching there are all sorts of questions ... because that's my role, Associate Dean, Learning and Teaching, so people tend to knock on my door with those sort of questions ... in a professional context – a lot of my questions and interaction is about learning and teaching. I think I'm pretty recognised as being the one with the most interest in it in that area, and that's faculty-wide. [Neil, Go8]

Nathan has a standard academic role, but he said in terms of engineering education: “I'm part of the go-to group.” Neil's institutional role aligns with his research interest in engineering education. The same is true for Sam, although his role is not a line manager in the hierarchy, but one specially created to support educational initiatives. His colleagues in the Faculty ask him questions about

the area of teaching, and sometimes admin and accreditation and things like that. Yeah, anything related to the education of students, a lot of that comes to me. My position is a new one that the Dean and Heads lobbied for. I started on a research project and worked for the first four years on research project funding, but in doing that worked on different other teaching and learning projects. It was recognised that the work I was doing was not going to fit work as a standard teaching research position in a school. It was created as a new one. The person I report to is the chair of the Faculty Education Committee. So, I sit under that structure and the Dean. [Sam, regional]

Each of the intermediate researchers say they are known at their university for engineering education either because of the specific role they have in the organisation or because of their research profile. Even so, they acknowledged the changed environment in higher education, particularly the control exerted by administration staff over academics and academic activities. Neil said:

One of the things that's very clear to me is that academics are becoming more the submissive element of the university, rather than a key element of the university. The very people that were employed to assist us are now dictating what we do. The administrators of the university are becoming the people wearing the suits and controlling the people that are really there – that really should be the creative aspect of the business. So I think there is an expectation, for what would have been and should have been creative academics to be more submissive and just do as they're told. I find that demoralising. There are certain benefits of becoming an academic which made it an attractive role. It's what tempted me out of industry into academia. But that freedom that allows you to be creative is being eroded and I don't like that. I think it's basically this expectation that we're supposed to be a submissive employee ... Because currently the language that's being used is almost dismissive of academic needs and it's all – you can see actually that there's some hostility at some levels towards bloody academics. [Neil, Go8]

They referred to the increased demand for publication metrics. Nathan listed “Points – counts – the count ... The journal rating I suppose. The count ... and the number of

publications” as the most important aspect of his work from the perspective of his university. Sam expressed it this way:

I think the university with the publication drive wants you to be active and disseminating information regularly. It's kind of an extra dimension. As a researcher, I want to see if what I'm doing is valid and get comment from others, but from the university's point of view, I think, they just want me to throw the information out there and be producing stuff ... basically, because that's all the university looks at. They don't read your paper. They look at how many times people search for it and cite it and that kind of thing ... The university wants you to be the leader of things, not a collaborator in everything. That's how I think they want to get to the top; they want everybody leading everything. So, that's important to them ... certainly prestige through rankings, so the more projects your university is leading and the more research areas you're leading in, that helps your ranking, to get to the top for whatever reason. [Sam, regional]

Neil commented that the pressure for publication metrics has skewed the focus to quantity at the expense of quality and he feels that this pressure is especially high at the Go8 universities, the ‘sandstone’ universities, such as the one where he works:

There was a time that academics would only write a paper when they had something to write about. Now it's like, okay, I have to write my paper this year. I have to write my paper. I haven't done a paper this year. I have to write something. There are papers about bullshit. So there's these pressures, I suppose, for pushing stuff out like a machine, but at the same time, particularly the sandstone universities, they want to retain this kudos ... whether conscious or not, it rewards certain things and it encourages certain things ... If you've got a high h-index, you've a much better chance of getting employed here. That comes from being a publication machine and getting lots of citations. It rewards people that have long publication lists and attract lots of grant funding ... it's quite obvious to me that it's about quantity and not quality ... and we're supposed to go around somewhat with our noses in the air saying, we're employed from a sandstone

university. But by the same token, we've got these enormous pressures to just churn out conference papers, journal papers. [Neil, Go8]

In their own Faculty, School or Departmental context there is some variation in perceptions with regard to whether engineering education research and teaching are valued. Neil and Sam said they felt unsupported, while Therese and Nathan said their work is valued at the local level:

Our Head of School is incredibly research output driven and he doesn't see the fact that research is an intrinsic part of learning and teaching. He sees it as an independent entity and teaching is a necessary evil for researchers as far as he's concerned. [Neil, Go8]

Because, we've lost our DVC academic and our new one doesn't start until November, it's in a state of flux and nobody knows where they stand, so I'm not well supported at the moment. [Sam, regional]

Managers have been very supportive of the PBL program, they've been supportive of having a focus on teaching and saying that teaching is important. So that's been really good for us. So we've travelled that path the last 10 years. So it is very good working here. [Therese, ATN]

It is because of our previous Dean. He in fact set up the engineering side. The [Faculty based engineering education research] group; he supported it greatly. [Nathan, metropolitan unaligned].

Nathan spoke about the advantage of working in a Faculty with an engineering education research centre that not only demonstrates institutional support for the transition from teaching and learning to educational researcher, but also provides practical resources to assist researcher development, such as the writing group:

The background to this paper is that I was part of a writing group. We'd meet once a week for 10 weeks or 12 weeks and the idea was to write an abstract in the paper

in the 12 weeks. Then as the sub-group – the three of us would then, at the same time, finish the paper off. So we're set tasks to do every week ... just in our faculty. There were 12 of us. Some of us had collaborators in the group; some of us didn't have collaborators in the group. So we'd exchange ideas within that group as well; assimilate ideas ... it was run by the people in the education research group but it was a sub-set of engineering science ... and it was successful and everybody who wrote a paper – some wrote for AAEE, some wrote for a journal and some just wanted to write an article they're going to submit later on. But it got them on the path to writing because it was very formalised. [Nathan, metropolitan unaligned]

Despite working in a Faculty that has a research centre in engineering education, Nathan questioned the credibility of this research. In doing so revealed his own lack of certainty with the research methods used in education-related research and perhaps why he was still an intermediate researcher although he had been working at the university for some time:

I don't know if it's seen by other researchers as real research. It's seen by other people as a form of research. Most researchers still don't think of it as strong because they don't think that surveys is a scientific approach to do research ... You can interpret the data; that's something else. Data interpretation occurs anywhere. But it's how you obtain the data. By interviews or question/answering. I also question that. [Nathan, metropolitan unaligned]

Both Sam and Nathan said they were supported in undertaking engineering education research. However, like many researchers, their continuing positions are dependent on a particular individual in authority (the Dean). A new person in that role could withdraw support.

6.3 Temporal references

As with emerging researchers, the intermediate researchers' strands of the identity-

trajectory are represented as changing over time. The participants referred to their past in explaining their current situations as engineering academics who research engineering education. Both Nathan and Neil came from industry:

I'm a materials engineer by training and I worked for 10 years for [company name] then came over to [this university] about 25 years ago. I'm an old man ... when I got to [this university] it was an Institute of Technology ... The Dean said to me there's not much research going on here. If you want to do some research like at [company name] you won't be able to do it; you have to do it outside. So I looked around and education interested me. So I went on both parts. Some years more in education; some years more in engineering. [Nathan, metropolitan unaligned]

There are certain benefits of becoming an academic which made it an attractive role. It's what tempted me out of industry into academia. [But] that freedom that allows you to be creative is being eroded and I don't like that. [Neil, Go8]

Sam and Therese referred to their past publications in a process of self-reflection:

For a conference, it's the entry point and there are a lot of people who are further on in the process than others, and for some it's their first paper. I read some of my first papers and think oh, missed a fair bit there. [Sam, regional]

So it is an important part that I think this review process has done much better than any process – to say this is the good part so don't change this part and keep doing this part. But what we do suggest you might focus on is this. Whereas normally you just get this totally negative review and you think God, I'm back at square one. The last 25 years of being an academic I've learnt nothing. But this made me feel like good, I have been learning something over the last 25 years. It gave me a feeling for whether the paper is well written. [Therese, ATN]

Neil also reflected on his past research to explain his current and intended future research:

I've had quite a varied interest in engineering education. I've looked at curricular design, program design. I've looked at some psychological factors of using humour in teaching, using technology in teaching as well. Again, this is using technology really, if you think of using online as technology. I'm settling down now. I think the area that I'm going to be focusing on from this point forward is the ratio of the blend in blended learning. So that's where I'm going to be focusing from now on, but that's going to draw in – as that interest, I think, evolves I'm probably going to start digging deeper into getting a better understanding of cognitive development, psychological aspects. These are areas that I haven't delved into at the moment. [Neil, Go8].

As will be discussed further in Section 6.6 on horizons for action, this comment of Neil's shows how researchers' reflections on the past will often also indicate their plans and aspirations for their future research. It is also an example of demonstrating personal agency.

6.4 Agency

Like some emerging researchers, the intermediate researcher participants demonstrated agency with respect to their 2012 AAEE conference papers by questioning the reviewers' comments. Neil's and Nathan's comments illustrate this:

I don't really believe in hindsight that we probably changed too much of the organisational structure of the paper ... we might have chosen not to follow the reviewer's recommendations on changing the organisation there. Regarding some repetitive things in there, now, we did cull ... so that could have been addressed. But there's also some things that are a little bit antagonistic. I mean, there's one thing I'm reading here, for example, and this could be typical – this is typical of what you get from a lot of reviewers. The argument is generally well made, except for the initial assumption that somehow we need to have both online and lectures. Well, that's not an assumption. I mean, that's a fact for a university – that recognises itself as an on-campus institution ... Immediately I'd be questioning,

okay, what's the background of that reviewer? Is that from an open university? Somebody who does purely online courses and doesn't understand the fact that there are different ways and our university's way is probably going to be more beneficial to be blended. [Neil, Go8]

Sometimes we would not agree with the reviewer's comment. We just said we don't agree with the reviewer's comments for this reason ... Methodology does measure something; they're not clear what it measures. We didn't agree with that. We thought we were quite clear about what we measured. So we told the editor that we believe that the reviewer might have misinterpreted our paper. That's the approach we took. We weren't afraid to say that but that's because we had minor changes ... If it was major we might have had different comments. [Nathan, metropolitan unaligned]

Sam demonstrated agency in his response to a reviewer comment when he wrote to the conference chair suggesting the reviewer had misinterpreted the 2012 AAEE conference review criteria to exclude practice-based papers:

The authors acknowledge that this does not conform with the research paper only format of this year's conference. We request that the conference chair consider this position and decide whether this paper is a useful contribution to this conference or not. [Sam, regional]

His agency was again apparent when he contacted a researcher with an international reputation about a nationally competitive grant:

When we put in the application for this project, I looked on the ALTC website and it had just announced she had a very similar project. That's when I got in touch with her to say, I think we might be doing the same thing, but I want to make sure we're not, because I'd like the grant. That's how we started talking about this, that and the other. Again, she's got a very high standing in the field. [Sam, regional]

These three intermediate researchers have demonstrated personal agency in respect to their conference papers and a grant, which are also artefacts of their intellectual strand.

6.5 Personal context

During our interviews, the intermediate researchers did not explicitly refer to their personal context as a justification for their actions. I acknowledge that the interview questions did not directly ask this question, but some participants in both the emerging and established researcher cohorts did mention their personal context during the course of their interview. This suggests to me that if a particular aspect of their personal context had significantly influenced how they came to their current careers, they would probably have referred to it.

The personal contexts of these researchers were mostly revealed in conversations about their life stages. Neil and Therese, for example, each have adult children. Nathan, a grandfather, said: “Yes that's why I'm going to Sydney. We have a new grandchild”. And Sam was newly married and finalising his PhD. Sam referred to finalising his PhD when talking about his intention to write journal papers: “I'm currently finalising my PhD, and once that's done, I'll have all these answers, or what I think are answers, and I think they're worthy of general publication.”

Actually Sam referred to his thesis supervisor in listing the people from other disciplines that he talks to. This supervisor is from the Faculty of Education: “I do have a thesis supervisor, who has been really helpful, but he's come on board late as a supervisor. But, I only talk to him about my thesis.”

As mentioned in Section 5.5, references to personal circumstances are often intertwined with comments about history and horizons for action.

6.6 Horizons for action

As was the case with the emerging researchers, the intermediate researchers outlined their horizons for action mainly with respect to their intellectual strand. Neil explained his intended actions in his research, and Sam described his proposals for writing journal articles from his PhD, as well as embedding outcomes from a project in curriculum design:

I've only recently found out that what I do is now called blended learning. So okay, it's got a name. What [that] does for me, or what it's doing for me now, is give me focus. I've taught in a variety of ways with a lot of online media. What I want to do this semester is to look at what I've got online, look at what I do face to face, and actually start questioning, I suppose, the value in whether it's online, whether it's face to face, and try and integrate it more so and actually have a better structure to it. So I reckon if I go on – if I try and put some structure on the whiteboard and then go online and look at what I do – what I plan to do face to face, I reckon that I'm probably going to see a number of holes in that structure that need plugging and see where things need to link up more so ... So that's where I'm going to be focusing from now on, but that's going to draw in – as that interest, I think, evolves I'm probably going to start digging deeper into getting a better understanding of cognitive development, psychological aspects ... That's the pathway I'd like to start going down. [Neil, Go8]

I made a point in the report I'm writing now, that when you introduce these things as isolated events, they're seen as isolated events. If you want students to accept the importance of intercultural competency, it needs to just keep cropping up all the time, the same as teamwork and report writing and that sort of thing. There's a risk that this inter-cultural competency type work will get put in first year design subjects, or project management subjects and will just be another one of those things that students dismiss as not real engineering, until they graduate and scramble for their notes ... A journal paper, I think, is more about final outcomes, and because of the nature of the research I've done, I'm not satisfied that I have

one, for a lot of the stuff I've done. I'm currently finalising my PhD, and once that's done, I'll have all these answers, or what I think are answers, and I think they're worthy of general publication. As we do more evaluation on this [particular project], then that might be a journal paper, but I think it's got to be fairly finished to be published in a journal. [Sam, regional]

Related to Therese's institutional strand was her horizon for action in taking up her new role as Deputy Head, Teaching and Learning:

In that role, I'm going to be trying to develop in the civil discipline some of the good things that we have developed in chemical engineering. So it's going to be interesting to see how I manage – if I can manage to do that in a different discipline and with people that I don't know. You know does it transplant and what is the essence of how we've achieved what we've achieved? ... Even if it's terrific here, that doesn't mean it's going to suit other teams. Or if you miss – there are sufficient conditions that you need to have otherwise it's not going to thrive. So I'm a deep thinker and I shall apply my deep thoughts to the problems that they have in civil engineering and see if I can work out why – it's pretty good in civil but it's not as good as here. They have a lot more students than us. Yeah, they have the different context. So can the good practice here be transplanted into civil and have similar good results? Or what else do I have to change? So it's going to be an interesting problem. [Therese, ATN]

A major difference between the discourses of the emerging researchers and the intermediate researchers is that for several of the emerging researchers their attitude was “I can't do that because ...”, whereas the phrasing of the intermediate researchers is commonly “I'm going to do this.” The intermediate researchers' horizons seem to have been expanded through knowing more about the research domain and having published more widely than the emerging researchers.

6.7 Response to the landscape model

The intermediate researchers were asked to locate their 2012 AAEE conference paper on the engineering education landscape model that was explained in Chapter 4. The locations of the stars they used to represent their papers are shown in Figure 6.1.

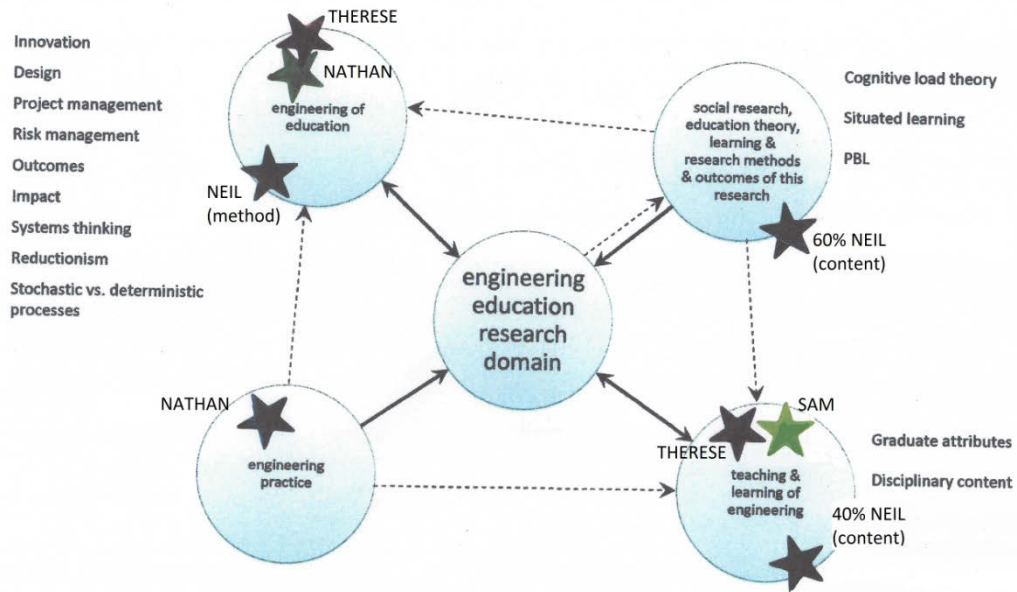


Figure 6.1: Intermediate researchers' self-location of their 2012 AAEE conference paper on the engineering education landscape model

Unlike the emerging researchers, who mostly used one star to locate their conference paper, all of the intermediate researchers except Sam used two stars. The other interesting thing to note is that no emerging researchers placed their star in the 'engineering of education' vicinity, whereas all but one of the intermediate researchers placed at least one of their stars in this area.

Like the emerging researchers Terry and Mark, Nathan's paper reports a teaching intervention that he used with students enrolled in his engineering subject, yet he did not

locate a star in the teaching of learning of engineering circle. As with Mark, I interpret this as Nathan acting to distance himself from the idea that his paper is simply reporting what he did in his subject. While Mark's paper included a strong theoretical basis for the work undertaken, Nathan has identified with a practice context for his work by locating his stars in the professional practice and engineering of education regions of the landscape.

Overall, stars were fairly equally clustered in the 'teaching and learning of engineering' and 'engineering of education' vicinities. This suggests that, in contrast to the more restricted outlook of the emerging researchers, these intermediate researchers are generally addressing, or can recognise, more multi-faceted questions than the emerging researchers. As Turner and McAlpine (2011) noted: "The scope of the projects rather than the activities themselves appeared to become gradually more complex as researchers became more experienced" (p. 50). Even so, it is apparent that the intermediate researchers were still using approaches heavily influenced by their engineering backgrounds. They want to simulate, and model, and 'solve' the student learning problem.

6.8 Summary of findings for intermediate researchers

The intermediate researchers showed they are continuing to resolve some residual uncertainties with regard to changing their research paradigm, but they understand that data collection and analysis may go beyond statistics. There is still some unfamiliarity with established research methodology, with Neil, for example, unaware of feminist theory as a research perspective. Their research motivation is chiefly about deepening their understanding of their teaching and learning contexts, and they have started to

develop multiple areas of research activity. These researchers articulated how writing about their research has helped them learn about research methods and in this way develop their intellectual strand.

Discussion of the reviews of their conference papers illustrated tension between the different approaches to theoretical and practice-based papers, particularly when reviewers interpreted the 2012 AAEE conference review criteria to exclude practice-based papers. Participants expressed negative opinions about any move by AAEE to include only theoretical research in its conferences.

The intermediate researchers explained how they are developing interpersonal networks outside of their disciplines and their own universities in order to gain ideas, information and different perspectives on the issues relevant to them. It is evident that their networking and intellectual strands are interdependent, and that the links they make between academic reading and writing contribute to their intertextual networks.

Two of these researchers have senior roles in their Faculty, with responsibility for teaching and learning. These two already had significant track records in technical research areas before they developed their engineering education profile. This contrasts with another, younger, intermediate researcher whose research areas is only in engineering education.

All of these researchers referred to pressure from their university administrators to publish, and they said engineering education research is not generally valued as a research area. They demonstrated agency with respect to their intellectual, networking and institutional strands. Their horizons for action also encompassed these strands.

In responding to the engineering education landscape model, the intermediate researchers revealed that they mostly recognise the multi-faceted nature of the questions they are investigating.

Chapter 7. Established researchers

Established researchers can be characterised as having a significant publication record during the period from 2009 to 2012. In this time frame, each published at least ten AAEE papers, at least five overseas engineering education conference papers (most publishing between eight and ten) and six or more journal papers or books. Most of the established researchers have been the leader of a project funded through a national competitive process (e.g. ARC or OLT), are supervising PhD students in engineering education and serve as editor or associate editor for an engineering education journal.

The researcher classification system was supported by responses from three of these participants, who self-identified as being researchers of some standing in the community:

Someone that's had quite a bit of experience in the area. [Will, metropolitan unaligned]

Then I did an Australia-wide survey, and that has been a significant piece of work. [Dennis, regional]

I had a successful research career behind me, international prizes; things like that. No one could attack that. [Stuart, Go8]

In this chapter I summarise each established researcher's interview and discuss how their explanations of their conference papers and responses to the peer reviews of their papers illustrate the various aspects of identity-trajectory and highlight aspects of their practice that characterise participants in this category.

7.1 Established researcher summaries

The description of each participant was developed from their interview transcript and activities, the document analysis of their conference paper and my researcher memo concerning that participant.

Erica

Erica listed her most important roles as networking, sharing work and validating/receiving acceptance of research. Like the intermediate researcher Sam, Erica identifies strongly as a member of the AAEE community, which she referred to as her “second family”. In other words, belonging to a national community of researchers is important to her. Both Sam and Erica work at regional universities that are typically a long distance from other universities, so geographical isolation may be a factor in this perception, even in these days of high virtual connectivity. The roles important to Erica’s university are: author, dissemination (from grants) and mentoring:

They rate because they get Brownie Points, dollars. Yeah, they want to have staff who have got the appropriate ratings, who are being cited, who are recognised nationally, internationally, which is why at the end of the day the promotions process requires you demonstrate that. So it all comes back to they want to see that you are actually publishing.

Erica commented that there was some tension between the two lists of valued roles:

But it's really a case of how can I make their priorities meet my priorities, so they want me to be an author. Okay, I'm quite happy to write the papers if that means that you'll be paying for me to go to the conference. So yeah, hopefully it's then a win/win situation, so there is tension in that we're wanting different things but if by me fulfilling their wishes they'll fulfil my wishes that's – I'm quite comfortable with that.

The review decision on Erica’s paper was ‘accept with minor changes’. Reviewer 1 was

generally positive but asked for more details of methodology and outcomes. Reviewer 2 was also generally positive and offered no suggestions for improvement. In the final version, as requested by reviewer 1, Erica deleted the last paragraph of the section describing the project aims and included three additional paragraphs of description of the assessment of the pilot implementation. For Erica, writing reviews was all about providing feedback to authors, the developmental aspect. She did not mention the perception that reviews guarantee quality of material at the conference. Erica has a leadership role in her School as a research group Deputy Director, which includes her participation in university-wide research administration committees. This means that Erica interacts with researchers from other disciplines in addition to engineering and education. Although Erica has this leadership role, my view is that through contact with other engineering academics in her School, her research group leadership role is ‘insitutionalising’ her intellectual and networking strands. She sees the AAEE conference as a way of connecting with the community, sharing and exchanging ideas, benchmarking against other universities, and “talking through your work at a deeper level”. Erica recognised different priorities between herself and the university in regards to conference papers but was able to reconcile the two; she uses achieving the university’s goals as a means to achieve her personal goals. Erica didn’t suggest changes or additions to the landscape but she used it to talk about the variety of different projects she is involved in (“fingers in lots of different pies”), which suggests a level of expertise and experience as a researcher. As shown in Figure 7.1, she used two stars to locate her paper, one in engineering of education and the other in teaching and learning of engineering. She said:

I think [the paper] sits in two diagonally opposite corners and I think it sits quite clearly in both ... So I'd say 50 per cent in each. Because I don't know how you can separate the two and I think they each impact on each other.

Steve

Steve listed being an academic, dissemination, and being a mentor as the roles that he most values. Interestingly, in terms of identity constructs he explained one aspect of what he meant by being an academic as “maintaining my credibility in terms that other people see what I've done or see what I've achieved”. This view of identity in relation to how other people see him fits into Brew’s trading variation view of research (see Section 2.1). In terms of importance to the university, Steve listed research money, and good teaching practice as important to his university:

I think our university actually is talking about, and I've seen some progress, in terms of elevating teaching to a level where yeah, research is important but if you looked at our strategic goals of our new faculties – science and engineering here – they're on an equal footing.

Steve acknowledged that there was little tension between the university’s valuation and his personal valuation of his roles in the process of writing conference papers. Steve was a bit pressed for time – he was going to an ARC project meeting straight after our interview. The ARC project reflects Steve’s well-developed networking strand, but his attitude and responses reminded me of Beddoes’ (2011) comment that one of the results of the emergent nature of engineering education research is that many “leaders, such as journal editors, are long-time administrators and reformers, but not educational or social science researchers” (p. 8). Steve still maintains some research presence in his typical engineering research area.

The decision on Steve’s paper was ‘accept with major changes’. Reviewer 1 suggested

that the paper be reclassified as a work-in-progress paper since it is a report on a specific intervention and asked for more information about how the sample members were selected. Reviewer 2 was more positive in not suggesting the paper should be reclassified. This reviewer suggested additional research questions and a different prioritisation of the relevant concepts, that is, Steve should be assessing how the perceptions of school teachers influence their students' perceptions. This reviewer also asked for some concluding remarks based on the findings. Steve and his co-authors argued the paper should stay at the full paper category because the results presented complement other work in the area but don't overlap it. As requested by reviewer 2, they added further detail about the sampling process and some concluding remarks. Despite having a version reviewed a second time, some clunky expression still remains in the published version. However, overall I agree with Steve that this warrants inclusion as a full paper. This is another instance where perceived research focus could have excluded an interesting contribution to the conference. In regard to locating his work on the landscape (see Figure 7.1) Steve responded:

It's hard to actually pigeonhole because there are components that I do [that] would fit into here, as well as here, and connecting that with that. So across all four I would have said ... I consider myself quite diverse ... not necessarily 25/25/25/25, but I move ... across different spaces.

Dennis

Dennis listed helping students as one of the most important roles for him, as well as providing feedback on “detailed ideas and research questions”, which is an aspect of helping research students and other academics. In terms of what is important to his university, Dennis highlighted research and servicing online students. Dennis agrees that staff can feel tension between their personal values/goals and those of the

university. On the landscape he used two stars – one in teaching and learning of engineering and the other in a circle he added to represent the secondary school system and other forms of outreach to increase awareness of engineering and potentially the pool of engineering students (see Figure 7.1). He also suggested that the landscape should include the sector-wide tertiary education framework that includes VET and HE: policies, funding rules etc.

The decision on Dennis's paper was 'accept with minor changes'. Reviewer 1 was positive and did not suggest any changes. Reviewer 2 was also positive, although there were some one-word responses to the criteria and questions about how students use feedback and how authors know/don't know this. Reviewer 2 also identified some minor typos. This paper describes a project and reports quantitative results from a first phase. Overall it is a well-written paper that does what it says it's going to do. Changes to the final version were very minor and included changing foreign phrases, such as *post hoc*, to italics and adding two sentences to the final section of the paper.

Dennis had things he wanted to say in the interview, almost regardless of what I wanted to ask, and he commandeered the interview to talk about the higher education sector, of which engineering education is a part. This reflects his assessment of his high level of professional capital and agency as a professor and experienced researcher. His thinking is 'out of the box' in terms of current university frameworks, and the level of complexity of his thinking is higher than most of the other people I interviewed (Stuart and Rob would be comparable). He questions the sector's definitions and values and especially its ways of 'measuring' impact. Dennis thinks of the impact of his work in terms of whether it leads to a change in practice rather than what the 'impact factor' is, and he regards research for research's sake as a waste of resources. He referred to a

document he wrote as part of a funded project as an example of how research should provide a different way of thinking about things. He is frustrated with university sector metrics that promote the value of publications as artefacts to be counted. This ability to think outside of the prevailing framework is possibly a characteristic of being a ‘Professor’, but it may also be a reflection of the security of tenure at professor level. This prompts the question: Does one have to be at professor level to feel safe enough to criticise the system, or does having a secure institutional identity set one’s intellectual strand free enough to criticise the system? Dennis has a wider view of the purpose of research and data sources than just “my subject” or even “my university”. Reviewers generally have a lower level of expertise than Dennis, so they are unable to make evaluative comments that would significantly improve his paper or influence his future research.

Stuart

Stuart works three days per week for a Go8 university and calls himself semi-retired. He strongly identifies as a professional engineer, although my perception is that he is an academic in the sense of someone who thinks about ideas. He listed writer, thinker and researcher as his three most valued roles and links these roles:

Whenever you write something ideas come into your head. So the act of writing the papers is actually ... The principal motivation for me for writing papers is that it produces ideas ... It's the struggle to actually describe what we're doing that actually helps to clarify the ideas.

In terms of importance to the university, Stuart listed “Brownie points right? Publications ... PhD examiners”. He took an unusual perspective in response to the idea of tension between these two lists by asking:

What do we mean by the university? Twenty-five thousand people; they've all got different ideas of what's important. So why does any one of them particularly matter? The university doesn't care about me; not really.

This is similar to Neil's idea that we academics are the university, which contrasts with the modern corporate image of a university. The decision on Stuart's paper, for which he was the sole author, was 'accept with minor changes'. Reviewer 1 was very positive and made only one suggestion for improvement, which was for the author to suggest what needs to be done to address the identified issues, especially for individual academics. Reviewer 2 was also positive, with some one word responses to the criteria, and suggestions/questions to clarify and strengthen the argument. Some grammar, expression and formatting suggestions were also included in this review. There were very minor changes from the reviewed to the published versions; the quality of the reviewed version was high anyway, with a cohesive and well-supported argument. I didn't get to talk to Stuart specifically about the reviews on this paper as he was so keen to talk about his career history and how and why he came to be researching engineering practice. However, he did make some comments about reviews generally. He likes to give authors constructive feedback, for example, but the review process is often a gatekeeping exercise. Stuart located his paper in the engineering practice circle of the landscape, as shown in Figure 7.1. Like Dennis, he is an experienced researcher and professor who took over the interview process to say what he wanted to say. Stuart began our conversation talking about language and what role that plays in thinking. The way he described one of his research projects aligns with Brew's domino concept:

I just knew, in the back of my head, that there was something very different about the engineers because of that firsthand experience. So then it was a question of filling the gap because I realised there was no way we were going to understand what was happening in Pakistan until we understand what happens with engineers

everywhere else. It's taken a long time. That understanding is still coming out in fits and bursts.

Rob

The roles most important to Rob were evangelist, collaborator, and author/writer. He listed grant applicant, author/writer of ERA publications, and research manager as the three roles most important to his university. He commented that he feels tension between the roles important to him and the roles important to his university:

I guess I'm at that point of wanting to see some change happen but I don't think that's very important to the university. The university runs along a business-as-usual model, that is, we'll be doing the same things in 100 years, don't you worry about that, just meet the KPIs.

One way Rob has dealt with the tension between the two types of roles is to change where he works:

I suppose there is enough of my job that allows me to do some of that and certainly here at [ATN university]. At [Go8 university] it was much more difficult to do any evangelising. People were very busy or they all figured they knew how to do it without my assistance. So there's not much joy in that process.

The decision on Rob's paper was 'accept with major changes'. Reviewer 1 was generally negative and seems to have been specifically looking for a research-type paper rather than a teaching practice paper, rating both methodology and research question as poor. Reviewer 2 was generally positive but asked for more evaluation of student learning and engagement. Contradictory reviews can mean that authors do not have clear direction about what changes to make to their paper. In response to Reviewer 1's expectation of a research paper, Rob and his co-author added in the published version of this paper a declarative paragraph in the background section clearly stating that this was not a research paper. There was also some restructuring of the paper for the final version

and reformatting of student quotes to conform to the conference paper template. The final version also included a short section on how the engineering subject could be improved and additional references. The changes made for the published version address comments of Reviewer 2 but not all of Reviewer 1's concerns because the paper is still a teaching practice paper. Four of the final nine pages are exactly the same as the reviewed version – mainly results and purpose sections – but there were significant changes to the rest of the paper. On the engineering landscape model (see Figure 7.1) Rob put his star on the trajectory from engineering practice to teaching and learning of engineering, closer to the latter circle: "I've done that because a lot of what's in here is about the teaching and learning aspects of it but it's motivated by changing engineering practice." Rob demonstrated a broad-ranging view of engineering education and deliberately chose to discuss a conference paper with divergent reviews because that would give us more to talk about. Rob could be characterised as working across many aspects of engineering education and also working in multidisciplinary projects across the university.

Will

The roles important to Will were: contributing to ongoing discussions within the community, investigating an interesting research question, and being a colleague to co-authors. Will also strongly identified as a member of AAEE. He said it is important for him to be a member of that community because:

That's where all my friends are ... I think that I've got some very good friends and very good colleagues in that community. I think that I've learnt a lot from the community about what it means to be an academic, and also what it means to be an academic in a very transdisciplinary area ... but also it's an intellectual home.

It's like the types of questions that I'm interested in are the types of questions that a lot of them are interested in as well.

The roles that were important to Will's university are publisher of papers that 'count', mentor of PhD students, and writer of text. The decision on Will's paper was 'accept with minor changes'. Reviewer 1 commented that the paper is generally well-written, but the question was not relevant to many other universities or had already been addressed. This reviewer suggested Will review the purpose of the paper and include a section about whether an increase in the online response rate is likely to alleviate the issues identified. However, this reviewer, who seems to have some experience and could state figures to back his/her claims, provided no references, which meant these figures were not particularly helpful to Will. Reviewer 2 had a very positive tone and included a suggestion for further study. The published version was the same as the reviewed version except for two additional sentences in the conclusion within the abstract and one additional sentence in the conclusion of the paper. These additional sentences are not completely consistent with each other but do indicate what the Faculty concerned might do as a result of this study. As shown in Figure 7.1, Will placed his star on the trajectory between engineering of education and social research, closer to the engineering of education circle.

7.2 Academic identity trajectories

All the established researchers had sophisticated, well-developed and strongly interconnected networking and institutional strands. Although most also had well-developed intellectual strands, their discussions relating to the intellectual strand were less specifically around research methods than those of the emerging and intermediate participants.

7.2.1 Intellectual strand

The link between writing and thinking is appreciated by established researchers. Stuart and Steve, for example, see writing as a way to clarify their thinking or to generate new ideas:

Whenever you write something ideas come into your head ... the principal motivation for me for writing papers is that it produces ideas ... It's the struggle to actually describe what we're doing that actually helps to clarify the ideas. That's something which I have known for long before I became an academic. [Stuart, Go8]

From writing it ... well, you gain new knowledge, and in terms of analysing the data that you collect or looking at the methods and seeing what their limitations are, I would say yes, you learn what works and what doesn't work ... I think you become much closer to the project or what you're working on, and often I think when you're writing things – ideas come into your mind about why didn't I do that... but I think you sense whether it was a good outcome or could you have done better. [Steve, ATN]

In terms of research methods, Dennis and Will are typical of established researchers in their favouring of qualitative methods:

So [I] actually do real research by talking to students and staff. Whereas these people are just using big databases ... and just reporting on something that's already three years old [Dennis, regional]

The work that I do and the work that my PhD students do, is generally ... all qualitative. [Will, metropolitan unaligned]

Experienced researchers also understand and can use statistical methods and modelling when it aligns with the research that they are doing. Stuart submitted two papers to the AAEE 2012 conference – one used qualitative methods, and the other used principal

components analysis and a Bayesian Network – thereby demonstrating his familiarity with a range of analysis methods. Will talked about using qualitative methods with his PhD students but his familiarity with statistical concepts was also illustrated in his interview:

We found that attendance at classes is basically a binomial distribution. [Will, metropolitan unaligned]

All of the established researchers were engaged in working on broad research questions at either international or national levels:

At the bottom of my mind I knew that this was a critical link in understanding poverty in developing countries. There was no question that water lay at the root of poverty – or the lack of access to water. When you see a school where the kids spend an hour or an hour-and-a-half a day carrying buckets of water so they can use the toilet, you realise that there's a big implication of that. Women spend their whole day carrying water. So I knew that there was an important issue here but I couldn't put my – couldn't see, at the time, what was happening and why it was happening ... I just knew, in the back of my head, that there was something very different about the engineers because of that firsthand experience. So then it was a question of filling the gap because I realised there was no way we were going to understand what was happening in Pakistan until we understand what happens with engineers everywhere else. It's taken a long time. [Stuart, Go8]

The higher education framework and funding policies and the structures and all of that ... I'm very interested in researching, but others don't seem to be. I think we're missing out as engineers, because I think we would have a lot to say – like if you're going to change engineering education, a lot of the change has got to happen at that level. It's actually political and it's actually changing the structure. So it's all of that and the things I've been talking about: the characteristics of the students, the declining maths entry. All of these things are really structural problems in the tertiary education system ... To me, that's the big picture stuff. I think we're missing out on a lot of good stuff, because we're in our little sand pits

and we're playing about ... I think we've become myopic, and not enough of us are actually looking at the big picture, which is where I sort of work. I think there's a lot of rich research to do. Actually looking at trends across the country and informing policy and decisions ... I think too few of us actually realise that often the only the way you're going to change something is to actually go outside and say well, what's the big picture? What's the driver? Because whilst we can change theories and things, I think we need to be actually changing what's happening in engineering education at a national level. [Dennis, regional]

It's that big-scale stuff that interests me more than at the course level, I must admit. [Rob, ATN]

At the same time I'm working on another sort of multi-institutional proposal that's looking at outcomes-based learning and just how do we actually achieve it? [Erica, regional]

This was done across a range of units, across a range of years. So what we were looking at was across units, across subjects ... the questions that I have are really sector wide, but generally still within an engineering context. [Will, metropolitan unaligned]

Will and Rob reported that when they are involved in single-subject studies they are usually mentoring a junior colleague, and their aim is to highlight how some aspect of the practice related to this subject can be transferred to other subjects and contexts:

I think that if the study is set up well ... based on the literature, and that it's done in a way that makes sense, then even though the focus may have been a particular class, the findings could be transferred to other classes and to other situations – and it's the distinction, between the work that I want to do, and the work that I help other people do. [Will, metropolitan unaligned]

Really what I was trying to do with this paper is to try and get some of that sense of there are different ways of engaging with students. [Rob, ATN]

As well as being involved in 'big picture' questions, established researchers continued to be involved in a diverse range of projects:

Most of the papers we wrote were quite diverse ... I would think most of my educational work would be ... It's hard to actually pigeon hole because there are components that I do [that] would fit into here, as well as here, and connecting that with that. So across all four I would have said ... I consider myself quite diverse ... not necessarily 25/25/25/25, but I move across different spaces. [Steve, ATN]

I've got other areas that are around engineering practice ... you've got PBL up here, some are up in there and – well a percentage in there so I don't think that I've got any papers over the years that have been just in one of these domains. They'd be crossing over because it's using this theory to justify this process, or wanting to achieve this... I'm always jumping around a fair bit. This last one was about a grant that we had looking at assessment within PBL. A grant that I'm involved in at the moment is looking at women in engineering in industry ... Yeah, it's different so it's a side step ... but at the same time I'm working on another sort of multi-institutional proposal that's looking at outcomes based learning and just how do we actually achieve it. So yeah, I've got fingers in lots and lots of different pies. [Erica, regional]

Stuart is an exception here as he has concentrated his research efforts on engineering practice, but this comment reflects a long and varied career prior to starting this research:

I have practiced engineering for most of my career. I was a fulltime engineer for the first 20 years and I continued to do a lot of consultancy ... I've done many different things at many different times. [Stuart, Go8]

Consistent with being able to use a range of research methods, Rob and Erica demonstrated an ability to mobilise a variety of perspectives in their research:

This time instead of it just being about final year project I said let's focus it on AQF8 ... I wanted to try and get some of that across and of course that's what the teaching was all about. So issues of appreciative inquiry and the adjacent possible. [Rob, ATN]

I think most papers I've written would cross over ... We're starting to put together some work to look at just what are the issues for women and what are activities that are happening at the moment that are trying to address it and how successful are they?... I did women in engineering stuff 10, 12 years ago but this is a totally different perspective on it. [Erica, regional]

Beddoes (2011) comments that one of the results of the emergent nature of engineering education research is that many “leaders, such as journal editors, are longtime administrators and reformers, but not educational or social science researchers” (p. 8). Both Rob and Steve could be characterised as reformers and administrators. Both have been involved in many nationally funded teaching and learning related projects, are past members of the AAEE Executive Committee, and have administrative and managerial roles in their own universities. For each of them the decision on their 2012 AAEE conference paper was ‘accept with major changes’. I suggest that one of the main reasons for this decision is that each lacks significant personal experience undertaking research, as opposed to undertaking a project and developing a resulting research-specific skill set:

A lot of what's in here is about the teaching and learning aspects ... So I did extract bits of some of his handouts and student comments. So it's kind of soft research but ... it's really trying to tell a different kind of story ... It wasn't really a research-y type paper, it was a bit of a show and tell paper ... I have a feeling it got bounced one more time with some minor details. [Rob, ATN]

We're assessing a program, but again, it's an ongoing program. We've just started it ... we need to ask more – well, develop a better strategy in terms of finding out what has changed. So there were some questions from the reviewers that we couldn't answer ... and sometimes you make a decision to write about it after the event, and I think it brings an important point that when you're actually writing about something, it's easier if you plan it all out prior to writing the paper, rather than trying to write the paper half way through or after the event ... What we were trying to measure was almost impossible to measure ... we should have asked a different research question, I think. [Steve, ATN]

Steve's use of the word "measure" is similar to some of the emerging researchers' use of the word and reflects discomfort with the philosophical conceptualisations of qualitative research methods. Akerlind (2008) also notes that increasing experience in research does not necessarily mean a corresponding development in research ability. Both Rob and Steve have become established in the community because of their reform agenda and the authority of their strong institutional positions, along with their good teaching practices and willingness to take on administrative roles and participate in teaching and learning projects. Although they have the number and variety of publications appropriate to this study's established researcher category, these two seemingly anomalous participants demonstrate one of the limitations of metrics for categorisation – that simply counting instances does not capture the nature of the phenomenon. In relation to their standing, while they may not be established 'researchers', they have made significant practice-based contributions to the field and the community and hence are held in esteem by its members. These contributions led to them becoming 'established' and helped them develop the strong networking strands common to all the researchers in this category.

7.2.2 Networking strand

The networking strand includes both the personal and the intertextual networks. Each of the established researchers indicated they have a strong personal network. All of them impact the intertextual networks of other AAEE community members by reviewing conference papers, but they are not necessarily equally impacted by reviews on their papers. I start by highlighting aspects of the researchers' personal networks before describing their intertextual networks and how these impact on their intellectual strands.

7.2.2.1 *Personal networks*

The personal networks of the established researchers include other leaders and established researchers in the higher education sector, not just in engineering education but also other disciplines. These networks contribute to the established researchers' intellectual strand by making research resources known or available, by supporting the use of different types of research methods, and by providing critique from nationally significant researchers.

Dennis found out about a large regularly updated dataset of information relating to student demographics by attending a non-academic conference:

I only found out about this two years ago, when I went to the NCVET Conference, where they have these huge numbers of stats available. One of the things that – and I'm not sure who does it, but it's a government-run thing – the LSAY, Longitudinal Study of Australian Youth (LSAY).

[Academic] is really good on all this sort of stuff, on socioeconomic stuff. She works on this boundary. She's LH Martin-enrolled, always in the paper with [academic] and there's three or four of them.

So whilst some of the things we're looking at – like [senior AAEE member] is looking at – what do we call it? Maths and Science in schools, that sort of thing. Whilst he's doing that, he's looking at how you change your developmental tools and things for schools, but it's actually, Can you change this at the national level?

So structurally what's going to happen is we as engineers – so [senior engineering academic]'s been doing that, ACED's been doing a bit of that.

And that's the play area I'm in, and I'm one of the few. I think [experienced researcher] does a little bit there.

Well my work went into a national ANET (Australian National Engineering Taskforce) report with [senior engineering academic] and [experienced researcher]. We ran two workshops around the country – that went on into the Senate Enquiry. [Dennis, regional]

Dennis also received feedback on his research from a nationally significant researcher:

So when you get criticised by [experienced researcher] in graduate attributes ... you know you're on the right track. If you stir him up, he's thinking about it. [Dennis, regional]

Stuart shared a conversation he had with the CEO of a major construction company: “A very senior engineer whom I interviewed who had just recently given up being CEO of a major construction company.” And Rob spoke about a workshop he ran for senior engineers under the auspices of Engineers Australia. These established researchers clearly know many people and have extensive personal networks that include individuals in authority in both the engineering and education sectors.

Both Rob and Will told about how they use their personal networks to have the conversations with other people that they need to have to help them sort their thinking:

That's just how I do things. I find I'm most effective working with other people. But sitting here doing it by myself doesn't seem to work ... you have much richer conversations. [Rob, ATN]

As a writer and a researcher, I need people. I need people to talk to, I need stimulus. I need people to think through the ideas ... in terms of the depth of the ideas that I just think that to do anything meaningful, you need that balance. You need that back and forth. Certainly that's the case in the questions that I'm interested in. [Will, metropolitan unaligned]

Established researchers also value the diversity of their networks and what they can learn by associating with interdisciplinary colleagues. Rob said:

It helps to see the similarities and differences and people in business are interested in cross-disciplinary things like sustainability. Likewise industrial design people I've also been talking to. I think a lot of this stuff, what does that cross-disciplinary collaboration look like. We don't really know until we actually do it. So it's this kind of action research thing. [Rob, ATN]

Steve's personal network includes educational colleagues who have shared their practice and helped him to improve his research:

I've learned a lot from my educational colleagues in terms of how to do good quality surveys and how to collect the right data and ask the right questions, which as an engineering academic by myself before, I was just muddling and hoping that I'd come up with the right question, and often didn't ... So I think we could get some really good ideas out of not limiting ourselves just to engineering and science. [Steve, ATN]

Stuart illustrated how established researchers contribute to the personal network as well as draw on its resources :

So much of engineering is about learning and teaching in practice. I had one of my former students – 18 months out – and we had a good chat for about 45 minutes. When we finished he said you know I feel so refreshed because now I

realise what I'm trying to do. I can go and read about it: teaching ... So he thought that his problem was his inability to speak English because he's a native Chinese speaker. When we got to the end of it we reached the point and I said, Well, the other people you work with they don't seem to be any better than you; they're struggling with it too. So it's not an English language issue is it? He said, No, you're right. He was so relieved because he felt that that was his fundamental impediment. So I said go and read about education and gave him some references. [Stuart, Go8]

Stuart also illustrated how the strong connections can be between personal and intertextual networking:

I came across a group at Stanford University – The funny thing is that I have for decades been working with a bunch of robotics researchers at Stanford University. You wouldn't believe it but their offices were up there on the landing and this group was working down below in the atrium. I had walked past them so many times without even realising who they were. They were part of the Stanford School of Management but an island of management people in engineering, which in theory was a good idea but of course they didn't talk to each other. These people upstairs didn't even know their names; didn't even know what they were doing ... So when I got together with them then – and they had drawn a blank too – they were struggling. They had to publish their stuff in management because that was part of their tenure issue ... you've got to publish in your discipline area ... Well the management people weren't interested in engineers. Also, they weren't interested in qualitative method ... In America qualitative methods are very much down at heel. So they were struggling to get any of their work published which is why I hadn't seen it. It's only in the last two or three years that their work has started to appear but the group was disbanded by Stanford because they hadn't published. [Stuart, Go8]

The strong link between personal and intertextual networking for these researchers was also stressed by Erica. As an academic at a regional university she said that geographical isolation negatively impacts on her ability to maintain ongoing conversations with other engineering education researchers, so the annual conference is

her opportunity to talk to people face to face. However, to secure university funding to attend the conference she has to write a paper to present at the conference:

So writing the paper is a means to an end and for me the end is the attendance at the conference. I can't attend the conference unless I've got a paper, so I write the paper to get me there. Yeah, but it's actually the conference I want to be at, not necessarily writing the paper that I want to present. [Erica, regional]

Attending the conference means that she can consolidate existing relationships with other researchers, which has the potential to result in project teams resulting in further contributions to her intertextual network and intellectual strand:

It's really the opportunity to be able to discuss at a deeper level what's happening ... it's the opportunity to actually be able to sit down and talk about what we're doing and are you doing something similar? ... So it's that talking things through and then being able to create the teams to go on with other projects that will go into the future ... All of the cross institutional teams that I've become part of are because of people I've met at conferences and conversations I've had at conferences. That's where it's all started. That's where I've developed the networks and I need the conferences to maintain the networks ... and to expand them, yeah ... I can get so much more out of three days conversations than sitting down and reading a set of proceedings. [Erica, regional]

Will illustrated another way that personal and intertextual networking are mutually supportive of the way that he thinks about himself:

If I didn't at least co-author a paper, then I wouldn't feel part of that community anymore, that I wasn't able to contribute in some way to it. So apart from the actual paper, the fact that it's published and the fact that I go means that I can be an active member of that community. [Will, metropolitan unaligned]

Stuart's view of himself as an outsider resonates with the feelings of professional isolation mentioned by Erica. Were the AAEE community to spend time and effort building networks among our members, it may be able to ameliorate these feelings and

provide richer avenues for intellectual connectedness. The analogy of the migrant experience developed by Manathunga (2009) in relation to the cultural alienation and isolation experienced by interdisciplinary researchers resonates here. Established researchers have roles to play here in paying attention to their language so that concepts are accessible to less experienced researchers and in developing a culture of ‘taking people with you’ where possible. This is particularly the case in reviews where the feedback should be accessible to the authors if they are to understand what is being said and then make changes to their papers.

7.2.2.2 Intertextual networks

Intertextual networks refer to the literature that participants read and cite in their own publications. The peer review process is a way that AAEE community members contribute to each other’s intertextual network since each conference paper is reviewed by at least two people to determine if it will be published. For Erica, the process of peer review of publications is validation that her research is worthwhile, and for Will it is a means to supplement supervisor validation for PhD students:

It's a validation of the work or an acceptance so it is that public acceptance. So having a peer reviewed paper that says yes, this work is actually of value and it's worthwhile people being aware of. [Erica, regional]

One of the strengths of a conference paper is – it can be a work in progress. It can be something: this is where I'm at; this is where I'm thinking ... and you open yourself up for critique, but also for feedback and input. I think that's the strength of publishing at conferences during your PhD. Certainly something that I was encouraged to do during my PhD was really to get that validity and reliability check from the community. Yes, that makes sense – what you're doing. Or have you considered this other track? As supervisors, we can only know so much, and

so ... by opening it up to the rest of the community, you get that bigger input.
[Will, metropolitan unaligned]

Most of the established researchers have their own well-developed intertextual network and their comments show how they view and contribute to others' intertextual network. Will and Steve located their research in relation to elements of their intertextual network:

The way that I frame publishing is it's not about the paper. What the paper does is add to the ongoing discussions within the community ... So very much I frame the way that I write papers as contributing to the community and discussions within the community. [Will, metropolitan unaligned]

In terms of to learn from what other people have done, looking at the literature, keep up to date with it, and maintaining my credibility in terms of that other people see what I've done or see what I've achieved, and have utilised some of the findings from some of my research programmes and also my teaching and learning innovations ... well in terms of looking at the literature that exists, connecting that literature with what you're wanting to do. [Steve, ATN]

Stuart specifically listed 'reader of published works' as one of his most important roles as a researcher. His comment illustrates how the intertextual and interpersonal are often interconnected, yet members of the community generally lack familiarity with published literature:

Another reason for listening to other people is that I do actually say, Oh gee, maybe I should read that ... I'm amazed at how little people read ... I sit in the audience and I'm thinking why haven't they read this? ... I guess that I've had the time – number one – and I've been forced to read so much stuff because we were searching so many different places for the possibility of finding data – published data – on what engineers do. It was a futile search most of the time but we did turn up a few good bits. So yes, why haven't they read this? [Stuart Go8]

Dennis picked up on the same perceived deficiency:

I think the other thing is so many times you read and say, Oh, this has been done before, like 10 years ago. I'm sure I've read this before. But there's a new group of people, and there's so much stuff out there that ... so I think there's real issues with – but no one's prepared – no one is prepared to stop and say, no. [Dennis, regional]

This ignorance of the existing literature is not limited to engineering education research.

Fensham (2004) echoes this attitude in the domain of science education research:

It is still quite common, however, in science education to find authors submitting papers to the research journals (and referees recommending them) that make no reference to earlier studies of the same research issue in other readily accessible journals. (p. 144)

As experienced researchers, Stuart's and Dennis's intertextual networks extend beyond

AAEE and national conferences to international conferences and publications:

[Experienced US researcher] wrote a wonderful paper in *Engineering Studies* in the first year ... that pointed out how your audience actually dictates your research. [Stuart Go8]

We looked at how engineers understand value. In fact this was my paper at FIE; I reported on this ... Some people actually read my papers; I do like that. [Stuart Go8]

I went to the NCVET Conference, where they have these huge numbers of stats available. One of the things ... is the LSAY. Longitudinal Study of Australian Youth (LSAY). There's ten or twenty thousand – I don't know how many thousand students they pick up at [15 years old] across Australia, in all sorts of different schools and everything else. They ... do all sorts of tests and questionnaires. They actually then track them through til they're 25, and actually chase them up. I think it's every year or every two years, they phone them and everything ... Then there's HILDA, which is the *Household, Income and Labour*

Dynamics in Australia, which is another huge national database. [Dennis, regional]

There was a classic figure which 2003 Civil Engineering ASCE found that ... [Dennis, regional]

I wrote a paper on their master of engineering practice ... So that was a lot to put in that paper ... Then I was asked to write a full paper for the journal, the AJEE. So I did that and I added in quite a bit more, and I referred to a paper, which was published in EJEE – *European Journal of Engineering Education*. [Dennis, regional]

As authors of AAEE conference papers, established researchers review papers submitted to the AAEE conferences. In this role of reviewer, Stuart and Dennis often recommend authors to read more widely, in other words to extend their intertextual network:

I've done a lot of reviews and I've had a lot of reviews ... I try to give them constructive feedback. I've tried to make the first statement positive – Wow, this is a really interesting paper. I enjoyed reading it – even if it's terrible because I know how discouraging it can be to get a totally negative review. So many reviews I've had you think, crikey, they must have had a bad day. So yeah, try to be encouraging and providing ... references. You read a paper and say well, here's a whole lot of references, go away and read those. It might give you a different idea. [Stuart, Go8]

I think one of the things that I do is provide feedback on detailed ideas and research questions ... I was asked to do a paper by the English Journal and it was a bit ordinary ... so I sort of suggested a structure, and gave a lot of spelling and grammatical advice. But also said look, try this theory and look at this paper and do this. I thought, well, this person is going to really get upset. Anyway I got an email from the editor saying thank you very much, because the other two people that read it had sort of said its okay. [The editor] said that this person has really

appreciated your feedback, because this is the first paper they've ever written. So they've actually learned a lot out of that process. [Dennis, regional]

Established researchers also receive reviews when they submit a paper to the AAEE annual conference. These reviews prompted Erica, Rob and Steve to make changes to their paper and illustrate the interwoven nature of the intertextual and intellectual strands:

When it was finished I still can see weaknesses in the paper, but I think at the end of the day it was the length of the paper that stopped me from being able to put in the depth, but that's what a paper is. So hopefully I've added enough in to deal with what the reviewers, well to deal with any other reader that would have had the same issues that the reviewer would. So I really did need to add a whole new section based on what they said [were] minor changes, but in the end it was a significant ... addition, which meant I had to take chunks out as well. [Erica, regional]

I think I had one review that didn't give a lot of feedback ... The other one that was more critical was really useful ... So one of the reviewers gave feedback that really highlighted [I hadn't] even talked about this bit and actually this is the most important bit and this is the most interesting bit. When I read it I thought what the hell are they talking about? But then when I re-read the paper with those comments in my mind I went, It's so blatantly obvious. How could anyone understand what I'm talking about here without that information in there ... the review that says "Well, I just plain don't understand this," is actually quite valuable because it means that you can address it. [Erica, regional]

So I did take up on that suggestion [in a review] and I went and acquired the student survey written comments and categorised them ... So I went through and categorised them according to – and it turned out it was kind of interesting how the students' comments fell ... There are two categories, one is what do you think was good and the other one was what do you think could be improved. [Rob, ATN]

Actually the focus of the paper changed after both reviewers' comments. [Steve, ATN]

Steve also commented that the review process contributed to his thinking in relation to future research activity:

We wanted a starting point, and I think we put something down on paper, and the review did help us I think, refine and reflect on where we wanted to go to ... next year when we do it, we'll probably collect a whole heap of different data. [Steve, ATN]

Will spoke generally about how an author's response to a review can depend on their intellectual strand, that is, their knowledge of how to address a deficiency identified in the paper:

Part of that process ... is the reviewing and the reviewer's comments and interpreting that to strengthen the paper ... Also, how do I then take that review on, or take those comments on, to then improve the text itself? It's a valid point that you say my methodology has a big hole in this area, but how do I actually improve the text to fix that? Or can I? [Will, metropolitan]

Although some of the established researchers made changes to their paper as a result of the reviews they received, the consensus of these participants is that the reviews they receive are generally not as critical as they could be, or were a negative gatekeeping exercise:

Sometimes I'll put in a paper and I'll think, Oh, that's going to get hammered. It's crap, but I've run out of time and at least using the reviewing process will give me an opportunity to re-write it. Then it's really sad when it comes back with this is good, accept that – you think what? How did that happen? [Erica, regional]

I think refereeing is ... not all that good these days. This [review] isn't too bad. But this was – from what they say – a pretty good paper. There's a few typos, but is that all they wanted? [Dennis, regional]

The reviewer for example didn't like the fact that we'd done things like this. We put students' comments in boxes in different fonts. So in the next version I took away the boxes but left the different fonts to indicate different voices. Still wasn't content with that so in the end I just went, Do I care? So I just homogenised it all ... I think one of the challenges of this conference is that the organisers have promulgated a much tighter research model for the papers and this paper didn't fit that very well. It wasn't really a research-y type paper. [Rob, ATN]

Stuart submitted two papers to the 2012 AAEE conference. His second paper was co-authored with six others, with Stuart the third author listed. The decision for this paper was also 'accept with minor changes'. For this paper one of the reviews could be described as 'positive but...'. The reviewer questioned why the statistical significance of the data was not tested. The type of analysis performed on the survey data (Principal components analysis, Bayesian Network) was not the typical descriptive statistics, so the typical student t-test for significance that the reviewer was looking for was not appropriate. This reviewer's name was mistakenly included in the material sent to Stuart, and it is interesting to note that I interviewed the reviewer for this project and classified him as an emerging researcher. In this case the review process was a learning opportunity for an emerging researcher rather than just providing critical feedback to Stuart and his co-authors, although in their final paper they did clarify issues mentioned by the reviewer. This situation demonstrates how in a fairly small community we can have a novice researcher reviewing an expert's paper. The lack of expertise means that it is not really a 'peer' review but more of a learning opportunity for the novice.

Rob also submitted two papers to 2012 AAEE conference. His second paper generated a negative response from reviewers:

Well that was a bit of a misfit as well because ... the project isn't at the stage where we could present results. So we described the methodology and everything

that was used but we couldn't get to the point of going, now let me show you the results because they're embargoed for now ... So I had two discomfiting experiences really. [Rob, ATN]

Similarly, Steve's second paper did not fit the way the review criteria were used by many reviewers to focus on research at the expense of teaching practice. As an authority figure in the community, he exercised his judgement and went ahead with the paper in order to disseminate teaching and learning resources that were created as part of a national research grant:

This is like the outcome of that ALTC project, and what we've produced and what we can now give to the community in terms of how they can utilise the modules that have been developed. So yeah, it was a hard one to know whether to put it in or not put it in, but ... I think it's important that we disseminate the results of all of the research grants ... I think that information needs to go out into the community. [Steve, ATN]

So for Rob and Steve, the reviewers' dominant interpretation of the review criteria served to try to limit acceptable papers to theoretically aligned research papers only. This tension over the application of the review criteria highlights how the engineering education community has not yet reached consensus on its own identity and purpose. This is a characteristic not only of our national community but of international communities as well. Rob put it this way:

It does make me wonder – and we've had this conversation in the REEN/REES group – are we only looking for one kind of paper and how do newbies get into the game of going “Hey I'd like to be a part of this community”? [Rob, ATN]

7.2.3 Institutional strand

The institutional strand is illustrated in the established researchers' comments about

their university environments and the people they work with. Established researchers, who are typically Professors and Associate Professors, are able to exert and mobilise more influence at their own university than other researchers. Dennis and Rob, for example, have direct contact with people in authority and other decision makers at their institution:

So I actually wrote five things to our new VC when she said I want ideas, or if you think there's problems. So I wrote five positive things, and I got a comment back saying could I have coffee with her one morning? I said, sure – to talk about one of them. [Dennis, regional]

Well we've put a word in our Head of School's ear who also is the Dean of Engineering here and I said I've started this collaboration with Business, we've got some money from the Business Deans Council to do an experiment next year and I said we really should be doing more of this. He jumped at this and said, “Yes this is a really good idea.” [Rob, ATN]

Even though they are in positions of authority, Steve, Will and Erica, demonstrate leadership more informally by mentoring colleagues:

To me it's important that I pass that knowledge to younger academics... my role here at uni – I mean, I'm a discipline leader, so I'm really the pseudo Head of School, so I get to look at the strategy directions, and also have input in early career academics we employ and – I want to pass on what I've learned so they don't have to struggle through the brick walls and the bureaucracy that I, as an academic on the way up, have hit, and maneuvered my way around or found better ways to do things. [Steve, ATN]

So in my current role, trying to support other people doing this sort of work and learning how to investigate their own practice, I try and edge them towards what I would regard as more interesting questions ... It's the distinction, I think, between the work that I want to do, and the work that I help other people do. So the work that I help other people do ... is fine to start with that class focus ... because that's

what interests people. That's what motivates people to actually start to get into this area. But the questions that I have are really sector wide, but generally still within an engineering context. [Will, metropolitan unaligned]

I encourage them to try and publish some of their work because they're doing some really good stuff. Two of them are doing PhDs in the area, so when they got their reviews back they came to me and said, "We need some help here. Can you interpret what this means and help us?" [Erica, regional]

However, like the emerging and intermediate researchers, most of the established researchers realise that engineering education research is regarded by other engineering researchers at their institutions as not 'real' research. Stuart said:

If they've come into this area from engineering, they're worried that their Dean is going to go to them and say this is not real engineering research. It's about time you published some hard, technical papers to keep your CV intact ... Nobody says it to me but that's because I'm probably too senior ... I know that my colleagues here in the Faculty of Engineering, they're not the least bit interested. [Stuart, Go8]

Will and Steve are exceptions to this. Will's belief that engineering education research is valued at his university is supported by the fact that it has:

A very large engineering and science education research group, with about 25 people from across the university ... So most of the other people in the faculty, even if they don't directly do engineering education research, they're at least aware that other people are doing it. That it's ... contributing to the research quantum of the university. Now, the funny thing about that though is that at this university, because we don't have a school of education or anything, there isn't another group in the university that's working towards, say, that ERA ranking – the FoR code type of thing. So yes, engineering and science education is valued, certainly by the faculty and I think by the university, because it brings in papers and stuff. [Will, metropolitan unaligned]

Referring to his university, Steve said:

Here, engineering education research is, I think, valued even though there's not a big group of people within the university, like at USQ and Swinburne. [Steve, ATN]

However, he then went on to say that he also does technical research as well:

I'm fortunate enough in my space that I do a little bit of technical research – if you look at my publications, there's technical research, and I have two PhD principal supervisors and five associates, and a couple of masters. So that allows me to, I suppose you can say play the game, and get technical research as well. [Steve, ATN]

Stuart noted that he has only been able to pursue his current research because of his strong track record in technical research:

So this issue of crossing the academic fence or jumping over is fraught with danger ... I was lucky enough, by good fortune, to have a research record, international prizes; things like that. No one could attack that, so I felt secure enough to jump into a different area and go out and do some interesting things ... For somebody young in their career, no way. It's enough of a struggle to stay where you are; it's not worth the risks unless you really want to throw security to the winds. [Stuart, Go8]

Several of the established researchers also commented on the higher education sector publication and research metrics that impact on the institutional environment by focusing academics and managers on maximizing the publication count:

The ERA – the Minister about a year after that, came in and said universities are not to use these ranks to drive output ... But they do. Ours does. Yeah, and the Minister has said you're not to. Yeah, and so someone could go round and actually look at all the websites and see what the rewards are for staff. Then actually feed that back – in a paper, back to OLT or back to the DEEWR and say you've got a problem. The Minister has said this. This is practice. You'd need lead underpants on. [Dennis, regional]

I can also see in other universities I've been to, and talking to colleagues, that it's research and research only ... If you have a good reputation and you've published widely and you've disseminated [it] helps you get promoted, and it gives you credibility – inside your own university and outside. [Steve, ATN]

They rate because they get Brownie points, dollars. Yeah, they want to have staff who have got the appropriate ratings, who are being cited, who are recognised nationally, internationally, which is why at the end of the day the promotions process requires you demonstrate that. So it all comes back to they want to see that you are actually publishing. They want to see your name on paper. [Erica, regional]

It's the reality of the world that we live in ... It's the way that things are measured, but it's also the way that things are funded ... Well, they're measured because they're easy things to count, as in put a number next to, but ... yeah, they're the things that give the university income. [Will, metropolitan unaligned]

Stuart and Dennis mentioned how this has the negative consequence of pushing academics to publish for the sake of publishing, rather than publishing a mature concept:

For the most part conference papers have become an act in which you speak but others don't listen. That's not part of the scene ... because for most people the motivation for being at a conference is to get a point that goes towards your – the act of giving the paper is part of the ritual. I know people who are serial offenders in getting papers published at conferences, they pay the registration fees, they don't turn up; they'll save the airfare, the accommodation costs. It's purely a promotion issue. You're getting the points on the board. So listening to what other people are saying is not part of the agenda. [Stuart, Go8]

I think we're now publishing for often the wrong reason, that is, just to get to a conference or to get a paper out. Because to tick a box, to get some money ... So

we're drip feeding the system, so we'll get a project and we'll do this little bit, will go in there and this little bit ... instead of waiting til we finish a project, we're doing a paper, or doing a conference paper and then ... you might have 10 papers along the way. Then put it all in a journal, three or four articles at the end, and I think that's all wrong. It is the metrics, yes. So the Federal Government or the university – in our case – is driving that. Therefore you have people saying well I need to get a paper done. What will I write it on? Instead of saying what am I researching, and actually setting out to do research and actually – at various points along, you might have planned where you're going to do papers. But at various points along, you might say, Oh, well this is significant, I'll publish. So I think that's a problem. [Dennis, regional]

Well, my work went into a national ANET (Australian National Engineering Taskforce) report with [senior engineering academic] and [experienced researcher] ... We ran two workshops around the country – that went on into the Senate Enquiry. No noddy points at all. So I think the whole idea of impact is not being measured ... so I think that the impact of what you do is – yeah, it's all wrong. [Dennis, regional]

Established researchers are typically looking to their research as a means of initiating change of some sort and are frustrated that the institutional and wider sector focus is on the publication metrics rather than the substantive matter of the research. Dennis again:

There are two or three other things that have come out of that, where you get no Noddy points. But you are actually changing practice. Not in engineering, but across all the disciplines. So I'm actually been working with people across disciplines. And it doesn't count for anything ... so something is very wrong with the research. We're just doing it to get the metrics ... I think we've become myopic, and not enough of us are actually looking at the big picture, which is where I sort of work. I've tried to get people here interested in, and they're just not interested you know. But I think there's a lot of rich research to do. [Dennis, regional]

Rob commented that he feels tension between the roles important to him and the roles

important to his university:

On a semi-regular basis. I guess I'm at that point of wanting to see some change happen but I don't think that's very important to the university. The university runs along a business as usual model that is we'll be doing the same things in 100 years, don't you worry about that, just meet the KPIs ... I think they're completely wrong about that in a way that couldn't have been predicted even five years ago and that is that there are people – there are other people who are also reading this literature and who are figuring out ways of making money in this game and they don't have the lumbering requirements of universities. [Rob, ATN]

Steve is expecting that an increased focus at his university on higher education research will both improve teaching and learning practice there and increase its status. He said:

I think our university actually is talking about, and I've seen some progress, in terms of elevating teaching to a level where yeah, research is important but if you looked at our strategic goals of our new faculties – science and engineering here – they're on an equal footing ... and there's a new – it's only really just starting, but there's a Higher Education Research Network ... So like minded higher education researchers are starting to get together and share as well ... and as that takes off I see that will improve the teaching and learning. Maybe never on an equal foot as research, but certainly improve so it's in the spotlight a lot more. [Steve, ATN]

Established researchers have strong institutional profiles as either experienced researchers or as Faculty managers. The managerial roles consolidate and extend their networks but may not necessarily contribute to the continued development of their intellectual strand in relation to the research part of their academic practice. In the case of Rob and Steve, their intellectual strand development seems to be lagging behind their institutional and networking strands.

7.3 Temporal references

Established researchers often made reference to their past when explaining their current

situation or current thinking – this is usually because they had so much past to refer to. As with the emerging and intermediate researchers, many of the established researchers started their professional lives in industry before they became academics. Rob recounted:

I think back to my early days as an engineer in the days when we were all writing software and the people who were most effective were the ones not only who disseminated ... I was originally interested in technology assisted – it's not so much technology assisted learning as it was – what you would really call knowledge management now ... That was really the provocation for my PhD. Then I started using the same technology with students and it wasn't the web then but it was a similar kind of technology and the students responded by saying why don't you just print all this. So I wandered off and thought I can't see how this is ever going to make a big difference. Then I discovered problem-based learning one day and it changed my life ... I remember how hard it was originally to think, Oh, how would I do this in a more PBL kind of way. But now it seems completely second nature. [Rob, ATN]

Stuart and Will referenced their past in explaining the motivation for their current work:

So I've realised over the last 10 years that trying to work within academia was futile but there was a yearning audience out there that are struggling; lots of engineers and even more so their managers who are struggling to understand why they can't make headway. [Stuart, Go8]

The only reason why I got into this field in the beginning was because there were big questions in my mind about how we can do the things that we do, better ... I've been in AAEE now for eight years, nine years. So not as long as others, but I find that it is my community. [Will, metropolitan unaligned]

Steve explained that he had learned from his past experiences, as had Erica in regard to dealing with reviewer comments:

You know, I've been an academic ten years, so I think it's time and experience teaches you these lessons, and as long as you learn from them, try to better yourself. [Steve, ATN]

It took me a few years to really understand that it's not personal and that you've got to look at it without – or even if you get the reviews back and it makes you hot-headed for a day or two, just put it aside. Read them and put it aside. [Erica, regional]

References to the past were frequently used to explain their current situations with regard to their teaching practice, their research or their engagement with the community, and were often bound up with references to the future. Such comments indicate their agency or horizons for action.

7.4 Agency

The established researchers demonstrated strong agency, that is, they took action to work towards achieving their objectives and leveraged their institutional status towards these ends. This action was variously directed towards promotion, changing university, engaging with industry, writing books or grant applications and responding to reviews on their conference papers.

Dennis demonstrated agency with respect to being promoted to professor level. His comment also shows how references to personal history are often bound up with references to other aspects of the identity-trajectory model:

I thought I'd never get promoted to professor, because ... there was no way that I could get promoted without a PhD. I was too busy doing my research ... so as an Associate Dean, it was perfect. Because you were doing some teaching, designing programs ... it was all evidence-based ... It was just not like I've got a good idea. Let's do this on program design or whatever. Then you're able to write that up and

– so you develop all these sorts of things that you work on. So that's how I got to where I am, because I demonstrated that all my work in graduate attributes was equivalent to having done a PhD. [Dennis, regional]

Rob referred to his more recent history when illustrating his agency with respect to engaging with industry:

So yesterday I gave a presentation to the senior engineers group at Engineers Australia on this reinventing the university thing [and] the other night ... I ran this industry forum. [Rob. ATN]

Stuart and Rob demonstrated agency with respect to the artefacts of their intellectual strand. For Stuart this was in relation to a book he was writing, and for Rob in relation to a grant application:

But I know that most of the stuff I talk about – it's very difficult to make it meaningful for an academic audience in engineering ... but I've realised in the end – and that's why I'm writing my book – that all this effort in academic publishing – it's useful up to a point but the audience, ultimately, has to be engineers. [Stuart, Go8]

I said let's focus it on AQF8 and I'd like to think that made a big difference. This is very current, this is exactly what every engineering school in the country is grappling with one way or another. This would be a really useful project. [Rob, ATN]

One way Rob dealt with the tension between the academic roles that he values and those that are valued by his university was by changing to a different university:

I suppose there is enough of my job that allows me to do some of that and certainly here at [ATN University]. At [Go8 University] it was much more difficult to do any evangelising. People were very busy or they all figured they knew how to do it without my assistance. So there's not much joy in that process. It was difficult to find collaborators. Very competitive university. Whereas here –

particularly because of the way my job is constructed ... I've naturally got an opportunity to go and work with people in other schools. [Rob, ATN]

Erica also commented that there was some tension between the roles that she values and those valued by her university. Erica had less job mobility than Rob, so moving universities was not an option. However, she managed to reconcile the two perspectives in her own way:

Yeah, well there's a certain amount of tension in that I guess I have different priorities to the university. But it's really a case of how can I make their priorities meet my priorities, so they want me to be an author. Okay, I'm quite happy to write the papers if that means that you'll be paying for me to go to the conference. So yeah, hopefully it's then a win/win situation, so there is tension in that we're wanting different things but if by me fulfilling their wishes they'll fulfil my wishes – I'm quite comfortable with that. [Erica, regional]

As might be expected, most of the established researchers were only asked to make minor changes to their papers before publication. Most reviews of these papers were positive in tone and had few questions or suggestions for improving them. Rob and Steve both received 'accept with major changes' decisions, with one referring to a specific outreach event and the other to teaching practice in a particular subject. These negative reviews seem to have been based on the interpretation by reviewers that the 2012 review criteria would only allow research papers to be accepted for the conference. While these authors did make changes to their reviewed papers before publication, these were not the sorts of substantial changes I would associate with a request for 'major changes'. Rob and Steve were able to argue their cases in the author rejoinder process so that their papers were eventually accepted. As experienced researchers they had strong networks and institutional profiles along with the agency to do this successfully. Rob responded to a reviewer's comments by including a

declarative paragraph in the background section of the final version clearly stating that it is not a research paper. He justified the paper's inclusion in the conference this way:

We thought it was important enough and unusual enough to make that effort ... I was trying to get some of that across, that there are other ways of doing things ... So it's kind of soft research but it was – it's really trying to tell a different kind of story. [Rob, ATN]

7.5 Personal context

As with the other participants, the established researchers take their personal context into account when making decisions about their academic career. Dennis, for example, spoke about retirement and his future work plans:

But I'm retiring ... so many people want me to work – do bits and pieces ... so I'll probably do about two months' work next year. [Dennis, regional]

Both Erica and Will have made decisions to limit their travel so that they can share parenting roles with their respective partners – although this didn't come out in the structured part of the interviews, but in more free-ranging discussion at the end of the interview with each of them. Despite no specific questions about how their personal situation affects decisions they make about their academic work, for emerging researchers this emerged in the interview anyway. I think it is noteworthy that established researchers were much less forthcoming about this aspect of their academic identity.

In terms of personal behaviour though, these researchers tended to respond rationally rather than emotionally to reviews of their conference papers. Erica commented on helping her more junior colleagues to rationalise their responses as well:

I think the main thing for me with the reviews over the last couple of years has been helping people try and understand that they are not personal ... I've got a bloke that I work with ... We wrote a paper together and when the reviews came back he sat on the other side of my desk and was so annoyed, so shitty. I said just let's look at it. It's not personal. This is the paper. This is what we're putting out there so what is the story that we're telling and are we telling it right?... I find that's a role I'm sort of really taking with people is getting them to try and think about it as not personal, it's not your work that's being criticised. It's how you've communicated it. [Erica, regional]

As with the intermediate researchers, references to personal circumstances are often intertwined with comments about history and horizons for action. Isolating them is not a straightforward or simple analytical exercise.

7.6 Horizons for action

Horizons for action are generated through personal agency and take into account lessons learned from past experiences. They are enabled or constrained by the intertwining of the personal and the academic (intellectual, networking and institutional) strands.

For established researchers such as Stuart, the horizon for action is global – he wants to see change across many countries. Rob and Dennis are also looking for change, but on a national level. Steve's ARC project is state-based with aspirations to become national.

Dennis commented that research publications are not about 'just reporting', but should also have some impact related to the focus of the work. Other established researchers share this view. While Dennis is aiming to inform national policy, "Actually looking at trends across the country and informing policy and decisions", Stuart and Rob would like to see a change in engineering practice as well as practices in teaching and learning of engineering:

There's a transformation agenda in the sense that in order to understand the practice you need to understand these processes going on. That in turn will empower them to do things differently. [Stuart, Go8]

I guess I'm at that point of wanting to see some change happen ... but it's motivated by changing engineering practice ... because I think a lot of what we teach in engineering, is about teaching people to be a backroom profession. [Rob, ATN.

For these participants, their successful track records in securing funding of projects, their developed conceptualisations of their work, their extensive personal and intertextual networks, along with their significant institutional status and strong personal agency, all contribute to their confidence that they can achieve their stated goals.

7.7 Responses to the landscape model

As shown in Figure 7.1, the established researchers were generally split between placing two stars in different activity areas (like intermediate researchers) or placing one star towards the middle of a trajectory between two areas. This suggests that they were addressing questions from more than one perspective. The exception here is Stuart, who has specialised in researching in the 'engineering practice' area for many years. He placed his star right in the middle of this area of the landscape. Dennis added the activity area of 'secondary school system' to the presented model in order to more fully represent his work.

Apart from Stuart, participants' responses to the landscape model showed that their projects either involved a range of activity areas or integrated them:

It's that big scale stuff that interests me more than at the course level ... so all of these things tend to blur. [Rob, ATN]

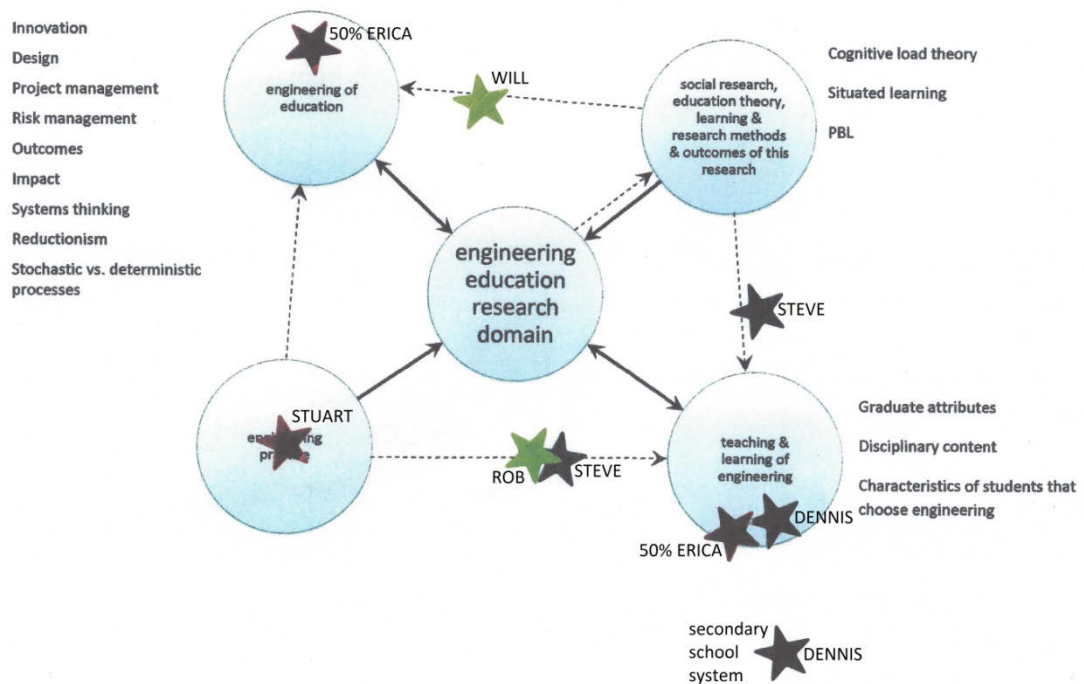


Figure 7.1: Established researchers' self-location of their AAEE 2012 paper on the engineering education landscape model

It's hard to actually pigeon hole because there are components that I do ... I consider myself quite diverse ... I move across different spaces. [Steve, ATN]

The questions that I have are really sector wide but generally still within an engineering context. [Will, metropolitan unaligned]

I don't think that I've got any papers over the years that have been just in one of these domains ... I think most papers I've written would cross over ... So yeah, I've got fingers in lots and lots of different pies. [Erica, regional]

Although the stars in Figure 7.1 are mainly clustered around the teaching and learning of engineering vicinity, as were the emerging researchers' stars, there are more stars on the trajectories leading to that circle rather than being placed in it. This suggests these established researchers may be using more than one perspective, or are taking a broader

view of their phenomenon of interest, which is the education of engineering students enrolled in their subjects.

Dennis and Stuart suggested changes or additions to the landscape model:

So I would actually make that an arrow back that way... the thing I think is missing from there is the higher education framework and funding policies ... So I think there's another big box there which is ... the country that you're working in. [Dennis, regional]

There's a wall there ... a very high wall. Now here it's a little different because there's another wall here but these people really like to get over that because ... I'm sorry I'm not going to play by your rules. [Stuart, Go8].

These comments further reflect how their levels of agency align with their levels of experience as engineering education researchers.

7.8 Summary of findings for established researchers

The identity-trajectory concept has provided insights into the various elements of academic identity development for established researchers. With respect to their intellectual strands, these researchers explicitly value the act of writing as it is linked to clarifying their thinking about aspects of their research and generating ideas for further work. They favour qualitative research methods while also being knowledgeable about quantitative methods.. These experienced academics are able to apply a variety of perspectives to individual projects and broader research questions. However, two of the established researchers interviewed did not seem to be able to demonstrate research skills at the same level as the others in this cohort, even though they had the number and variety of publications appropriate to this category. In a small national community, their strong network and institutional strands have contributed to their status as experienced

researchers.

All of these researchers have extensive personal networks that they draw on for information about what other people are doing or to form project teams. They value diversity in these networks and include people from other universities, other countries and other disciplines. They draw on these networks and also make significant contributions to them. The personal networks of these researchers are strongly interconnected to their intertextual networks. These intertextual networks, like the personal networks, extend beyond the AAEE conferences to international conferences and journals.

The established researchers have strong and extensive personal networks at their own universities. They are either in positions of authority themselves, or they demonstrate leadership by mentoring other academics and PhD students. They have been successful in the higher education environment, with that success usually coming not only from their activity in engineering education but also their earlier, more typical, technical research. They acknowledge that in most Australian universities engineering education research has a lower status than technical research.

These researchers demonstrate strong agency in various ways that relate to different strands, by, for example, changing universities, initiating industry forums, writing books or grant applications, arguing for their institutional standing and responding to reviews on their conference papers. As a result of their strong agency and (mostly) well-developed intellectual, networking and institutional strands, these researchers have horizons for action at national and international levels, since this is the scope of the projects they are typically involved with.

The strong agency of these researchers was also evident when they suggested changes and additions to the engineering education landscape model. They either used two stars to locate their conference paper on the landscape model or placed one star on the trajectory between two areas, which suggests that they are working with multiple facets of the phenomenon they are interested in. However, one researcher was an exception; he placed his star in the centre of the engineering practice area of the landscape, indicating a deeper rather than a broader focus to his work.

Having characterised these researchers in terms of identity-trajectory, I am able to compare and contrast the characteristics and experiences of the established researchers with their emerging and intermediate researcher colleagues. In the next chapter I discuss the roles enacted by participants in these categories as they engage with writing a conference paper.

Chapter 8. Roles associated with writing a conference paper

As discussed in Section 3.1, the roles an individual enacts become opportunities to express and develop identity. When the roles relate to academic work and contexts, they provide the opportunity for development of an academic identity (Fitzmaurice 2013).

Roles associated with research make an important contribution to academic disciplinary identity: “Research has often been seen as central to academic identities” (Taylor 2008, p. 39). In particular, the role of writing is “the key site of contemporary scholarly practice and the performance of scholarly identity” (Barnacle & Mewburn 2010, p. 434). This chapter discusses the roles enacted by participants in the process of writing a conference paper and explores the similarities and differences between these roles based on participants’ levels of expertise and university types. The academic strands of identity trajectory are used to frame the discussion of the roles nominated by participants as being most important to them, and the roles they perceived as most important to their university. This analysis provides additional information for interpreting how academics think about their research and how this evolves with research expertise.

8.1 Roles valued by participants

As described in Chapter 4 and further in Appendix II, during the interview participants listed the roles that they perform or enact in the process of writing a paper for an AAEE conference. They also separately listed the three roles that they most value. Table 8.1 illustrates these roles that participants nominated as being most important to them. The meaning associated with each role was interpreted from each participant’s dialogue

about that role as recorded in the interview transcripts. The various roles were then characterised according to the academic strands of the identity trajectory framework, with the participants grouped by level of expertise.

Established researchers populate the networking strand in Table 8.1, particularly the interpersonal element of networking. Dennis's only personally valued role falls into the networking strand. For Steve and Erica, all of the roles most important to them fall into this strand and for Rob and Will, two of their three most important roles are networking related. For the emerging and intermediate researchers this strand is much more sparsely populated. Sam (intermediate) and Adele (emerging) are exceptions who each nominated two interpersonal networking-related roles as being important to them. Both of these participants have learnt the value of having an interpersonal network from past personal experience. For Adele this a feature carried into her academic practice from a prominent role in industry as well as a function of her extrovert personality. Sam has learnt the importance of a strong interpersonal network in developing project teams for OLT projects.

It is the intellectual strand which contains the most commonly listed role across all categories of participants, that of researcher. The following participants gave these examples of what being a researcher includes:

[It means] understanding what's going on [Terry, emerging, metropolitan unaligned]

I go to conferences and therefore I learn [Evan, emerging, Go8]

I enjoy the chase, the intellectual exercise [Nathan, intermediate, metropolitan unaligned]

Satisfying your curiosity [Neil, intermediate, Go8]

[Generating] interesting findings and being able to do something with them [Will, established, metropolitan unaligned].

These comments all relate to the intellectual strand of academic identity. Evan's comment about learning at conferences implies he is learning from the people and the presentations at these conferences, and it demonstrates how an activity can support development in more than one strand.

While the emerging researchers have some roles in the networking strand, they mainly populate the intellectual strand. For Wayne and Tom, all of their most valued roles are in this intellectual strand. These two have produced papers for the 2012 AAEE conference but they more strongly identify with their technical research area than engineering education research. Alex and Evan, as PhD candidates, have two of their three most valued roles in this strand.

Another difference between the emerging researchers and other levels of expertise is that the emerging researchers populate the intellectual strand with roles that are sub-roles of being a researcher. Alex and Wayne nominated asking questions and analysing data as explicit roles that they value. Intermediate and established researchers Neil and Steve included such sub-roles in the over-arching term researcher:

What's included in the idea of me being a researcher? It's multi-faceted. First of all, I think is – to ask a question, have I got something here to go with? If the initial gut feeling is, yes, I have, then you back that up to see what other people are doing, so you're not reinventing the wheel. So literary reviews, benchmarking and the like, and the whole sort of scholarly approach to, I suppose, giving some sort of credence to what you're proposing to do. So I suppose there's a literature aspect of it. [Neil, intermediate, Go8]

Well the first start to the process is probably an idea generation about what you want to do, and then see if there's any literature tied up with it, but also developing methodology around if you're putting in place some – or you're collecting data or you're trying something innovative. [Steve, established, ATN]

This suggests that emerging researchers are paying attention to the processes involved in educational research as they transition from one research paradigm to another. If established researchers have already made this transition, then what is now implicit to them still needs to be made explicit to the emerging researchers. Another way of putting this is that established researchers have developed research-related schemas that incorporate all the related roles, while most of the emerging researchers have yet to develop such schemas and so articulate all aspects of the transition process.

The institutional strand is the least populated by all categories of participants, with three notable exceptions. All of Therese's personally most valued roles align with this strand, suggesting her focus is on raising her institutional identity. The role of writer appears here for Therese, as her discourse about being a writer centres on creating a track record in engineering education. This is similar to Ian's comment that he writes to generate a track record of publication. Mark also commented that he writes because "You get something to put on your CV [that] you put in your promotion application."

These participants would fit in the trading variation of Brew's (2001) framework of how researchers think about their research (see Chapter 2, Section 2.1). Researchers in this variation perceive their research to have value inasmuch as it earns them recognition and reward. Fensham (2004) also noted that for some of his respondents the purpose of undertaking their research and publishing it was to create artefacts that contribute to their institutional profile rather than to influence any practice in the area of science education research. He saw this as a consequence of the current university environment:

I suppose this is an inevitable consequence of the growth of the research area and of science education becoming an academic research area, within a university culture, that rewards scholarly research much more highly than teaching or professional practice. (p. 163)

Although creating the written artefact is a contribution to the intellectual strand, it also contributes to developing the institutional strand. This demonstrates another way that an activity can overlap two strands. This way of thinking about the role of being a writer is similar to the way the role is perceived and valued by researchers' universities. This will be discussed in the next section.

However, such discourse around being a writer contrasts with the comments of other participants who nominated this role. Stuart, Rob, Alex, Tom and Wayne, for example, linked writing to different aspects of research:

The principal motivation for me for writing papers is that it produces ideas.
[Stuart, established, Go8]

I write to disseminate findings. [Rob, established, ATN]

That's another skill I'm trying to develop and that's why that's moved up in the importance. [Alex, emerging, regional]

...second most important would be the quality of your exposition. So for a suitably knowledgeable person, how easy is it for them to pick up my paper, read it, understand it and perhaps even implement it, if they felt inspired to do so.
[Tom, emerging, Go8]

I've always enjoyed being a writer. [Wayne, emerging, regional]

For these participants, the role of writer has been categorised in the intellectual strand because their associated discourse in their interview relates to the process of writing rather than the production of the artefact for the publication count.

The other notable participant in the institutional strand is Ian, whose only response to roles of personal importance was “track record”. Like Mark, his participation in grants and conferences is motivated by creating a track record so that his institution views him as an active researcher for promotion purposes.

Examination of interview transcripts shows that three of the four emerging and intermediate participants who nominated the role of teacher/educator as important to them used these terms in relation to educating colleagues at their own university or other members of the engineering education community, rather than the context of enrolled students in a class. As shown in Table 8.1, the teacher/educator role was not nominated by any established researcher as being one of their most valued roles. These emerging and intermediate participants discussed the teacher role in terms similar to those used by the established researchers when they talked about dissemination. Evan and Sam, for example, said:

[I like] teaching other people within the field about what I did [Evan, emerging, Go8]

Educating not just students about new things...find new information and pass it one to ... whoever is interested. That's the teaching role. [Sam, intermediate, regional]

By contrast, Steve talks about the same concept but frames it as a research function (“disseminating those results”) rather than the teaching function referred to by Evan and Sam:

[I like] the idea of disseminating those results so somebody else can pick up and say, Oh that's a good idea – I never thought of that – how can I utilise that? [Steve, established, ATN]

In a similar way, while two of the emerging researchers (Evan and Adele) valued being learners, none of the intermediate or established researchers nominated that role.

However, they did talk about learning when they write, when they read, and when they converse with other researchers in the community. So they are learning, they just don't specifically identify themselves as ‘learners’. The importance of the relationship between dialogue and identity is outlined in Section 3.1, which shows that “discourses and identities are intimately linked” (Bamber 2012, p. 159). Learning the language is part of identifying with a particular community, and emerging researchers have yet to use language like the established researchers. In other words, they have yet to learn the discourse associated with being an established researcher.

There are other differences as well. While all the established researchers indicated that they were performing some type of mentoring role, either of colleagues or PhD students, among the intermediate researchers, only Therese, who has a managerial role in her department as Discipline Head, mentioned mentoring of any description. Adele is the only emerging researcher to include mentoring in her list of roles. Along with catalyst and change agent, she sees her mentoring in relation to teaching practice within

her School. This aligns with the educator role mentioned by the other emerging researchers and the dissemination role of the established researchers. Being seen to mentor colleagues and postgraduate students is a contribution to the institution because it potentially builds institutional capability.

Two of the established researchers indicated that it is important to them to be seen as someone whose research is accepted by the community:

... maintaining my credibility in terms of that other people see what I've done or see what I've achieved... [Steve, established, ATN], and

...but getting then that feedback ... that it's a validation of the work or an acceptance so it is that public acceptance. So having a peer reviewed paper that says yes, this work is actually of value and it's worthwhile people being aware of... [Erica, established, regional]

In the case of these researchers the way they see themselves, that is part of their academic identity depends on this external validation by other members of the research field.

It is also worth noting that all the intermediate level researchers mentioned being the leader/manager of groups, projects or teams as one of their roles, although Therese and Nathan did not nominate this as one of their personally most valued roles. Of the six established researchers, only one specifically listed this type of role and none of the emerging researchers listed it. This suggests that intermediate researchers apply for or nominate themselves for these leadership roles because they contribute to their track records as educational researchers and hence raise their institutional profiles. Sam put it this way:

That's a sort of engagement in the research field at the top level. The university wants you to be the leader of things, not a collaborator in everything. That's how I think they want to get to the top; they want everybody leading everything. So, that's important to them. [Sam, intermediate, regional]

As Sam implies, being a project leader contrasts with being a member of a project team or a collaborator, roles that were listed as personally important by Terry, an emerging researcher, Nathan, an intermediate researcher, and established researchers, Rob and Will. It seems the established researchers are not as driven to lead projects as the intermediate researchers, since by definition established researchers already have a strong institutional profile.

In summary, emerging and intermediate researchers mainly value roles associated with the intellectual strand, and established researchers mainly value roles associated with the networking strand. From their studies of PhD students and early career researchers, Turner and McAlpine (2011) report that the networking strand “expanded over time” (p. 51). My data suggests that the networking strand continues to expand for most engineering educational researchers well past the early career stage.

8.1.1 Visualisation of strands of academic identity

Figure 8.1 illustrates the identity-trajectory strand interaction for emerging, intermediate and established researcher categories. Each category is shown with the identity-trajectory strands as circles foregrounded against an ‘agency and horizons for action’ field. Each circle represents a strand, and the degree of dominance of each strand is represented by the relative diameter of the circles. The relative dominance of a strand is determined by the importance of that strand to participants in each category of expertise as indicated from analysis of their interview dialogue.

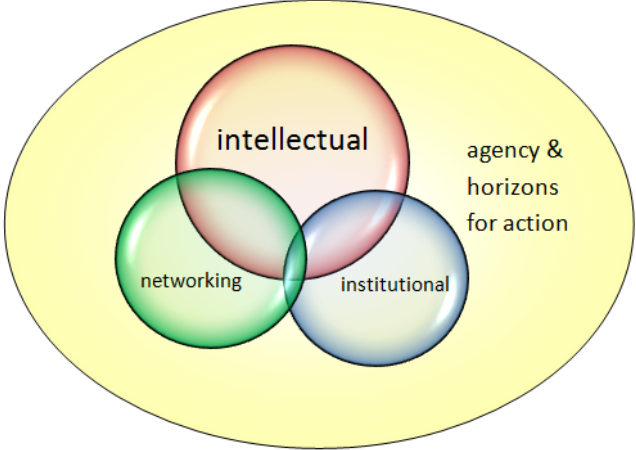
Part (a) of Figure 8.1 shows that elements of the intellectual strand dominate the roles nominated by the emerging researchers. Interview transcripts for these researchers have significantly more dialogue characterised as relating to the intellectual strand than either of the networking or institutional strands. These researchers generally have relatively restricted networks (both interpersonal and intertextual) and they tend to have the lowest institutional profile of the three researcher categories used in this study.

Part (b) of Figure 8.1 shows that while the intermediate researchers may still be resolving some of the difficulties with research epistemologies and methods that dominate the emerging researchers' thinking, they have an expanded network and a greater institutional profile compared to the emerging researchers.

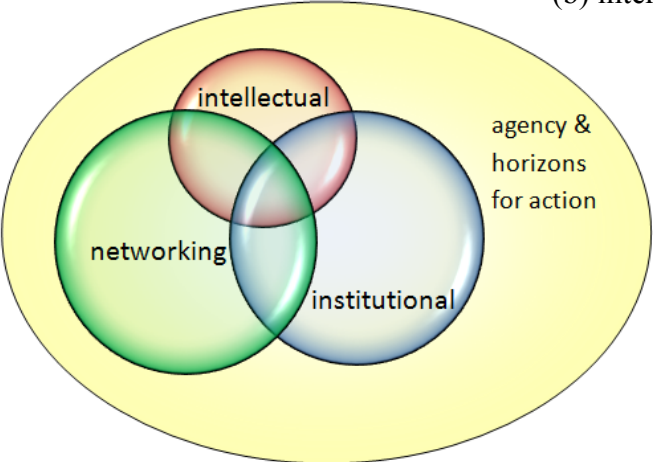
Part (c) of Figure 8.1 shows that elements of the networking strand dominate the dialogue and roles nominated by the established researchers. They also have the highest institutional profile of the three categories. While the intellectual strand is the smallest strand in Figure 8.1 (c), this is not meant to imply that established researchers aren't thinking or producing artefacts. Rather, it suggests that for established researchers the norms of this research domain have become implicit in how they work and they therefore pay less explicit attention to the individual aspects that emerging researchers are still negotiating.

The overlap between the different strands is also meant to indicate that some activities develop more than one aspect of academic identity. For example, Evan refers to learning (associated with the intellectual strand) from conference presentations (associated with the networking strand); and creating the written artefact is a contribution to the intellectual strand, but also contributes to developing the institutional

strand because universities value publication counts. This has been demonstrated in relation to the networking and intellectual strands, and the institutional and intellectual strands in this chapter and will be discussed further in Chapter 9.

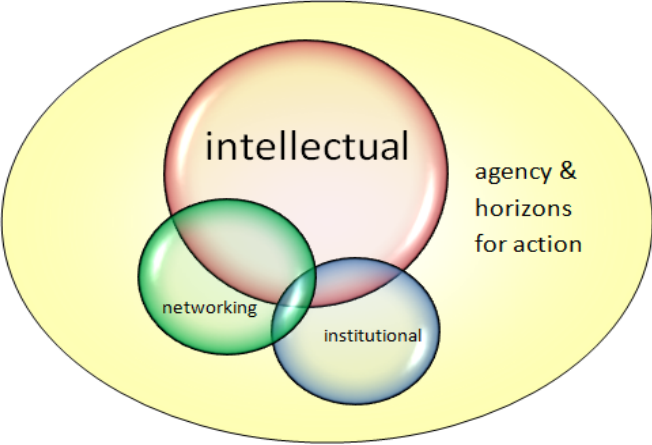


(b) intermediate researchers



(c) established researchers

Figure 8.1: Identity-trajectory strand interaction for emerging, intermediate and established researchers



(a) emerging researchers

8.2 Roles that participants regard as valued by their institutions

Table 8.2 illustrates the roles that participants regard as valued by their universities. The lists of roles that participants perceive to be valued by their institutions are dominated by roles that fit in the intellectual strand and are related to the ERA metrics. The role most often mentioned by all categories of researcher is “writer/publisher of ERA publications”. For emerging researchers this relates to writing conference papers that go through a peer review process before publication. Intermediate researchers are sensitive to the push from their universities to write journal papers in addition to conference papers, while for established researchers this is perceived as pressure to bring research money into the university and hence becoming a research manager. The next most valued role in the intellectual strand is “researcher”, which is closely linked to the most valued writer role, as is “the count”, which was nominated by an intermediate and an established researcher. That these roles of writer and researcher are valued by universities is demonstrated by the overlap of the institutional and intellectual strand in each of the Venn diagrams shown in Figure 8.1.

In the network strand, the participants’ perceptions of the institutionally most valued role is that of disseminator, presumably because this implies that the academic has something to disseminate through an ERA countable product such as a journal paper or research project. Within the networking strand, emerging researchers believe their university values their participation in projects, whereas intermediate researchers believe they need to lead such projects in order to be valued at their university.

Table 8.2: Roles participants perceive as most valued by their institution

		Emerging Researchers								Intermediate Researchers				Established researchers						
		Terry	Mike	Ian	Alex	Wayne	Evan	Adele	Tom	Mark	Therese	Nathan	Sam	Neil	Rob	Steve	Will	Erica	Dennis	Stuart
Intellectual strand	writer/publisher of ERA publications	8			regional	regional				Go8		metropolitan unaligned		Go8	ATN		metropolitan unaligned	regional		
	researcher	4	metropolitan unaligned		regional		Go8						regional							
	grant applicant/awardee	3								Go8	ATN				ATN					
	academic	3					Go8	Go8					regional							
	"the count"	2										metropolitan unaligned								Go8
	journal papers	2									ATN	metropolitan unaligned								
	international standing/reputation	2							Go8					Go8						
	peer reviewed	2						Go8	Go8											
	reviewer	1				regional														
	record of research output	1		metropolitan unaligned																
	substantive output from project	1			metropolitan unaligned															
	identification of my performance	1		metropolitan unaligned																
	original content	1							Go8											
	research money	1														ATN				
	writer of text	1																metropolitan unaligned		
	research manager	1													ATN					
Networking strand	dissemination	4		metropolitan unaligned				Go8								ATN		regional		
	team member/collaborator	2	metropolitan unaligned			regional														
	presenter	1							Go8											
	project leader	1											regional							
Institutional strand	educator/performance in T&L	4		metropolitan unaligned	regional		Go8								ATN					
	research supervisor	3									ATN						metropolitan unaligned	regional		
	mentoring researchers	2															metropolitan unaligned	regional		
	distance/online students	1																	regional	
	submissive employee	1												Go8						
	administrator	1	metropolitan unaligned																	
	postgrad completions	1																		Go8
	research is growing	1																		regional
	fulfilling lives	1																		regional

ATN
 metropolitan unaligned
 regional
 Go8

Under the institutional strand, it is interesting that emerging and established researchers believe their institution values their performance as a teacher, but none of the intermediate researchers listed this as a valued role. Two established researchers nominated this role as important to their university: Steve at an ATN, and Dennis at a regional university, although Dennis was specifically referring to online students. In addition to their performance in teaching, established researchers believe their performance as supervisors and mentors for researchers and PhD students is valued because this leads to PhD completions, which are another source of revenue under the current funding system and generate research papers that contribute to the ERA quantum.

8.3 Summary of findings with respect to roles

This chapter has examined the roles associated with writing a conference paper to create a snapshot of how these academics are evolving in their identity as an engineering education researcher. Analysis of the roles valued by participants suggests a spectrum, with emerging researchers towards one end and established researchers towards the other. The roles most valued by the emerging researchers are in the intellectual strand of the identity-trajectory, and those of the established researchers are most aligned with interpersonal networking. The intermediate researchers are split between these two positions, except for one who focussed on roles in the institutional strand. The pressure to produce publications that count towards the institutional ERA is demonstrated by the participants' almost universal nomination of roles related to writing as important to all their universities.

This chapter highlights the difference in dialogue between emerging and established

researchers. This difference points to a process of change that emerging researchers undertake in becoming established engineering education researchers. In the next chapter I describe other differences between researchers at different levels of expertise that have become apparent from the analysis of the interview transcripts and the landscape mapping exercise.

Chapter 9. Variations in academic identity

As discussed in Chapter 3, academic identity can be thought of as three strands of identity-trajectory: intellectual, networking, and institutional. These strands interweave over time so that any one may dominate in a particular phase of a researcher's career. The examination of interview transcripts from participants with different levels of expertise shows that the discourse around each strand changes according to experience, with emerging researcher discourse generally different from that of established researchers. This was seen in the previous chapter with respect to the educator and disseminator roles for emerging and established researchers respectively. Participants' levels of agency and their horizons for action also differ with levels of expertise. In this chapter I use identity-trajectory to frame discussion of the roles, interview dialogue, and responses to the landscape mapping activity and the ways they differ with levels of expertise and types of university.

9.1 How academic identity changes with expertise

With the findings from participant interviews, their conference papers and the reviews on these papers now analysed, variations in academic identity can be described using the framework of identity-trajectory.

9.1.1 Intellectual strand development

The changes in the discourse of participants in relation to the intellectual strand demonstrates the changes in the ways engineering academics come to think about educational research and research methods. As well, there are increasing stages in the

sophistication, application and range of theoretical frameworks that individuals researchers use. Mike, for example, is typical of most of the emerging researchers in not using a theoretical framework:

That tends to be the type of engineering education and research that I tend to do ... Measure something, report on it. It's less in terms of ... looking at the theoretical framework... and I think that's maybe the challenge for engineering education researchers. [Mike, emerging, metropolitan unaligned]

By contrast, the intermediate researchers tend to compare their results to a nominated framework, as Neil describes:

I suppose we're out of the engineers' mould, there's the experimental aspect of it as well, where we actually do the tests. We do the laboratory experiments and nine times out of ten these days it involves ... surveys, or we start questioning students or staff or whatever. A statistical approach to interpreting those results and see whether it backs up the findings of other academics and ... comparing your experimental findings with the theory and ... being able to use your expertise to come to a logical conclusion. Yeah, so that's what's really important to me ... and that's what I mean by research. [Neil, intermediate, Go8]

Established researchers like Will and Erica typically have a variety of frameworks that they can apply in their research, or are developing a new framework to help people to think about their research topic in a new way:

The work that I do and the work that my PhD students do, is generally – well, it's all qualitative. [Will, established, metropolitan unaligned]

A grant that I'm involved in at the moment is looking at women in engineering in industry, so that's going back into the engineering practice ... I did women in engineering stuff 10, 12 years ago but this is a totally different perspective on it. [Erica, established, regional]

These quotes also illustrate how experience can lead to a change in attitude towards the

credibility of qualitative research methodologies. This change has been reported by Fensham (2004) in his empirical study of science education researchers: “Recognition of these qualitative methodologies for research is still quite a surprise to persons whose background is in more quantitative sciences” (p. 79).

For emerging researchers, who usually focus on problems relating to their local context, the impact they generally seek for their research is either on learning in their own subject area or on their research profile. Established researchers, however, referred to the impact of their research as the capacity of the research to cause or lead change or inform policy outside of their own institution, not for the publication count per se. They also deal with complex or big picture problems:

It's that big scale stuff that interests me more than at the course level I must admit.
[Rob, established, ATN]

The questions that I have are really sector wide but generally still within an engineering context. [Will, established, metropolitan unaligned]

Experience also alters perceptions of the quality of reviews. With their more sophisticated intellectual strand, established researchers are more able to appreciate a reviewer's expertise, or lack of it. The following three comments illustrate that established researchers generally think that review quality is poor:

Yeah, I think refereeing is ...not all that good these days. [Dennis, established regional]

Sometimes I'll put in a paper and I'll think oh, that's going to get hammered. It's crap, but I've run out of time and at least using the reviewing process will give me an opportunity to re-write it. Then it's really sad when it comes back with this is good, accept ... you think what? How did that happen? [Erica, established, regional]

Some of the reviews that I've seen sometimes I'm really surprised at ... I'm thinking good grief, come on, surely we can take a slightly wider view of the world. We don't have to be so narrow minded. I think there's an element of that.. [Stuart, established, Go8]

These comments contrast with statements from emerging and intermediate researchers who perceive that review quality is improving:

[I'm] fairly happy with the reviews I had this year ...the reviewers and the reviews that I got have improved. [Alex, emerging, regional]

I have to say, I thought the standard of the reviews were probably the best I've seen. [Adele, emerging, Go8]

Yeah, the quality of my paper improved more with these reviewer comments than any other conference paper I've ever written. [Therese, intermediate, ATN]

Not all established researchers have significant differences in their intellectual strand compared to emerging researchers. As described in Chapter 7, established researchers Rob and Steve demonstrated a practice-based pathway in the community rather than a research-based pathway. As professors, they have roles of authority in their Faculty such as ADTL, are typically involved in a range of projects and have well-developed personal networks, but they have limited personal experience of conducting research and their dialogue sometimes resembles the positivistic dialogue of emerging researchers. For example, Steve, like Mike is still looking to measure something:

Sometimes those things are hard to measure ... What we were trying to measure was almost impossible to measure ... and the review did help us I think, refine and reflect on where we wanted to go ... So it helped us focus back on – we should have asked a different research question, I think. [Steve, established, ATN]

That tends to be the type of engineering education and research that I tend to do ... Measure something, report on it. [Mike, emerging, metropolitan unaligned]

There is also further similarity in the discourses of Terry and Rob in response to reviewers' comments about the research methods or analyses used in their conference papers:

I'm looking at [a paper] here where they were talking about methodology and they just listed a whole heap of things that they were meant to have and I thought that's a fair point, I should have put that in. [Terry, emerging, metropolitan unaligned]

So I did take up on that suggestion and I went and acquired the student survey written comments and categorised them. So in the next version there's a little table that has – so I went through and categorised them ... and it turned out it was kind of interesting ... how the students' comments fell. [Rob, established, ATN]

This situation may have arisen because there are still very few strong researchers in engineering education in Australia. However, the leadership roles and the esteem with which these participants are regarded demonstrate that these practitioners are valued alongside technical researchers in the engineering education community in Australia.

Although these established researchers, Steve and Rob, may not have as sophisticated an intellectual strand as the other established researchers in this study, they do share the characteristic of having a strong interpersonal network.

9.1.2 Networking strand development

The extent of a researcher's network changes with their level of expertise. Emerging researchers typically have local interpersonal networks, with the AAEE conference a major networking event for them. Intermediate researchers develop personal networks outside of their own country, university, and engineering disciplines by attending

international conferences. Established researchers have extensive interpersonal and intertextual networks, both nationally and internationally, that support their intellectual strand. This propensity for a strong interpersonal network is demonstrated in their valuing the networking roles shown in Table 8.1 and in the relative size of the networking circles in Figure 8.1. Turner and McAlpine (2011) note how for their early career academics, networks “expanded over time as individuals had more opportunities to meet others and became more recognised for their expertise [and] networking was seen as a way to advance one’s intellectual development” (p. 51).

As researchers gain experience, the purpose of their networking strand, i.e. what they look for in their network, changes. Emerging researchers look to their network for development opportunities to learn more about doing this research. Evan is an example:

I also learn about what others do and I guess that's by attending conferences and not just about the writing. [Evan, emerging, Go8]

As Erica described it, established researchers might prefer to use a conference to communicate with peers at a “deeper level” – a phrase that implies her valuing of both the networking and intellectual strands. It is through these interpersonal discussions that they create project teams for future research:

It's really the opportunity to be able to discuss at a deeper level what's happening and what people are doing ... So it's that talking things through and then being able to create the teams to go on with other projects that will go into the future. So many grants now you need to have multiple institutions ... All of the cross institutional teams that I've become part of are because of people I've met at conferences and conversations I've had at conferences ... That's where I've developed the networks and I need the conferences to maintain the networks ... and to expand them ... So I can get so much more out of three days conversations than sitting down and reading a set of proceedings. [Erica, established, regional]

Intermediate researchers such as Therese might instead look to the network for interesting projects to work on to continue to develop their expertise:

I meet people who've got students and I say how did you get students? Have you got any students who want to come to my team? [Therese, intermediate, ATN]

Established researcher Will commented that engaging with members of the AAEE community helped him learn how to do the identity work necessary to transition from engineering academic to engineering education researcher. The phrase “intellectual home” especially indicates that Will identifies with this community on both the academic and personal levels:

I think that I've learnt a lot from the community about what it means to be an academic, and also what it means to be an academic in a very trans-disciplinary, if you like, area. How do you navigate the path of not being an engineer – or an engineering academic, but also not being a higher education research academic? How to navigate that, but also it's an intellectual home. It's like the types of questions that I'm interested in are the types of questions that a lot of them are interested in as well. So I think it's an important part of – as an academic, but also just as a person. [Will, established, metropolitan unaligned]

Comments recorded in previous chapters also demonstrate how strongly the intellectual and networking strands interact with each other (as shown in Figure 8.1), while the networking strand establishes “the intellectual location for one’s contributions” (McAlpine & Amundsen 2011, p. 180). The first two strands are largely focussed beyond the individual institution where an academic may be employed. However, the institutional environment is also important in supporting or constraining the development of academic identity.

9.1.3 Institutional strand development

For emerging researchers, the institutional strand is important because it gives them the support (time and resources) to develop the type of research they are interested in, or because it creates an environment that discourages research by not recognising their work. Institutional encouragement benefits the development of authors' networking strand by supporting them to attend conferences and their intellectual strand by providing resources at their university to support developing expertise. For these reasons the institutional strand intersects with the other strands in Figure 8.1. Some of the participants said they have this sort of explicit support from their institutions:

The school will fund you to go to AAEE conference, at the moment. So they funded four or five of us to go and we wouldn't get funded to go to another conference ... [Head of School] funds four to five people every year to go to AAEE, which he doesn't fund any other conferences. We all got \$2000 this year. [Mike, emerging, metropolitan unaligned]

The previous discipline leader was actively encouraging people to do research into education. Our previous Dean was quite keen on it as well ... So I guess you do have support because (a) there's people here I can talk to about it and (b) it is actually encouraged by people at senior levels. [Terry, emerging, metropolitan unaligned]

The background to this paper is that I was part of a writing group. We'd meet once a week for 10 weeks or 12 weeks ... So we're set tasks to do every week ... Some of us had collaborators in the group; some of us didn't ... So we'd exchange ideas within that group as well; assimilate ideas ... it was run by the people in the [Faculty-based] education research group. [Nathan, intermediate, metropolitan unaligned]

As described in Section 3.3, over the years a number of researchers have investigated the link between institutional support and researcher performance (Wood 1990, Bailey

1999, McGrail et al. 2006, Hardre et al. 2011). This support is more important for emerging and intermediate level researchers because they typically transition into this research domain from a technical engineering academic background. Established researchers, who are usually at Associate Professor and Professor level, have less need of this support because they tend to have more institutional credibility by virtue of the research output they have demonstrated over time. They can activate more institutional ‘capital’ than researchers at the Lecturer or Senior Lecturer level, or at least they are likely to have sufficient agency to resolve issues differently. For example, Rob moved university to be in a more sympathetic environment, while Erica talked about making institutional priorities “meet my priorities”.

Because of the emerging nature of this research domain, institutional support is often dependent on the attitude of a local Dean or Departmental Head with strong views on the subject. If this leader leaves the institution, support for educational research within that unit can go with them. For example, one of the faculty-based research groups that existed when I interviewed academics has since been disbanded following the appointment of a new Dean to that Faculty.

One way that institutions can support the development of their academic staff’s intellectual strand is to support research writing. McAlpine (2012a) argues that institutions should support the development of their research personnel with specific pedagogical strategies, while McGrail et al. (2006) and Murray (2013) call on universities to explicitly support writing for all academics:

It is not sufficient, therefore, for individuals to engage with writing; institutions must engage with writing too, not only by acknowledging the role of engagement with writing but also by acknowledging the role of writing in academic work. For those with responsibility for developing research capacity, the implication of this

study is that they should not assume that new researchers in all disciplines should be left to find their own way to make writing part of their work (Murray 2013, p. 90).

However, in the context of engineering education research in Australia, such institutional resources are unlikely to be forthcoming at most universities because engineering education is not regarded as 'real' research, despite our researchers producing publications for the university to 'count'. This perception of the engineering education research area also extends to the academics within it, to the point where they are regarded as not 'real' researchers. This institutional attitude is evident in these responses from emerging researchers Mark and Alex:

One of the issues that's faced is this thing about the importance or role of engineering education ... within the institution as a legitimate area to do research in ... which arises in various aspects from whether there is somewhere to record your efforts ... where you might seek research funds, so for example, if you seek research funds from ... the Office of Teaching and Learning ... the University's Research Office refuses to deal with those submissions, because it's not research. So you float around the University looking for someone important to sign your application ... they haven't got a mechanism for receiving your application, signing it and then passing it on ... the Research Office have got a very good means of putting things in front of someone important to sign off as a university signatory. But it's not research like ARC or ... industry funding sources. So that's a bit of a battle. I don't know if other universities are similar. [Mark, emerging, Go8]

We get presentations from our Office of Higher Degrees in Research about what is reportable ... anything that has learning or teaching associated with it, they tend to view fairly cynically when they're trying to determine whether it's real research. If you were testing concrete beams or something, it must be real research. But if you're not they seem to apply almost different standards because they can't quite cope with qualitative and the quantitative difference ... this seems to be a

common thing. Maybe we see it in engineering education because we see both sides of the coin. We see the technical researchers and what they do, and say well we're just as rigorous, but we seem to have different standards applied to us ... we have to justify our status much more strongly.[Alex, emerging, regional]

While the intermediate and established researchers also perceive the research area to be less valued than technical research, they are not as concerned about it as the emerging researchers who are trying to establish their institutional profiles through their engineering education research. Intermediate and established researchers will have already achieved their status through various pathways and by the time they reach Associate Professor or Professor level they may feel they can do what they want to do rather than what they are required to do. Such pathways include technical research (Therese, Neil, Stuart and Nathan), administrative/managerial roles in their university such as Discipline Head or ADTL (Neil and Therese again, also Rob, Steve, Dennis and Will), or through the quality of their engineering education research alone (Sam and Erica only).

Hatmaker (2012) examined how professional engineers discuss the various roles they enact in the workplace and notes the “hierarchy that places technical work at a higher status than interpersonal or relational work” (p. 123). Status hierarchies in the engineering professional world may influence the status hierarchy in engineering Faculties, where typical technical research is regarded as more valuable than teaching and therefore more valuable than research in engineering education. This may in part explain why the credibility of disciplinary-based education research seems harder to argue for in engineering than in mathematics and science.

For engineering academics at most Australian universities, where institutional support is

unlikely to be forthcoming, a more practicable way to facilitate researcher development is through continuing engagement with the annual AAEE conferences, or similar quality engineering education conferences. Mason (1998) echoes Dewey's (1922/2009) 'Education as engineering', when he talks about the learning process that applies just as much to researchers as it does to undergraduate students:

Insight is a personal construct that is produced through participation in an action, supported and influenced by a collegial conjecturing environment. It is coproduced, not instigated. It evolves. It is best supported by an experiential approach in which exercises are developed and honed that tend to highlight significant noticing that can then be developed into action-informing frameworks (p. 371).

In the case of engineering education researchers, the action is writing a paper that will be peer reviewed by selected members of our community and then presented to the wider community at the conference. Reviews that provide constructive feedback and conversations at the conference contribute to both personal knowledge frameworks and community negotiations of research practices.

Murray (2013) found that for many academics the process of writing was helped by engaging in "relationships with others who write" (p. 87). The AAEE community is an important space where individuals who lack institutional engineering education research groups may find other academics who write about engineering education. One of the most valuable aspects of the AAEE conference for members of the Australasian community is this opportunity to meet authors whose papers we have read/reviewed, and the potential to then pool resources and collaborate with these researchers on projects, or as Will called it, learn how to "navigate the path". The annual AAEE conference is important as place to engage with this scholarly community. Participants

who talked about intellectual isolation at their own institution strongly identified with the AAEE community: “AAEE is my second family” [Erica, established, regional]. This view of the importance of the annual conference is shared by members of other communities of engineering education researchers (Borrego et al. 2009; Jesiek et al. 2009, 2010). Isolated science education researchers have similarly reported on the importance of their conferences (Fensham 2004).

Another difference between researchers of different levels of expertise is that established researchers act as mentors for other academics and/or postgraduate research students in engineering education, while intermediate researchers talked of mentoring their colleagues but not postgraduate students. The only emerging researchers who mentioned mentoring did so with respect to teaching practice rather than research. This appears to be another step in the developmental trajectory and would also contribute to the researchers’ institutional profile since universities are paid by the government for PhD completions.

9.1.4 Development of agency and horizons for action

Researchers’ horizons for action are strongly linked to their agency as well as their intellectual and networking strands. All researchers demonstrated some agency by the ways they responded to reviewers’ comments on their conference papers, but their various levels of expertise were reflected in significant differentiation in their horizons for action.

The agency of emerging researchers was enacted by their prioritising teaching over research activity, even though they acknowledged it is research activity that will get them promoted. Even so, they placed limits on the range of their activity as an

engineering education researcher. The scope of their activity is limited by their underdeveloped intellectual and networking strands – especially the intertextual network in this case.

Intermediate researchers demonstrated agency in responding to reviews on their conference papers, with Sam, for example, contacting an Australian researcher with an international reputation when he was submitting a grant application.

The horizons for action discussed by the intermediate researchers include the intellectual strand and the institutional strand. Neil articulated the next steps in his research and Sam talked about writing journal articles and embedding research outcomes in curriculum design. Therese's horizon was dominated by the new role of Deputy Head that she would soon be undertaking at her university.

Established researchers demonstrated the most agency and the most extensive horizons for action. Like the emerging and intermediate researchers, their agency was enacted in responding to reviews of their conference papers. It extended however, to taking control of at least part of my interview in order to say what they wanted to say rather than simply answer my questions. As a result, the interviews with established researchers ranged over many aspects of the engineering education domain and the higher education sector generally. This behaviour was not demonstrated by emerging and intermediate level researchers. Established researchers also showed their agency in other ways such as writing a book and moving from a Go8 to an ATN university because the environment at the Go8 was "too competitive".

Established researchers also had the largest horizons for action, with various transformational agenda at the state, national or global level in both higher education

policy and engineering practice. By contrast, emerging and intermediate researchers typically focussed more on what was happening in the classroom.

9.2 How strand interaction changes with institution

There are fewer recognisable patterns of identity development across institution types compared to levels of expertise, since all Australian universities operate under the same government funding criteria and regulations. The few identifiable patterns are explained below. In their study of STEM professors, Cretchley et al. (2014) also report little difference in the perceptions of academics from three different types of Australian universities: “The findings were ... remarkably consistent across the three universities” (p. 649).

Participants from all types of universities commented on the pressure to publish artefacts that would contribute to their university’s ERA metrics. This pressure seemed to be felt most keenly by participants at Go8 universities. The agency of established researchers means they are more able to negotiate roles in institutions that have more supportive environments. For example, one established researcher demonstrated agentic behaviour by leaving a Go8 that he felt did not support engineering education research to join an ATN that had a much more supportive environment for the research that he prefers. This unsympathetic environment at the more prestigious Go8 universities was remarked upon by other participants, Neil being typical:

Particularly the sandstone universities ... we're supposed to go around somewhat with our noses in the air saying, we're employed from ... a sandstone university. But by the same token, we've got these enormous pressures to just churn out conference papers, journal papers ... our Head of School is incredibly research output driven. [Neil, intermediate, Go8]

Clegg (2008) has also speculated:

Less prestigious places in terms of the league tables of universities might actually allow for the emergence of new, secure, hybridised identities that are not as hampered by the overweening pressure of research productivity. (p. 341)

The two Australian universities that established discipline-specific educational research centres are a regional and an unaligned metropolitan university, and so they would be regarded as “less prestigious” than the Go8s. Emerging researchers at these two universities were able to articulate in much more detail the roles/activities they practice in being a researcher than emerging researchers at other universities. The roles they mentioned included: questioner, reader of literature, data collector, analyst, proof reader/editor, writer and re-writer, formatter, interpreter (of reviews and ethics application feedback), and host (for focus groups). Emerging researchers from other institutions mentioned either ‘researcher’ or ‘education researcher’. The granularity of description of researcher roles evident in the responses from participants in institutional disciplinary research groups (see responses of Alex, Wayne and Nathan in Table 8.1) demonstrates how the institutional strand can support the intellectual strand for these emerging researchers.

In terms of supporting the networking strand by funding academics’ attendance at AAEE conferences, such funding is usually available only to those who author a peer reviewed paper that will be published in the proceedings. Exceptions to this would be the very few institutions that have people in authority over discretionary spending who are personally sympathetic to engineering education. Even so, such discretionary spending would usually be associated with a particular role such as Associate Dean Teaching and Learning. In these cases attending the conference would not necessarily depend on presenting a paper. The type of university seems to have little relation to

such support of the networking strand.

9.3 Mapping participants area/s of activity on the engineering education research landscape

All participants could locate the topic of their conference paper on the presented model (Figure 9.1). One established researcher, Dennis, added a region of activity (secondary school system) to the model, in addition to an existing region of activity, in order to more fully represent his work. Everyone else used the model as presented and the location of all participants' stars are shown in Figure 9.1. As illustrated by the following quotations, participants at all levels were able to articulate why their star belonged in a location:

I think the way that's very much about – I'd probably try and sit it there ... because it's very much looking at social research theory and how can we put it into that educational domain. I'm hoping it will have implications for – ah actually there we go. For this, the engineering of education I guess. [Alex, emerging, regional]

What we're trying to do in this project is informed by engineering practice, so it's about what graduates are going to have to do. I am not sure if it's engineering of education. It's certainly a different way of thinking about running a class by supporting the tutor, not just the student ... I'd say if it was going to go somewhere it's kind of, well, in your diagram it fits nicely. It's kind of here and here and influenced by that one ... It's probably in this teaching and learning bit. [Sam, intermediate, regional]

I think it sits in two diagonally opposite corners and I think it sits quite clearly in both ... It's what we're getting the students to do, but it's about how we develop that assessment process so it's the engineering of it. It's the design of it in order to

meet particular requirements. So I'd say 50 per cent in each. [Erica, established, regional]

Intermediate and emerging researchers did not suggest amendments to the landscape model, but some did engage in discussion to clarify aspects of the presented model. For example:

Because I imagine the lawyers would teach differently than the business ... we're just saying we're different. The way we approach education is different to the way other disciplines approach their – which in business context they might call – culture. But as engineers we apply systems. [Therese, intermediate, ATN]

I'd have to think more deeply about this bubble. I haven't really contemplated the contents of this bubble at all. Engineering of education? Is that the politics of engineering education? Is that what you're thinking of there?... But how is this bubble different from this bubble? Teaching and learning of – are these people the same people? Who would be in here that probably wouldn't be in one of these?... Engineering practice is what? Real engineers working in industry? [Tom, emerging, Go8]

These degrees of engagement with the model reflect the different levels of agency these participants are able to enact and align with their levels of experience as engineering education researchers.

Figure 9.1 shows the locations of all the participants' stars. Most stars are clustered in the 'teaching and learning of engineering' element or on one of the trajectories leading to it. This reflects the view of many participants that their educational research is inextricably linked to their practice of engineering teaching. As a community we seem to be concerned with the impact on student learning rather than philosophies of learning, although some of us may use a particular philosophy or perspective to assess the impact of a subject design on student learning.

Subsequent to the interviews, the landscape was amended slightly by removing the central circle, locating the whole diagram in the national higher education sector, and including the secondary school system as ‘engineering in K-12’ (see Figure 9.2). This revised landscape model was used at two workshops with engineering academics, one at the 2013 AAEE conference and the other at the 2014 AAEE Winter School for researchers. Posters produced by participants and recordings of the discussion of two groups at the workshop provided additional data. One group recorded were those who located their research work in the social science neighbourhood of the landscape. This group had members with a mixture of expertise levels that ranged from emerging to established researchers. The other recording was of a group of emerging researchers who located their research in the teaching and learning neighbourhood. The emerging researchers at the 2013 conference workshop were actively seeking mentors or other forms of guidance:

I would like to have the Dummies Guide to Educational Research. [emerging, ATN]

I would like to get some collaborations going with someone who really does some educational research ... to formulate my survey question better and evaluating properly what we’ve already done. [emerging, regional]

They demonstrated intentional use of their networking strand to provide opportunities for development of the intellectual strand of themselves and others by assisting each other in identifying a useful person at the conference or making a resource available:

You should talk to ... [emerging, regional]

I have a USB from a good workshop on that – I’ll bring it tomorrow and you can download it to your laptop. [emerging, ATN]

What is also interesting to note in Figure 9.1 is that those in the teaching and learning neighbourhood are across all levels of expertise. The emerging, intermediate and established researchers and even those identifying with the social research vicinity at the 2013 AAEE conference workshop are “looking for change in teaching practices” as a result of their research. This conviction that research should be applied or implemented aligns with the engineering disciplinary outlook that still perseveres in the attitude that theoretical understandings should be interpreted or adapted to practice. In the same way that we use the findings of science in our engineering work, we should use the findings of social science in our engineering education work. This is different from becoming social science ‘clones’. Engineering education researchers should allow their perspectives and skills to contextualise their research by providing perspectives and insights that can differentiate their work from educational research in engineering.

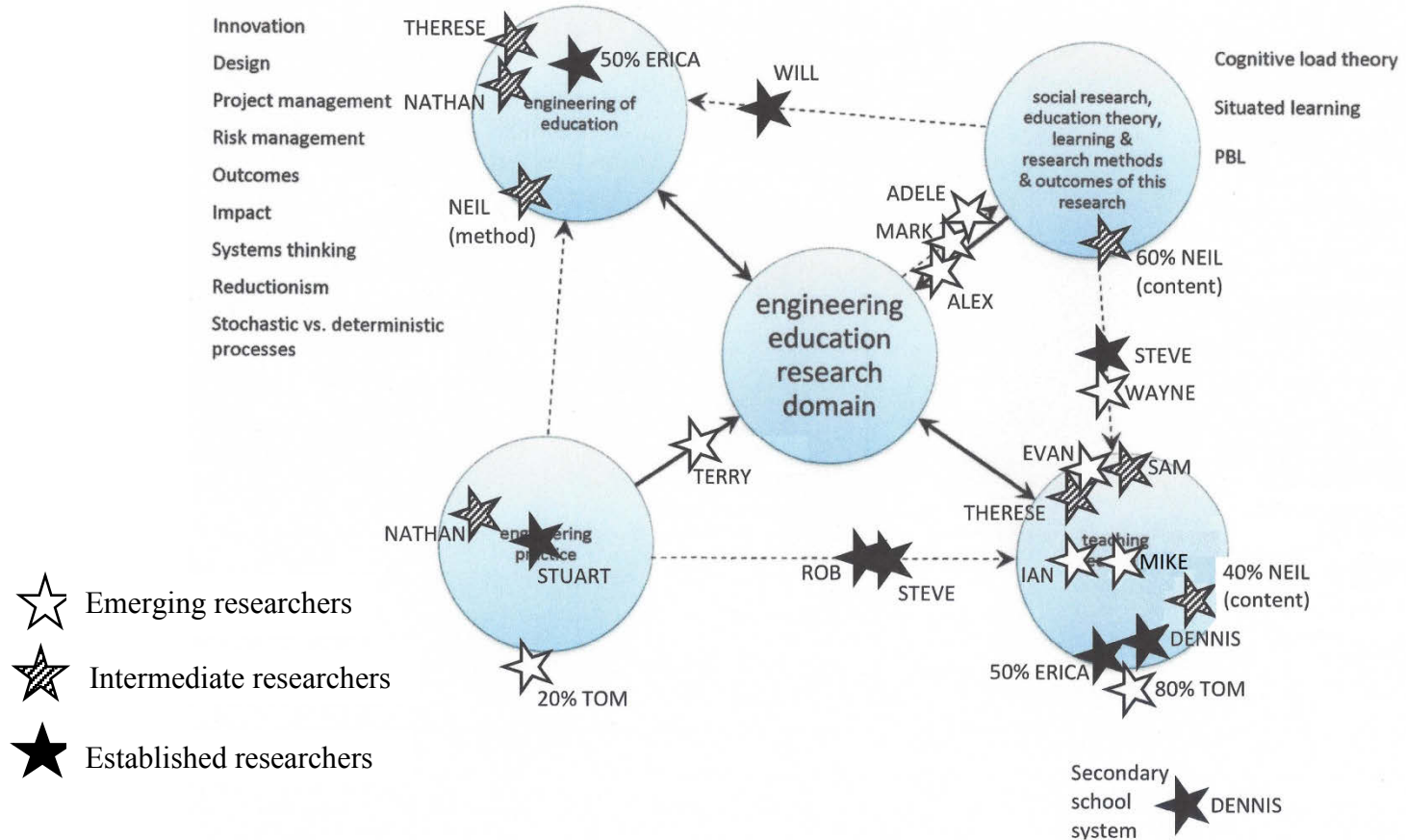


Figure 9.1: All researchers' self-location of their 2012 AAEE conference paper on the engineering education landscape model

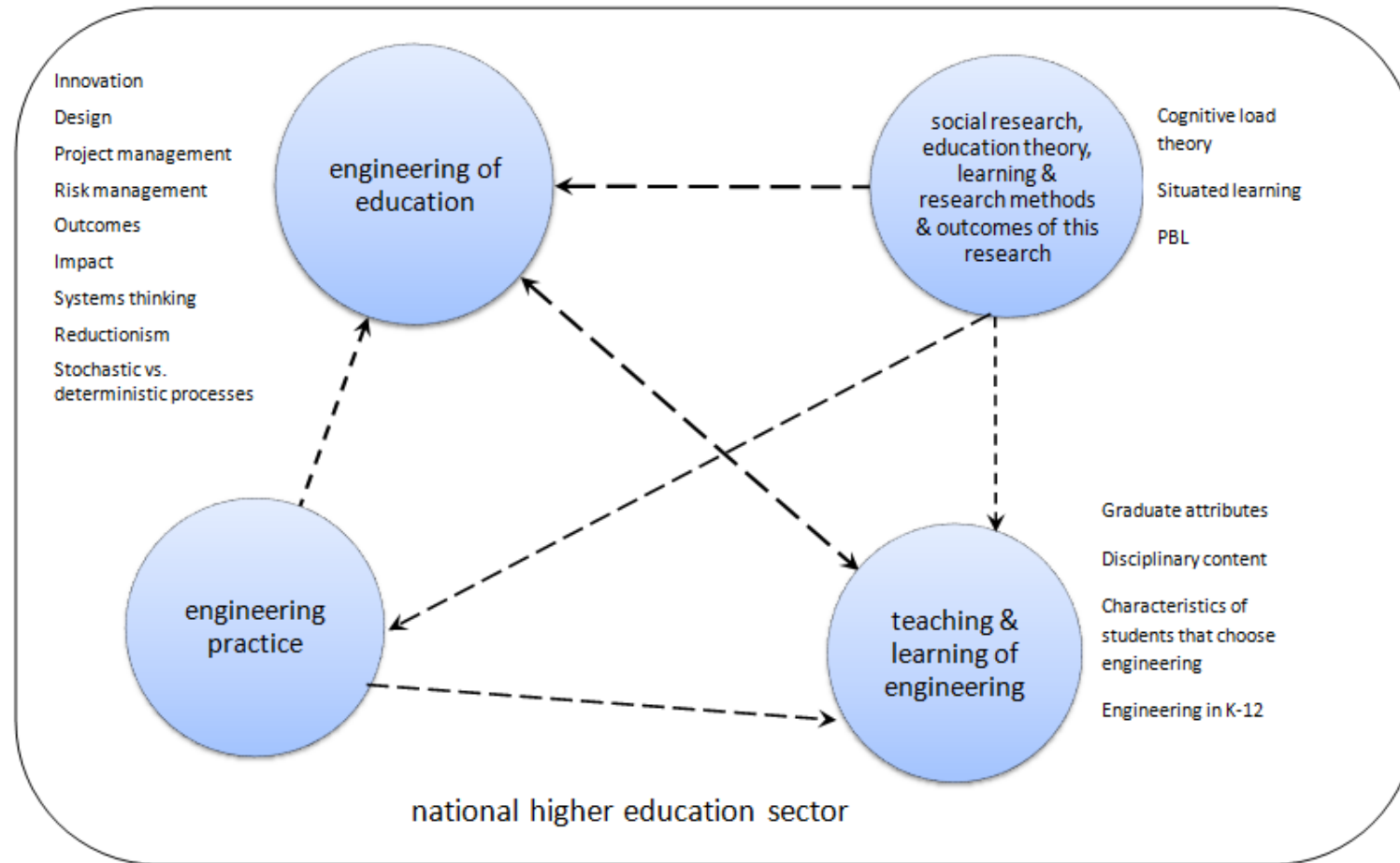


Figure 9.2: Amended engineering education research landscape model

There were strong voices from participants opposing what they interpreted as a move to privilege theoretical research at the annual AAEE conference as a means of improving the quality of research within the community in line with the hierarchy shown in Table 2.1 and reproduced below:

Table 9.1: Levels of rigor in inquiry in engineering education (after Streveler, Borrego & Smith 2007)

Level of inquiry	Attributes of academic at that level
Level 0: Teacher	Teaches as taught
Level 1: Excellent teaching	Uses accepted teaching theories and practices
Level 2: Scholarly teaching	Assesses performance informed by best practice and makes improvements
Level 3: Scholarship of teaching and learning	Engages in educational experimentation and makes results public, open to critique and evaluation.
Level 4: Rigorous research in engineering education	Is public, open to critique, asks why or how questions about learning rather than what or how much, ties questions to learning, pedagogical, or social theory and interprets results of the research in light of that theory, pays attention to design of the study and methods used.

This supposed insistence on rigor was perceived as a move towards exclusivity and a lack of acceptance for practice-based investigations and non-theoretical research, and the complaints reflect similar views reported in other locations (Jesiek et al. 2011).

These calls for the continued inclusion of practice papers in the conference came from participants across all expertise levels and university types:

We want everyone to feel part of the community and to be valued for their contributions and not get into some kind of us and them ... That's just not at all helpful. [Rob, established, ATN]

There's always been this idea that there's fundamentally two types of papers we see at the conference. What they call the show and tell paper and the research papers – the engineering research papers ... Well, but the worry of that has been that it would divide the camp into the elitists and the, if you like, the apprentices, the people that aren't quite there yet, but let's patronise them for a while. I don't think it needs to be like that at all. I mean, I would hate to divide the community. I would hate to be perceived as becoming more elite. [Neil, intermediate, Go8]

Now I think there is a place in the conference for people to report on practice. This conference seemed to take the view that ... they were trying to move to a more research based place, and downplay the practice aspect ... If you're reporting on practice ... it tells those people that they're not valued at the conference. [Mark, emerging, Go8]

If engineering education and research doesn't inform practice in Australian universities, then it's missed the point ... I got this overwhelming feeling that the people in the audience didn't feel connected to AAEE as an organisation, because they are all practitioners and AAEE seems to be running an agenda of engineering education research, which is not necessarily related to improving practice. [Mike, emerging, metropolitan, unaligned]

These arguments for inclusion were reinforced at the 2013 conference workshop, with one group asking: “How do we create an engineering education system where all people feel equally welcome to participate?”

One of the characteristics of the engineering education community is that there are members who are researchers, there are members who are practitioners (i.e. academics who teach engineering subjects to engineering students), and there are members who are both researchers and practitioners. I suggest this would be different from many engineering academic communities where there are few (if any) practitioners involved, and I agree with the view noted in an NRC report (National Research Council 2012) that theoretical research is no more important than practice-based research. Furthermore

I suggest that high-quality research can be achieved within the different parts of the landscape, as demonstrated by established researchers Erica and Dennis, whose research includes the teaching and learning of engineering. There is also scope for practitioners, as demonstrated by Rob and Steve, to become established members in the community.

I argue that our community would be better served by discussing, understanding and embracing the characteristics of quality academic writing rather than perpetuating the adversarial discourse of practice-based work versus theoretical work. The intentional use of peer review to contribute to each others' development as researchers is one way to support this quality. This view is shared by a broad range of participants of this study:

If we want to get taken seriously as a valid research sector, we as a community need to be responsible for the quality of what we put in ... All you need are a couple of really crappy papers in the conference proceedings, and it's enough to undermine. You know, people go, that was crap. So, I think ... if we want to get taken seriously, we have to be our own quality control meter. [Adele, emerging, Go8]

If you don't have a proper review process you just don't write the papers as well. You don't think as much about your own papers, you don't review the literature in such a deep way, you don't construct your argument so well, and so on and so on. So the depth of the quality of the research is much improved by having a really effective review process ... So, in terms of the profile of engineering education research, I think it's really vital that we do this. This is something that we can do as a community. [Therese, intermediate, ATN]

I think as well it's about improving the work that's going on within the community, beyond the actual paper. So if you know that in order to get published in this community, you need to have done this and done this and done this. Then I think that that would push more people to finding out how to do that better, before they even get to writing the text ... if I have to be able to describe the method and the literature that I've drawn from, and state some sort of conclusion that is in some

ways saying something to someone else in a different context, then I'm going to think differently about what I do. [Will, established, metropolitan]

The landscape allows us to conceptualise engineering education as a knowledge domain that embraces various areas of endeavour, including developing one's research literacy, as suggested by McKenna et al. (2009). It allows community members to find a home within it, instilling a sense of belonging and acceptance and an understanding of how they can contribute. It can also be used as the foundation for conversations to facilitate the social construction and subsequent shared understanding of the research community's standards and norms, including what constitutes quality research. This dialogue is important for a knowledge domain that is still emerging as a recognised area in Australian universities, and it is necessary to allow informed judgements about research quality to be made and understood. It is also important for emerging researchers who are learning the language of educational research since it is through learning this language that we frame our thoughts and consolidate our academic identity.


Hence, in contrast to Streveler et al.'s (2007) model shown in Table 9.1, I propose a developmental model that combines the landscape with an understanding of the characteristics of quality research demonstrated by the established researchers. Table 9.2 was used at the 2013 AAEE conference workshop, the 2014 AAEE Winter School and in a keynote presentation at the 2015 REES conference. The 2013 AAEE conference workshop included some of the participants interviewed in this research as well as other members of the AAEE community. The 2014 AAEE Winter School consisted of further members of the community, while the 2015 REES keynote had an audience from the international engineering education community. In each situation Table 9.2 allowed participants to evaluate their level of expertise against the

characteristics of the researchers interviewed in this study. After the 2015 REES keynote, members of the audience described how they intended to use Table 9.2 at their own institutions with developing researchers. Such a model encourages improvements in quality of the studies in all areas of the landscape, rather than the perception that improvement can be achieved by adopting a specific approach or can only be achieved by moving to a particular area within the landscape.

Open discussion and engagement with such a model could also help individuals to articulate and understand observed changes in their own and their peers' research as expertise is developed. It may also facilitate development of a language for researchers, particularly those new to the field, that enables them to plan, discuss and evaluate this progression. An initial step would be an acknowledgement by our community that the quality of a researcher's work is not related to its position on the landscape, nor the type of research, but rather is a characteristic of the processes, methods, thinking and interpretation applied in the researcher's investigation. Similar sorts of tensions appear in general higher education research, for example, Harland's (2009) discussion of developmental aims versus ideas about quality in research, and Rowland's (2009) response to Harland.

To be a community we need to socially construct our understanding of the standards and norms in our field of research. We need a way of personally evaluating our own research and determining the changes we may need to make in its level of sophistication or subject matter. The landscape also allows us to identify other community members working in the same vicinity and hence identify potential mentors and/or collaborators to help us develop as individual researchers and consequently the research field we work in.

Table 9.2: Table for Researcher Self-evaluation

Increasing expertise 			
Focus of Research Questions	Research and publications often about their own work	Looking to generalise their classroom experiences &/or use more than one perspective	Broad, sector-wide questions
Range of Methods Used	small range of methods used	Developing experience with chosen methods quantitative and /or qualitative	Comfortable with different theoretical methods
Research Instruments	Survey most common research instrument used	Wider use of instruments including interviews, observations, document analysis etc	Wider use of instruments aligned to selected method/s
Data Analysis	Percentage of respondents and/or supporting free response comments most common	descriptive statistical analysis (quantitative) and/or thematic analysis of interview transcripts (qualitative) most common	Analysis method usually determined to align with the theoretical perspective used to investigate problem
Research outcomes	Results inform the specific research context, invisible contextual variables often not considered or made explicit	Results can be transferred to and/or inform different contexts	Results can be generalised or inform different contexts &/or contribute to theory development
Understanding of Discipline theories	Educational theories often referred to in literature review but not used as lens for research analysis	Reference to educational theories in analysis and interpretation	Educational theories drive data collection, analysis and interpretation
Understanding of Discipline language	Learning the educational language: epistemology, pedagogy, phenomenography, thematic analysis, ethnography, hermeneutics etc	Familiar enough with educational language to talk to peers in engineering education	Understanding of educational language sufficient to allow its use for debate, critique and analysis with others outside engineering education
Extent of Peer Network	Local peer research network typically within engineering	Developing wider peer network largely within engineering education	Well developed peer network including education researchers from other disciplines
Funding source	Self funded or local (School/Faculty) teaching and learning grant	University grant or national teaching and learning grant	National competitive or externally funded research grants often involving cross disciplinary collaboration

The comments made by both interview and workshop participants reinforce the importance of the annual conference for researchers at all levels of expertise. At the AAEE 2013 workshop, one participant spoke about a realisation of “what a rare event it is – feeling like people will help me with my research”, and another said, “I appreciated the mentoring, sharing issues and hearing some wisdom come back”. Other across-the-board comments highlighted the difficulties of being a lone active engineering education researcher in their institution. One conference participant said:

It’s a big thing for me coming to this here, for my first time, so many people are doing so many things but I’ve got no other way that I’d know about that.

All these participants could locate their paper on the engineering education landscape shown in Figure 4.3. The landscape provides a different way of characterising papers compared to the hierarchical model of Table 9.1 and shows the range of topics academics in engineering education are involved in. Framing the community’s discussion this way can help dissipate some of the tensions developing in AAEE about theoretical papers being more valuable than practice-based papers. In not having such a discussion we run the risk that the discourse will serve to perpetuate the researcher vs. teacher stereotypes of academic practice and prolong the argument about what constitutes ‘real’ research. By showing the range of topics that engineering education authors are writing about, a landscape model can also be used to demonstrate that engineering education is a knowledge domain that includes various areas of endeavour and hence cannot be pigeon-holed as any one type of inquiry. In the interviews reported in this study, the landscape model successfully stimulated dialogue about the topics of concern to our community and allowed people to find a home in the landscape. This dialogue is important for the identity of a knowledge domain that is still emerging as a recognised area of scholarship in Australian universities (King 2008; Kavanagh et al.

2012), particularly when government policies propagate the view of research as a commodity. As Brew (2001) has commented: “This is particularly worrying in some of the newer disciplines and in education ... where researchers may be endeavouring to establish new forms of inquiry” (p. 283).

9.4 Summary

Using the identity trajectory has revealed differences between the various categories of researchers. Emerging researchers are paying close attention to aspects of the intellectual strand development as they transition to the new research paradigm of engineering education, but many are still looking to ‘measure’ something. This transition includes learning not only about different research methods but also the language of being a researcher. Intermediate researchers are developing the interpersonal networks they need to be established researchers, and value being in leadership roles, rather than being a team member. Their research is either motivated by a desire to better understand an issue, or to publish an artefact that has value in developing their track record as an educational researcher.

Established researchers have strong personal agency and horizons for action that encompass their national or international transformation agenda. They also have better developed interpersonal and intertextual networks than intermediate and emerging researchers. They also value their mentoring roles, whether formally or informally conducted. All established researchers have strong institutional profiles and positions of authority, such as professors or ADTL. In some cases, for both established and intermediate researchers this institutional strand seems to be more important to them than their intellectual strand development. Development of researchers’ intellectual and networking strands seems best supported at universities that have an engineering

education research group.

The engineering education research landscape model appears to be a valid stimulus for dialogue about the extent of the research domain. It has facilitated discussion around locations in the landscape that researchers can relate to. Such dialogue will help individual researchers identify their contributions to the research domain and support their colleagues and postgraduate students as they undergo the transformation to engineering education researchers.

The landscape can be used to dissipate some of the tension that has recently developed in our community over the perception that theoretical research is being prioritised over practice-based research. I would argue that the practice vs. research dichotomy is ultimately divisive. There are people in our community whose practice is the education of engineering students, some whose practice is the research of engineering education, and others who practice both. Wherever these practitioners are on the landscape, our national conference should provide them with both a forum for communication and an environment that helps them develop their academic identities and improve the quality of their publications.

Chapter 10. Recommendations

Borrego and Streveler (2014) argue that because of the emerging nature of engineering education as a research domain and the “conceptual hurdles” that engineering academics face in transitioning to a different type of research, there is a “need to support engineering educators as they learn to conduct inquiry” (p. 466). In this chapter I outline my recommendations for supporting engineering educators. There are three sets of recommendations, each varying according to stakeholder responsibilities and practices:

- individual engineering researchers
- faculties of engineering and universities
- professional associations such as AAEE.

I also discuss implications for further research.

10.1 Recommendations for individual engineering education researchers and reviewers

Another important source of one’s own identity are stories about others. (Sfard & Prusak 2005, p. 18)

The recommendations for individual researchers are addressed to those engineering academics seeking to develop their expertise in engineering education research, rather than just focussing on increasing their publication count. In the process of contributing to the annual conference there are two main roles that individuals carry out – as an author of a conference paper and as a reviewer of others’ papers. The sections below include recommendations that apply to each of these roles. Relationships with other members of the research community are important for both of these roles, not only for cognitive development but also for professional development through sharing stories about how engineering academics are being and becoming engineering education researchers.

10.1.1 As an author

To author a paper for the AAEE annual conference, or any similar engineering education conference, an academic must first have conducted some research associated with the education of engineers or evaluated some related practices. The following recommendations focus on supporting less experienced researchers to develop their research writing skills.

Recommendation 1. It is useful to recognise that engineering education involves a research paradigm that is different from typical engineering fields and it will therefore require negotiation of unfamiliar research methodologies, perspectives and language. This takes time, energy and application to master. The self-evaluation guide in Table 9.2 is designed to help researchers identify their level of expertise as well as areas that need improvement. When the individual has identified an area to improve, it is recommended they begin by reading about that aspect of the research using guides produced by authorities such as the UK Higher Education Academy's Engineering Subject Centre and the American National Science Foundation. Continue reading related articles from the engineering education literature such as the European Journal of Engineering Education, the Australasian Journal of Engineering Education and the International Journal of Engineering Education and work up to the Journal of Engineering Education. Throughout this reading, take note of the research questions posed, any theoretical perspectives used, the types of data used and the methods for collecting and analysing them. This will highlight the similarities to and differences from typical engineering research. These activities will also help the individual to develop both their intellectual strand and their intertextual network, which are strongly interconnected.

Recommendation 2. Working with other people provides opportunities to use the language and concepts appropriate to the new research area and build an interpersonal network. Therefore, it is recommended that researchers find a colleague to work with who is interested in similar academic work. Ideally this colleague would be from the same university campus to maximise the opportunities for discussion and because it is usually simpler to work with someone who is operating under the same institutional system of constraints. However a research project with a colleague at another university might lend itself to comparison-type research, which is a common starting point for many studies. Finding a mentor with a social science background is also extremely useful for learning about current learning theories and research methodologies.

Recommendation 3. Most engineering academics appreciate the value of learning by doing. This applies to publishing in engineering education as well. It is recommended that from the beginning of a project, researchers include writing about a study as part of the project plan. Even if a particular paper is never published, much more can be learned from having to write it up than if the writing were neglected. What is learned in the writing process can then be applied in the next study.

Recommendation 4. Submitting papers to the AAEE conference, or a similar quality engineering education conference, is a way for researchers to receive feedback on their work through the review process. Even looking at the review criteria indicates what is expected in a conference paper in this research field. It is recommended that authors take notice of what reviewers say, even if they appear to have misinterpreted the nature of the work. This should prompt thinking about how future papers may be written so that readers can appreciate the authors' intentions.

Recommendation 5. It is recommended that authors read any literature suggested by members of their research community, even if it seems to not apply to their work. To think about and articulate why one reads particular sorts of literature is a valuable process which contributes to both intellectual and intertextual networking strand development. Participants of this research study identified the characteristics of a good quality conference paper as:

- The paper would be of benefit to others.
- The paper cited literature which provided background to the work and identified a question to be addressed.
- Sound methodology is described.
- There is a clear explanation of what was done and the structure supports the explanation.
- Conclusions are supported by evidence.
- The language was of a professional standard.

These are not unusual criteria for academic publications; the significance is that they have come from the community emerging researchers are trying to join.

Recommendation 6. It is strongly recommended that authors take every opportunity to talk with other engineering education researchers. This allows them not only to learn about what it is to be this type of researcher, but also to develop, through dialogue, their identities as researchers in engineering education.

10.1.2 As a reviewer

Undertaking a peer review of a conference paper is a learning opportunity for both the reviewer and the author of the paper. Since the peer review process has implications for the identity development of both individual researchers in the field and for the field overall, reviewers should pay attention to how they write reviews and try to provide

constructive advice for the author/s, rather than just producing artefacts of compliance. The review process for conference papers is one way for novice researchers to gain exposure to the expertise of established researchers and is especially valuable for novice researchers who are geographically or institutionally isolated from other members of the community. The following recommendations are intended to challenge established researchers to use the review process to be leaders and grow the community's expertise.

Recommendation 7. The participants in this research study said they were looking to reviewers to provide the sort of feedback on their papers that would enable them to improve it. They identified a number of characteristics of good reviews. It is therefore recommended that when giving feedback, reviewers:

- start with a positive statement about some aspect of the paper
- suggest relevant references
- critique methodology and data collection
- be frank about weaknesses in the paper
- be specific in suggesting solutions to paper deficiencies
- explain the reviewers' opinions
- critique written expression, spelling and grammar.

Recommendation 8. It is recommended that reviewers note that authors appreciate detailed and specific feedback, even though not all authors will act on all feedback provided. So while high quality reviews won't always act as enablers, poor quality reviews are likely to constrain those emerging researchers who are trying to improve their research. Focussing in particular on how authors describe their research methodologies will generate learning opportunities for both authors and reviewers.

10.2 Recommendations for Faculties of Engineering and Universities

Universities should note that authors in this study who made substantial changes

between the reviewed and final versions of their paper were those working at universities with a research group in engineering education. These research groups provide institutional support for the development of both the intellectual and networking strands of academic identity and hence it is the institution's own interest to enable academics' development as educational researchers for potential publication and grant outcomes. Institutional environments also impacted on our researchers' horizons for action, although this effect is mediated by the individual's agency.

Recommendation 9. It is recommended that engineering faculties create structures to allow a range of identity trajectories to flourish rather than the cookie-cutter approach of only rewarding one type of academic. Institutions lacking a research centre in engineering education can still support their engineering education research staff by devising strategies that support them to develop their academic writing and explicitly signalling that this type of research is valued by the faculty. This supports staff in the development of their academic identity as educational researchers which, in turn, will lead to more staff productivity since staff who feel supported by their institution are more productive.

McAlpine (2012a) recommends explicitly devising strategies to develop academic writing as a way to support staff development because it is such a fundamental aspect of developing academic identity. I suggest that the language associated with such strategies would do well to align with Lee and Boud's (2009) suggestion of research being seen as a site for learning:

Research itself becomes 'pedagogical', a term we take to refer to a deliberate focus on the educative dimension of research activity ... research activity needs to become explicitly a site and an opportunity for learning and development. (p. 98)

Recommendation 10. Academic staff who research engineering education are often recognised in their own institution as innovative teachers. It would be tempting for anyone accountable for the quality of teaching and learning in a university to burden these academics with the responsibility of mentoring their colleagues. It is therefore recommended that such academics be allowed space and time to have dialogue with other engineering education researchers so that they can consolidate their academic identity, deepen their skillset and broaden their network.

10.3 Recommendations for professional associations

In the Australian context the dominant professional association for engineering educators is AAEE. While the AAEE Executive had been trying to improve the quality of papers at the conference, this study has found that the AAEE review criteria document has come to be perceived as embodying a movement towards preferencing theoretical research over practice-based papers that has been brewing in the community for some time. We are yet to have an open and inclusive discussion in the community about the characteristics of quality of a paper, rather than being side-tracked by a perceived hierarchy in the type of research undertaken.

Recommendation 11. It is recommended that the Association continue clarifying its expectations for both the authors of conference papers and reviewers. Providing exemplars of both papers and reviews would assist members of the community to benchmark their efforts and provide stimuli for discussion about both of these types of writing. The Association should also continue to hold workshops, along with the Winter School, to provide emerging researchers with opportunities to continue their identity development.

Recommendation 12. The peer review process for conference papers is controlled by the AAEE, which therefore has a role to play in generating expectations that members will hold each accountable for meeting the review criteria. This study suggests that the Association may serve to improve the research field in the longer term by encouraging harsh decisions – including ‘reject’ when appropriate – provided the reviewer’s decision is accompanied by supportive constructive feedback. This has the potential to cause conceptual conflict, but the subsequent new understandings should contribute to the development of an author’s intellectual strand. It is therefore recommended that AAEE remind reviewers to provide frank and specific, yet supportive, peer review. For example, established researchers noted a lack of knowledge of existing literature in many of the papers they reviewed or listened to at the conference – being familiar with the relevant literature is a basic characteristic of scholarship.

Recommendation 13. The intentional use of peer review to contribute to each others’ development as researchers also has implications for lifting the profile of the engineering education community in general and the AAEE community in particular. It is recommended the Association make available to all reviewers the other reviews on the papers they reviewed, once they have submitted their review. This would allow reviewers to benchmark their thinking with the other reviewers and would be especially useful for our emerging researchers as they learn about the research area and learn how to write reviews. This procedure is practised in some journals.

Recommendation 14: For AAEE conference organisers and the AAEE community at large, continuing the practice versus theoretical research argument is likely to be counterproductive to developing the expertise of community members and growing the membership numbers. Inferences that the conference should only accept theoretical ‘research’ papers may continue to exclude many members of the community, since

‘practice’ is the typical pathway into the field for engineering academics. It is recommended, therefore, that our national conference provides a forum to support the transition of these practitioners and their continuing development of expertise in systemic inquiry by encouraging quality scholarship in our publications, regardless of whether it is theoretical or practice-based.

10.4 Implications for further research

This section contains implications for further research that were identified in the course of undertaking this study.

10.4.1 Alternative methods of data collection

One of the constraints on this study is that I interviewed participants once, rather than undertake a longitudinal study designed to see time-related changes to their views of themselves and their work, as was undertaken by McAlpine and her colleagues (McAlpine, Amundsen & Jazvac-Martek 2010; McAlpine & Lucas 2011; McAlpine & Amundsen 2011; McAlpine & Turner 2012; McAlpine, Amundsen & Turner 2013a, b). In developing the identity-trajectory framework, these researchers constructed individual narratives of their research subjects from the longitudinal data. However other identity researchers (e.g. McLean & Pasupathi 2012) argue that in narrating everyday and important events, such as receiving reviews on a conference paper, identity is developed and sustained. In my study, the snapshot sampling of participants at different levels of expertise is intended to provide, in a shorter timeframe, insights approaching those of a longitudinal study by using the themes relating to identity-trajectory, especially the strands that relate specifically to the academic context (intellectual, networking and institutional). However, further insights are likely to be gained from a longitudinal study.

10.4.2 Sampling of female academics

The identity-trajectory concept does not explicitly acknowledge differences in academic identity development such as individual ethnicity, cultural background or gender.

Because it focuses on the experience of the individual rather than the group, identity-trajectory does not fit into the social identity and self-categorization models or conceptualisations of identity (Hogg, Terry & White 1995). These ways of thinking about identity, in contrast to identity-trajectory, place the emphasis on the influence of society on an individual's behaviour and construct of self. According to these perspectives, people come to know who they are through their interactions with others in society. While some of our interview transcripts allude to one or another of these aspects, they are not the major focus of this study, although they would be interesting extensions of it.

Cretchley et al. (2014) report in a recent study of STEM professoriate that in engineering departments: "Men dominated in the ratio of five to one" (p. 656). Gender differences in academic identity development would be particularly interesting to explore since there is significant gender disparity in most sectors of engineering practice and education in the Australian context, as there is in the US (Jorgenson 2002).

I was disappointed that I could not identify a sufficient number of female academics who met our sampling criteria in order to get an equal gender representation in this research. However, the 20% female participation that was achieved is only slightly greater than the proportion of female academics in engineering across the nation (See Table 10.1).

Table 10.1: Percentage of female academics (all levels) in engineering in Australian universities

Year	% of female academics in engineering	Source
2006	14	King 2008
2009	15.5	Dobson 2012

I note that seven women I included on my initial list of potential interviewees (that is they had submitted to two of the last three AAEE conferences) did not submit a fully reviewed paper at the 2012 conference. This prompts two questions about why this happened:

- Was it because of the perceived shift towards research type publications for the AAEE conference?
- Was it because women are over-represented in Faculty administration or management roles and so have no time to do the research required to be able to write a conference paper?

Several recent studies have demonstrated that women spend more time teaching undergraduates and performing service and administration duties (Bozeman & Gaughan 2011; Misra et al. 2011) and that this creates resentment and poor workplace culture (Kavanagh et al. 2012). Cretchley et al. 2014 note in their survey of STEM professors that there were “substantial gender differences, with women indicating higher job satisfaction from [learning and teaching] activity than men” (p. 657). The previously identified female AAEE members still came to the conference, presented work in progress papers or ran workshops, but did not contribute to a peer-reviewed paper. Their attendance suggests they are still interested in engineering education, but are not always in a position to ‘do’ research.

10.4.3 Other aspects of academic practice

This research focused on one aspect of academic practice, namely research. It could be

extended to encompass other aspects of academic practice such as teaching and service roles. It would be interesting, for example, to compare the experiences of engineering education researchers in these roles with those of engineering academics undertaking more typical engineering research to investigate how making the choice to a type of researcher influences other aspects of academic practice.

10.4.4 Other cohorts in the engineering education community

While I have concentrated on the members of the AAEE community transitioning from typical engineering research areas into engineering education research, this community also enjoys the participation of researchers with disciplinary backgrounds other than engineering. The identity transformations of these individuals in becoming engineering education researchers is still to be explored.

10.4.5 Influence of prior industrial experience on academic participation in a research domain

I noted in the course of my interviews that a number of participants had had significant industrial experience before becoming academics, for example, Stuart, Adele, Alex, and Nathan. These participants have woven this history into their narratives of personal experience. It would be interesting to investigate the influence of academics' prior industrial experience on their participation in typical engineering research domains. In particular, it would be useful to find out whether people enter academia from industry with the objective of contributing to improving the calibre of young engineers and so gravitate to engineering education research.

10.4.6 Characterising identity development in typical engineering research domains

It would also be an interesting extension of this work to use the identity-trajectory framework to characterise the identity development of researchers in typical engineering research domains such as structural engineering or control theory. A comparison of the dimensions of the intellectual, networking and institutional strands between typical engineering researchers and engineering education researchers would likely provide additional insights into how the development of how all these researchers can be supported. Research using the identity-trajectory is eminently transferable to other contexts.

Chapter 11. Conclusions

This chapter provides a summary of the research undertaken and the conclusions that have come from the findings of this research. These conclusions have been reached by using the identity-trajectory concept as a framework for this research, which seeks to understand those engineering academics who want to improve the quality of their research in engineering education.

The use of the identity-trajectory framework has provided insights into appreciating the inter-relationships between the intellectual, networking and institutional aspects of academic identity construction of members of the engineering education community in Australia. Awareness of the distributed nature of identity formation supports the transformation from engineering academic to engineering education researcher. This analysis demonstrates the influence of the networking and institutional strands to intellectual development of engineering academics engaged in this transition.

The identity-trajectory theory was developed from the experiences of postgraduate students and early-career researchers. This study demonstrates that the identity-trajectory theory offers insights into how the engineering education field can sustain not only experienced researchers but also transdisciplinary researchers at all levels of expertise, for example, researchers whose trajectories are going in directions different from when they started their academic careers.

As an analytical tool, the academic strands (intellectual, networking and institutional) generate insights into academic identity development for the emerging, intermediate and established researchers. Combining these with findings related to agency and horizons for action contributes more understanding to the differences in academic identity

development between researchers at various levels of expertise. However, comments relating to personal context and personal history were more difficult to separate from the other aspects of the theory because of the pervasive nature of these constructs.

The process of writing a paper for the annual AAEE conference, which includes carrying out the study and negotiating the peer reviews, allows an individual to develop the intellectual and intertextual networking strands of their academic identity. For emerging researchers, aspects of the intellectual strand dominate, especially in relation to the initial reliance on, and subsequent dissatisfaction with, quantitative research methods (see section 5.2.1). Emerging researchers are yet to develop a diverse and extensive network, either personal or textual. Because there is little institutional support for this research in most Australian universities, many of them are undertaking their research in the domain of engineering education despite the lack of support from their university rather than because of it. For those without institutional support for their research area, the intertextual and interpersonal support available at the annual AAEE conference is an important alternative. Peer review contributes to emerging researchers' intertextual networking strand and impacts their intellectual strand as well. Although these researchers demonstrated some agency with respect to choosing this area of research and responding to reviewers' comments, their horizons for action were often limited by how they envisage participation in engineering education as a researcher and author. The constraints they imposed on their own participation are based on their views of the engineering research paradigm and are strongly linked to the development of the intellectual strand of their identity-trajectory.

Intermediate researchers show capacity for collecting and analysing data in ways that go beyond statistics – their interviews included discussion of numerical and non-numerical data and illustrate a progressive understanding of the contribution of qualitative research

methods to explaining the phenomena of interest in an educational context. Most have also started to develop multiple areas of research activity in the field. Intermediate researchers are developing interpersonal networks outside of their discipline and beyond their own universities as they seek information and cultivate new perspectives. That they are developing intertextual networks is evidenced by the links made between academic reading and writing. They demonstrated agency with respect to their intellectual, networking and institutional strands, and their horizons for action encompassed the intellectual and institutional strands.

Established researchers favour qualitative research methods but still use and demonstrate understanding of statistical analysis methods when relevant. This is a major point of difference to the emerging researchers. These experienced academics make intellectual contributions to the field by using a variety of perspectives that they apply to projects and research questions. All of the established researchers interviewed have extensive personal networks that they can draw on for guidance or for forming project teams when applying for nationally competitive grant funding. They value diversity in these networks, which include academics from other universities and countries as well as other disciplines. The personal networks of these researchers are strongly interconnected to their intertextual networks, which extend beyond the AAEE conference to international conferences and journals – another major point of difference to the emerging researchers. Established researchers tend to be in a position of authority at their own university, or they demonstrate leadership by mentoring colleagues and PhD students. These researchers demonstrate strong agency by, for example, changing where they work, initiating industry forums, writing books and applying for large grants. As a result of their strong agency and well developed intellectual, networking and institutional strands, these researchers have horizons for action that encompass

changes in policy or practice, both nationally and internationally.

While participants at all levels of expertise and type of university refer to pressure from university administrators to publish, they also say that engineering education research is not generally valued as a research area. This creates a climate where those academics who personally value both the aims of engineering education and the research it generates are the ones who remain in the field, often demonstrating strong agency as they negotiate institutional structures to do so.

The continuing importance of the AAEE conference for the intellectual and networking strands of its community is apparent for all the research participants, although in different ways. As part of the conference experience, both responding to reviews and writing reviews contribute to the development of the intellectual and networking strands of participants' academic identity as engineering education researchers. In particular, they value the peer review process because it not only improves their writing and research design, it also contributes to the development of the field.

Discussion of conference paper reviews illustrated this tension between theoretical research and practice-based papers when reviewers were accused of interpreting the 2012 AAEE conference review criteria to exclude practice-based papers. There were negative opinions about any move by AAEE to make the conference exclusively for theoretical research.

The engineering education research landscape model, presented in this study, appears to be a valid stimulus for dialogue about the research domain. Such a dialogue will help us identify our research areas and network with other researchers, thus providing opportunities to build our academic identity as a particular type of researcher. It has already been used to dissipate some of the tension in the AAEE community around the

theory versus practice dichotomy by changing the focus of the conversation to how individuals can intentionally develop a sense of themselves and others as researchers, wherever they are on the landscape.

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Appendix I: Categorisation of participants as either an emerging, intermediate or established researcher

Participants were categorised as emerging, intermediate or established based on the number of different types of publications they authored and other researcher activity for the time period from 2009 to 2012 as shown in the table on the following page.

The publication types that were counted include AAEE conference papers, overseas engineering education conference papers, journal papers, book chapters, and books. For both domestic and international conferences the scores are recorded in rows where n is the number of papers. The absolute values of the scoring system are much less important than the relative values which have been allocated in an attempt to reflect the expected contribution from that type of publication. If a participant is the first author on any paper the score for that paper is multiplied by 2 since conventionally the first author is also the principal researcher. Journal papers and book chapters generally require a higher standard of work than conference papers so these are scored as twice as much as a conference paper with additional score for first authors. Books are scored at three times as much as conference papers.

Research activities included being project leader for a project that was funded through an external competitive process such as for ARC and OLT grants, supervising PhD students, and being an editor or associate editor for an engineering education related journal.

Using this categorisation system only established researchers supervised PhD students or served on editorial boards for journals. They have also been the project leader for multiple grants and mostly authored between 5 and 10 papers for overseas engineering education conferences between 2009 and 2012. Overseas conference attendance is likely to reflect the institutional profile of these researchers since more institutional resources are required to send a staff member overseas than for a domestic conference. Intermediate researchers tend to have fewer overseas conference papers than the established researchers. Although Nathan has scored highly for journals, he has very few conference papers and no other research activity recorded so was categorised as intermediate. Only three of the emerging researchers are listed as co-authors of overseas conference papers and only two of them have co-authored journal articles or a book chapter.

	Emerging Researchers									Intermediate Researchers				Established Researchers					
Pseudonym	Tom	Terry	Mike	Ian	Adele	Evan	Wayne	Mark	Alex	Neil	Therese	Sam	Nathan	Will	Erica	Dennis	Steve	Stuart	Rob
AAEE conference publications since 2009 (first author x 2)																			
< 5	2	6	7	7				6					4						
5 > n < 10					8	8	10		10		9			10	10		9	10	10
> 10										10		10				10			
overseas EE conference publications since 2009 (first author x 2)																			
< 5	0	0	0	0	0	0	1	2	2	1	1	6	1		8				
5 > n < 10														9		10	8	10	5
> 10																			
journal paper / book chapter (x 2 for each + 2 if first author)																			
< 5	0	0	0	0	0	2	0	4	0	2	8	2	24	10	6	8	8	12	12
5 > n < 10																			
> 10																			
book (x 3 for each + 1 if first author)																			
< 5	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
5 > n < 10																			
> 10																			
external competitive grant leader (x3)																			
< 5	0	0	0	0	0	0	0	0	0	0	0	3	0	0	6	6	6	0	6
5 > n < 10																			
> 10																			
supervising PhD students (x 4)																			
< 5	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	4
5 > n < 10																			
> 10																			
assoc. editor/editor (x3)																			
< 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	3
5 > n < 10																			
> 10																			
TOTAL	2	6	7	7	8	10	11	12	12	16	18	21	29	33	33	34	34	36	40

Appendix II: Interview protocol

The semi-structured interview involved a series of activities and lines of questioning as shown on the following page.

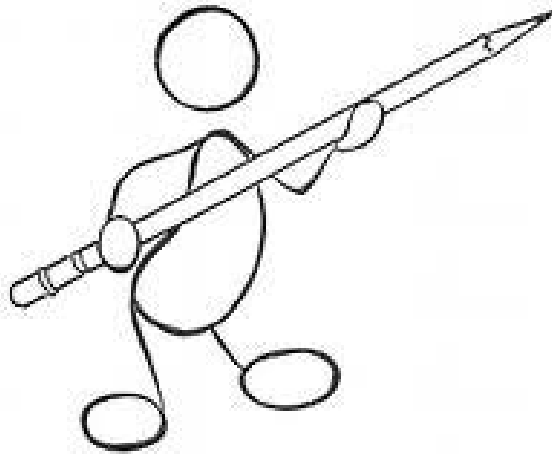
After signing the consent form, participants were asked to write the roles they enact in the process of producing a conference paper around the writer stick figure illustrated in Figure II.1. Example roles generated during the interview piloting process were included at the bottom of the page to give participants a better idea of what I was asking them to do. On the back of this sheet of paper participants were asked to list the three researcher roles that were most important to them, and then those that were most important to their university. The roles listed in this activity were interpreted through the lens of identity-trajectory like the following discussion.

After listing and discussion of these roles the interview process changed to discussion of the participants' 2012 AAEE conference paper and the changes they made to it as a result of comments from reviewers as well as discussion of the reviews themselves. Discussion of participants' 2012 AAEE conference paper was rounded out by asking them to place a sticker of a star on the engineering education landscape model at the location where they felt their conference paper most belonged. The interview concluded with discussion of who they talk to about engineering education.

Please note that the "1 page rejoinder" item 3.b on the following page refers to author responses to comments by peer reviewers for those papers which were accepted with 'major' revisions to the 2012 AAEE conference.

Interview process

1. Talk about project information sheet and ask for signature on consent form
2. Stick figure and landscape model
 - a. What aspects of the academic writing process do you relate to – write around stick figure
 - b. List these on the back of the stick figure in order of importance to you
 - c. Go through top few – why are these important to you?
 - d. List on the back in order of importance to your university.
3. Talk about abstract, draft, review, final submission process
 - a. Relationship between review comments and process for producing final paper
 - b. Did you do the 1 page rejoinder
 - c. How did you find the structured abstract
 - d. How useful were the review criteria this year as reviewer/as author
 - e. What effect does being a reviewer have on you as an author – vice versa?
4. Landscape model
 - a. Choose a star sticker and stick it where you think your paper belongs on the research landscape model.
 - b. Why does it belong there?
 - c. Is this where most of your publications would be on the landscape?
5. Networking
 - a. Who do you talk to about your educational issues?
 - b. What sorts of things do you talk about
 - c. Who do you collaborate with & on what types of projects?
 - d. How would your HOS describe what you do?
6. What % of your publication record is in engineering education?
 - a. What other engineering education conferences have you published/attended in the last 3 years?



Technical specialist		reader of published works
Mentor (eg of postgrad. student/s)		reviewer
Disseminator of research findings		author/ writer
Educational researcher		grant applicant
Research manager	academic	evangelist
Critic	editor	technology transfer

Figure II.1: Stick figure diagram to generate researcher roles enacted during production of a conference paper

Importance to me

- 1.
- 2.
- 3.

Importance to my university

- 1.
- 2.
- 3.

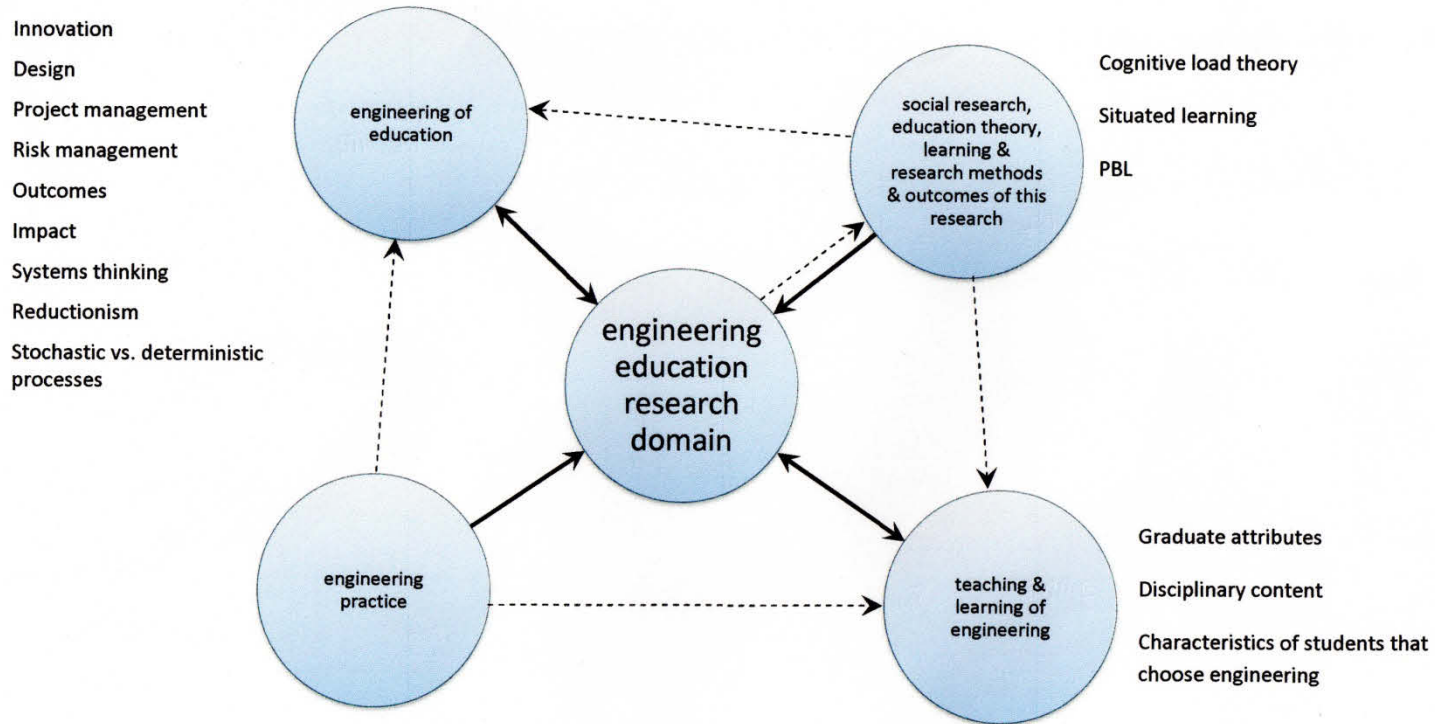


Figure II.2: Engineering education landscape map

Appendix III: 2012 AAEE conference paper review criteria

AAEE 2012 FULL PAPER REVIEW CRITERIA

OVERVIEW OF THE CRITERIA

The following list of criteria was generated by a Delphi Panel of national and international experts specifically for use with the AAEE annual conference as well as potentially in AAEE's *Australasian Journal of Engineering Education*. The comments in italics are intended as clarification for authors and reviewers and form an important part of the criteria.

1. FOCUS OF THE PAPER

The text clearly:

- describes the research question / hypothesis / focus of the study; and
- explains the implications of the project for engineering education research or practice.

“Implications” may include consideration of whether the findings could be applied elsewhere, how the findings might be confirmed or refuted in other contexts, or how the work reflects on existing literature in the field.

2. RELEVANCE

The text clearly:

- relates the work undertaken to relevant discussions in the engineering education literature and other disciplinary literature as required; and
- describes its contribution to these discussions.

The contribution may be confirming, building on or challenging existing work, or contributing to new theory.

3. METHODOLOGY

The text clearly:

- describes and justifies the appropriateness of the overall design, methods, theories and analytic processes; and
- discusses the limitations of the study.

“Appropriateness” means appropriate to the goals and questions of the study and the argument being pursued. “Limitations” refers to the limitations of the study and not of the methodology as whole.

4. ARGUMENT

The text clearly presents original ideas or results of general significance that are:

- supported by convincing evidence, and
- clearly reasoned, illustrating the connection between claims and evidence.

Evidence is made convincing by demonstrating that the kinds of evidence used are appropriate to the question being asked and the way it supports the argument.

5. WRITING QUALITY

The text uses appropriate English language of a sufficient standard to clearly convey the argument and enable the reader to make sense of the paper.

Authors are encouraged to have a colleague read the paper before submission, especially where English is not their first language.

6. USE OF ILLUSTRATIONS

Uses Tables and Figures only where they clarify the argument, and Tables and Figures are meaningfully explained in the text.

Appendix IV: Papers published during the course of my candidature in chronological order of publication

Gardner A. & Willey K. (2013) The response of emerging engineering education researchers to peer review of conference papers, in proceedings of the Research in Engineering Education Symposium, Kuala Lumpur, Malaysia.

Gardner A. & Willey K. (2013) Exploring the impact of peer review on the development of engineering education researchers, in proceedings of 2013 AAEE annual conference Gold Coast, Australia.

Gardner A. & Willey K. (2013) Mapping the engineering education research landscape in Australia, in proceedings of the 2013 AAEE annual conference Gold Coast, Australia.

Gardner A. & Willey K. (2014) Mapping the landscape of engineering education research: an Australian perspective, in proceedings of the 2014 annual SEFI conference, Birmingham, UK.

Gardner A. & Willey K. (2014) Authors' perceptions of peer review of conference papers and how they characterise a 'good' one, in proceedings of the 2014 annual SEFI conference, Birmingham, UK.

Gardner A. & Willey K. (under review) Framing the experience of emerging researchers in engineering education, invited paper for the International Journal of Engineering Education special issue of REES 2013.

Gardner A. & Willey K. (under review) The role of peer review in identity development for engineering education researchers, submitted to the European Journal of Engineering Education 7th June, 2014.

The response of emerging engineering education researchers to peer review of
conference papers

Anne Gardner
University of Technology, Sydney, Australia
Anne.Gardner@uts.edu.au
Keith Willey
University of Technology, Sydney, Australia
Keith.Willey@uts.edu.au

***Abstract:** Our research, an element which is reported in this paper, investigates the effectiveness of peer review of conference papers in enabling peer learning within the Australasian Association for Engineering Education (AAEE) community. This paper reports the responses of six 'new/emerging' authors from three types of Australian universities to the peer reviews of their AAEE 2012 conference papers. The findings and discussion focus on those aspects of the reviews and the authors' circumstances that appear to either enable or constrain their development as engineering education researchers. The study finds that authors belonging to a discipline-based educational research group made substantial changes to their papers before final submission and we argue that these research groups support these authors in developing their academic identity as an engineering education researcher.*

Introduction and background

Peer review has been the focus of an ongoing study at the last three conferences of the Australasian Association for Engineering Education (AAEE). A rationale for this focus has been that the community could leverage the peer review process to provide better quality advice to each other and hence support each others' development as researchers. This is particularly relevant to our community as engineering education research is still emerging as a recognised research area in Australian universities (King 2008; Kavanagh et al 2012) and while many engineering academics hold research qualifications and expertise in their own engineering field, they are faced with developing new perspectives and expertise when moving into educationally related research. At the 2012 AAEE conference, 53% of authors were from the Australasian community and have a first degree in engineering, so examining the transition from engineering academic to engineering education researcher is relevant to a major group of stakeholders in AAEE.

This research looks at whether peer review of conference papers can effectively enable peer learning and support researcher development within the AAEE community. Traditionally conferences have provided an opportunity to participate in dialogue on the author's work in a shorter timeframe than has usually occurred for journals, and a common practice has been to turn conference papers into journal articles in the light of feedback received on the conference presentation. Previous REEN symposia, like this one, have recognised the importance of such dialogue by emphasising discussion in sessions rather than presentation. Such a focus was attempted at the last AAEE conference. However, with the current trend for only minimal discussion time at most conferences, the comments of anonymous reviewers of the submitted paper may be the only developmental help many authors get from conference attendance. Although required to meet government and institutional requirements to be acknowledged as a research publication we argue that our engineering education community needs to do more with the peer review process than focusing on gatekeeping and compliance,

leveraging it to provide constructive developmental feedback to authors since very few AAEE members undertake formal research study, including a higher degree, in engineering education – the traditional way of socialisation into a research domain. This feedback should be aimed at assisting authors to acquire the standards and norms of the discipline and develop researchers' judgement (Fitzpatrick 2010). Our previous research on reviews at AAEE conferences (Jolly et al, 2011, Willey et al, 2011a and b, Gardner et al, 2012, Jolly et al, 2012) has shown that reviews generally lack the basic qualities of 'good' feedback, that of being specific and relevant (Gibbs & Simpson, 2004). Reasons for the poor quality of reviews include the quality of feedback is generally not evaluated, lack of time, or the available reviewers may not have the required expertise (Gardner et al, 2012).

Many engineering academics are faced with developing new perspectives and expertise when moving into social research. The integration of educational research perspectives into an engineering academic's research tool-kit is a multi-faceted, complex and sometimes lengthy process that can be interpreted as the development of multiple aspects of their academic identity. Engineering faculties that seek to broaden their research base into engineering education need to be mindful of the impact of identity development on their academics' successful transition into this different research paradigm. Arguably novice/emerging researchers have the furthest to 'go' in this transition and thus are an interesting group to focus on. This paper reports how six 'new/emerging' authors from three types of Australian universities (see Table 1) responded to the peer reviews of their AAEE 2012 conference papers. The findings and discussion focus on those aspects of the reviews and/or these authors' contexts that appear to either enable or constrain their development as engineering education researchers.

Theoretical framework

Gee's identity framework (Gee 2000) was used to determine characteristics of engineering academics to focus on in our research so that we build variation into the data (Corbin & Strauss, 2008). The aim of having variation in our samples is to allow for the appearance of differences in the dimensions defined by the framework to "capture" (Corbin & Strauss, 2008, p.306) the complexity of our context.

Gee's framework categorises various aspects of an individual's identity according to the source of authority for that identity aspect. Aspects of our natural identity are developed from forces in nature (N-identity), aspects of institutional identity are authorised by institutions (I-identity), our discourse identity is developed in the dialogue that we participate in (D-identity), and our affinity identity is shaped by the experiences we have with others of similar interest (A-identity). Gee (2000) contends that identity is continuously in construction and is developed in relation to others. We argue that to investigate an academic's development as an educational researcher we need a model that examines the changing and discursive nature of their identity construction.

Methodology

The affinity group we are interested in are engineering academics who are 'active' members of AAEE. In this project we are defining engineering academics as 'active' members of AAEE if they authored a paper for the 2012 AAEE conference AND at least one of the three previous years' AAEE conferences. The author list from these conferences was used to identify potential participants and these academics were invited

to participate in the research project. Nineteen members of AAEE were interviewed for the overall project. Participants were classified according to gender (male or female – an N-identity); what type of university they work for (Group of Eight (Go8), regional, or metropolitan unaligned, as described in Table 1– an I-identity); and their level of expertise in engineering education research (new/emerging, intermediate, established – a D-identity).

In this project a participant’s level of experience as an engineering education researcher was determined by the number of specific types of publications they had written in the last four years (conference papers, journal papers, book chapters) along with other indicators of research activity such as being the project leader of a grant where the funding is provided through a nationally competitive process, whether they are supervising research students working on educationally related topics, and whether they were currently serving in an editorial role for an educationally related journal. Using this system, participants fell into three broad groups: new/emerging, intermediate, and established researchers. The six participants included in this paper represent the emerging researchers who had been interviewed at the time of writing this paper. The pseudonyms for these participants are listed in Table 1 below, along with an outline of the type of university where they are currently employed.

Table 1: Participants’ type of university

Type of university	Description	Participants
Group of Eight [Go8]	The ‘Group of Eight’ (http://www.go8.edu.au/home) is a coalition of research intensive universities which tend to be the oldest universities in Australia. .	Adele Evan
Regional	Regional universities are those with their main campus in a regional city or town rather than a state capital city. As well as on-campus students, these universities are characterised by significant numbers of external/distance students.	Alex Wayne
Metropolitan unaligned	The metropolitan unaligned universities are those based in a state capital city, but not included in the Go8 or the Australian Technology Network..	Terry Mike

A document analysis was conducted comparing each participant’s draft paper submitted for review for the 2012 AAEE conference, to the final version of their paper. The two reviews of each paper were also examined. A semi-structured interview was conducted with each participant in their campus office, or an alternative location nominated by them. Each interview took one hour and occurred in the timeframe between three weeks and five months after the deadline for submission of the final version of the paper to the conference. During the interview participants were asked to re-read the reviews they received on their paper, comment on how helpful they had found these reviews in preparing the final version of their paper, and discuss any changes they had made between the draft and final versions. This generated discussion about the reviews themselves and about the changes the participants had actually made to their papers that were prompted by review comments.

Participants were also presented with the engineering education research landscape model shown in Figure 1. This model was developed by the authors of this paper from examination of the range of papers submitted to the last three AAEE conferences. Participants used a coloured adhesive star to locate their paper on this model and then explained why they had stuck their star/s in the position they did. This information was intended to be used in two ways. The first of these is to use responses from individual participants to provide additional information about their identity since “...the need to

research particular issues grows from the contexts in which the researcher operates....” (Clough & Nutbrown, 2012, p. 11), so the area that they publish in is likely to be one that they identify with. The second intention is to use responses from all the participants to determine the range of different areas that members of the AAEE community are working on. This second use of the data will be addressed in a future publication.

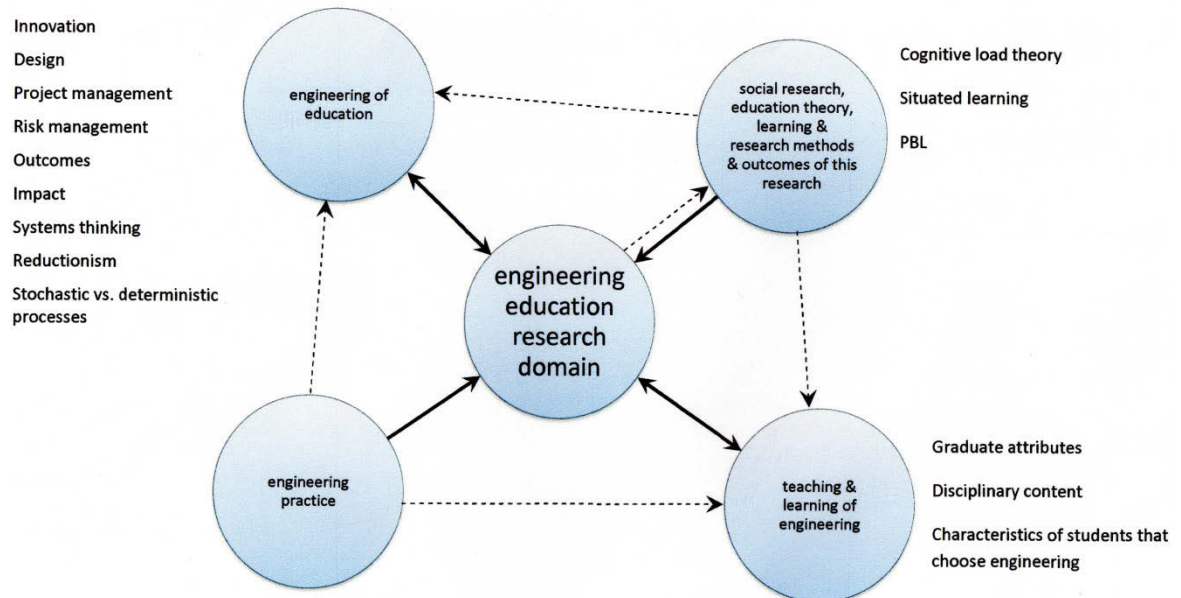


Figure 1: Engineering Education Research landscape

Transcripts were created from audio recordings of the interviews, which were then coded in NVivo 10 for themes relating to the usefulness of the reviews and changes participants had made to their paper.

Findings

There are two aspects to the feedback provided in reviews: the decision and the comments. Authors used both to interpret the reviewers’ opinion of their paper. Of the six people we are discussing in this paper, all had papers with the decision to ‘accept with minor changes’ except for Terry whose paper was judged as ‘accept with major changes’. A comparative examination of the reviewed version and the final published version of each paper shows that Evan, Mike and Adele made minor changes to the reviewed version of their paper, while Alex, Wayne, and Terry made more substantial changes. We will first comment on each participant and their response to their paper’s review before discussing the main themes identified.

Evan has recently (in the last six months) changed from part-time tutor to full-time academic at a Go8 university. This change coincided with enrolling in a PhD because “*I’ll need to do a PhD to progress...*”. Evan made minimal changes to his draft paper – two instances where a short phrase was added to clarify the rest of the information in that sentence, as requested by his Reviewer 1 - before final submission stage, and did not address most issues raised by the reviewers, which he conceded in his interview: “*I think I made a few tweaks and just read over it, but I don’t think I made huge changes*”. This behaviour is consistent with his comments that he was just publishing to comply with the expectations of being an academic: “*because I am an academic then I must publish*”. He placed his star in the teaching and learning area of the landscape (see Figure 2) since his paper describes a teaching and learning project Evan was involved

in: *"It's a project I ran, just one where it was my responsibility and I figured I need it published"*.

Like Evan, Mike placed his star in the teaching and learning area of the landscape (see Figure 2). He locates his educational research – not just this paper - there because *"...it informs my practice. I don't like the idea of educational research for its own sake... if engineering education and research doesn't inform practice in Australian universities, then it's missed the point..."*. Mike is an academic of approximately twenty years standing, currently working at a metropolitan unaligned university. The reviews on Mike's paper were contradictory e.g. one reviewer expressing reservations about the methodology while the other reviewer commented *"the methodology strikes me as rock solid"*. While an experienced author may be able to discern feedback from such contradictory reviews, it is more difficult for a new researcher to interpret and learn from these contradictions. Changes to the final version of the paper include short responses to some of the issues/questions raised by the reviewers, however, many of Reviewer 1's concerns remain unaddressed. This may be in part because of the difficulty in addressing issues of methodology after a study has taken place *"the first [review] I wasn't so happy about, possibly because he brought out things which I think were separate to what I could control here..."*.

Adele has a fractional appointment at a Go8 university which she began after significant experience in industry. Adele's paper was accepted subject to minor changes and there were very minor changes between the reviewed version and the published version of this paper. These changes related to formatting, abbreviating terms and numbering tables. There are slight differences in the Background section but these amounted to tightening the writing rather than any change of ideas or essential expression of them. Both reviews of this paper were overwhelmingly positive and pointed to the need for the minor abbreviation and table numbering changes which were made for the final version. One reviewer did attempt to engage at a deeper level by asking questions about the categories in the survey but there was no response to this in the final paper. While the quality of the originally submitted paper was high, which elicited the positive reviews, for many of the review criterion the only response from the reviewers was one word: "Excellent". While positive, this did not assist the author in further improving their paper, and Adele commented she would have appreciated some elaboration on this one word to find out what was 'Excellent' about it so that she could do it again: *"I actually find, sometimes, excellent, as the sole comment, ... more frustrating. Because you think, well, could you actually tell me why it was excellent so that I know what I did well? ... so that I can do it again?"* Adele also mentioned that if reviewers have difficulties with something in her paper she would appreciate knowing exactly where in the paper the problem is ie the more specific reviewers can be, the better: *"... a particular comment - where is that relevant? Which section? ... is it there, or is it two pages over that really needed that clarification? That's what I find frustrating,...knowing exactly where their particular comments are relevant to"*. Unlike Mike and Evan who located their stars in the teaching and learning area on the landscape, Adele placed hers on the arrow pointing to the social research neighbourhood (see Figure 2). She commented that this was an unusual area for her, with her previous educational papers fitting between teaching and learning and engineering of education.

Alex also placed her star in the social research neighbourhood *"...because it's very much looking at social research theory and how can we put it into that educational domain."* This paper is related to her PhD which she began 12 months ago. Previous to that her

publications were more aligned with the teaching and learning area. Like Adele, Alex came to academia from industry, but without research experience in her engineering speciality, and is now working at a regional university. Alex began a PhD “*because I decided I'd probably be sticking around academia for a little while and if you're going to do that you need to have a PhD*”, but only after finding a research area that she was interested in. Both reviews of Alex’s paper have a generally positive tone even though the theoretical nature of the paper and the theory discussed are not commonly found in AAEE conference papers: “*It's a funny paper because it's a discussion paper or a theoretical background paper... It's not a collect some data and analyse it and here's my results type paper.*” Both reviews also ask for an illustration of how the theory could be applied to the engineering education domain. This prompted what we regard as substantial changes to the last page and a half of Alex’s paper where she completely deleted a table and its explanatory paragraphs and replaced them with suggested ways of using the theory in engineering education. Alex found suggestions from the reviewers helpful in improving the paper: “*So what I did do, and what the reviewer suggested was outline how I would apply this theoretical background to a project... Which makes a lot more sense when you're then reading the paper... So yeah, it certainly did give me the direction that I needed to complete the paper the way I wanted to.*”

Wayne works at a regional university like Alex, and has research experience in his engineering speciality. Wayne’s reviews were very brief, mainly mentioning typographical errors and data presentation issues such as the possibility of changing the graphs to tables. Consequently Wayne’s response to the reviewers’ comments in his final submission was to reformat some graphs in a table. We can understand that Wayne did not find these reviews very helpful and Wayne’s experience raises questions in regard to the level of expertise of reviewers in the AAEE community. “*Thinking of my experiences of publishing in the education conferences, as opposed to the [stereotypical engineering research field] papers ... I've had 100 per cent success with getting things accepted in the education conferences...*”. The decision of ‘accept with minor changes’ and the comments Wayne’s paper received combined with his previous ‘success’ at educational conferences contribute to his perception that he is a competent educational researcher. Interestingly despite the positive reviews the changes to Wayne’s paper from the reviewed to the final version were more substantial than the changes made by Adele, Evan and Mike on their papers. Wayne wrote his paper with another engineering academic and his interview suggests that the changes in the final paper came more from his co-author (an ‘established’ engineering education researcher) than the reviews: “*certainly [the co-author] and I had a bit of back and forth*”. His previous educational papers would fit in the teaching and learning area but this current paper sees him moving more towards the social research (see Figure 2), a move he said is largely driven by his co-author mentor.

Terry’s area of teaching and mainstream engineering research is a practice-oriented aspect of engineering and his identification with this area is illustrated in locating his star on the engineering practice trajectory, as shown in Figure 2, even though his paper is essentially about evaluating practice in the subject that he teaches. Terry has significant experience teaching in this area and works at a metropolitan unaligned university. Substantial changes were expected in Terry’s paper since the decision was ‘accept with major changes’. Reviewer 1 expressed serious misgivings with the methodology and its description. His final paper did include a fuller description of the details of the method used but did not address a major questioning of the

appropriateness of the data collection method, or the English expression and formatting deficiencies noted by reviewers. For a paper with a ‘major changes’ decision it is noteworthy that much of the reviewed version remains unchanged in the final version – this may come down to Terry’s attitude that: “... *whether they say major changes or minor changes, to me I don't think it's a huge difference*”.

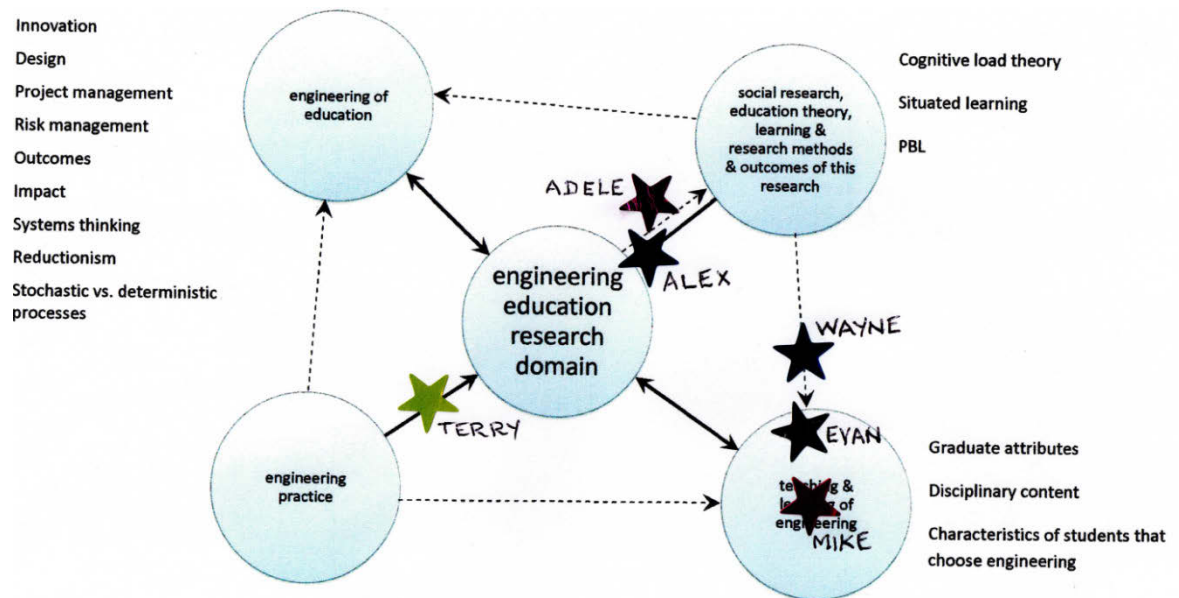


Figure 2: Participant located stars on the Engineering Education Research landscape

Discussion

While Evan and Alex are both enrolled in PhDs in engineering education their different responses to the reviews of their papers may be explained by the way they see themselves. Both reported undertaking their postgraduate program because it is expected that an academic has a PhD. While compliance with this expectation seems to be the main issue for Evan, Alex sees her PhD as intentional development of a ‘possible self’ identity (Markus & Nurius, 1986) as an engineering education researcher which aligns with where she located her star in Figure 2. This identity is supported at her regional university where there is a named research group in the engineering faculty for disciplinary education research. The research group gives institutional authority to the development of Alex’s discourse and affinity identities ie her institutional, discourse and affinity identities would be mutually supportive. Similar arguments are reported in the study by Tonso (2006) into institutionally supported identities of engineering students and McNair and colleagues (2011) into institutionally supported (or not) interdisciplinary identities of engineering students and academics. Alex acknowledges her development as a researcher which includes better appreciation of what reviewers are saying “*I've improved myself as a writer and researcher, but I think the reviewers also seem to be at a better level. I got more out of them, or they were in tune with what I was thinking, I guess.*”

Wayne and Terry also made major changes for their final paper. Wayne works at the same university as Alex, and Terry works at a metropolitan unaligned university which also has a disciplinary specific educational research group. Even though Wayne and Terry’s interaction with these research groups may be different to Alex’s, having an active research group on campus would provide institutional authority to them

developing discourse and affinity identities in engineering education: “*So I guess you do have support because (a) there's people here I can talk to about it and (b) it is actually encouraged by people at senior levels*” [Terry]. Actually for Terry we suggest that wanting to be seen to be an active member of the research group provided some of the motivation for him to write this paper for the AAEE conference: “*...I've explicitly been told if you're a part of a research group you're going to find it easier to get promotions...*”[Terry].

The alignment of the stars in Figure 2 shows that the two female participants (Adele and Alex) in this study place themselves very close to each other in the landscape. While this might suggest gender (N-identity) effects in identity development as an educational researcher, this cohort is too small to draw any conclusions. This is one aspect that will be examined further in the wider study.

For Evan (Go8) and Mike (metropolitan unaligned) their educational research is inextricably linked to their practice of teaching engineering students which is illustrated on the engineering education research landscape (see Figure 2) where they placed their stars in the ‘teaching and learning of engineering’ circle. The final papers from both of these authors did not address all the issues raised by their respective reviewers. We also note that these academics work at universities without disciplinary educational research groups and neither seem to have a strong mentor, as Wayne does. As with the gender issue, in the wider project we will be looking at how other researchers who locate their star in this area respond to peer reviews of their paper.

As suggested in Borrego (2007), to assist the development of new/emerging researchers making the transition to engineering education research, reviewers and mentors need to focus on their understanding of methodology, especially data collection and data analysis. Examining the reviews for the papers written by these emerging researchers, we could see that reviewers often asked for issues of methodology to be addressed, especially in relation to type of data collected and how it is analysed:

“... they were saying that there's an unacknowledged possibility of the Hawthorne Effect.” [Evan]

“There was one comment here about the use of the extracts from focus groups. They weren't convinced that that was a way to show results...” [Terry]

The above comment from Terry illustrates the problem in our research domain when not all reviewers are established researchers themselves, resulting in them challenging the practices of the different (and still unfamiliar to them) paradigm while others could not clearly articulate the reasons for their judgement. We previously noted that Adele called for reviewers to be specific in their comments, other participants also commented negatively when judgements were not explained: “*I think reviewer 2... they may as well have given him boxes to tick just about - from the comments*” [Wayne]. Although this was also partly put down to the nature of the reviewing process: “*I think some reviewers once it's anonymous they don't feel as though they need to put effort into what they're actually saying*” [Terry]. There was also support from the authors for reviewers to not couch their comments in euphemisms but to clearly say what problems they see in the paper: “*because you want to be able to see the things that you've done wrong.*” [Mike]

These findings support the results suggested in our earlier studies (Jolly et al 2011, Willey et al 2011a,b) and highlight the importance of quality reviews and the need for new researchers to collaborate and/or be mentored by someone with more experience. We found aspects of each of the papers in this study that we would have included in a

review if we were writing it, but which were not mentioned in the formal reviews provided, so not all participants received quality reviews. Positive reviews of poor research can also stifle development and reinforce emerging researchers' misconceptions about the quality of their work (for example Wayne's comment about his 100% acceptance rate). To foster improved research it is important that reviewers have both the knowledge and skill to challenge authors in a constructive way, although we acknowledge that regardless of the quality of the review there are some authors who will not make the recommended changes to their paper. We suggest that more transparency in the review process would assist reviewer development by for example, once the review process is complete, making all reviews for a particular paper available to the reviewers who reviewed it, or making exemplar reviews available to reviewers.

There were several strong voices from these participants decrying what they saw as a move to make the annual AAEE conference exclusively focussed on research. Mike's comment illustrates this perception: *"I got this overwhelming feeling that the people in the audience didn't feel connected to AAEE as an organisation, because they are all practitioners and AAEE seems to be running an agenda of engineering education research, which is not necessarily related to improving practice"*[Mike]. Most of these emerging researchers wrote papers about their teaching practice. These types of papers are about what we do (practice) while others are about how we think about what we do (research). How we think about what we do may change what we do and what we do may influence how we think about what we do ie they have a symbiotic relationship, and we believe our national conference should continue to be an outlet where both such papers are included.

Concluding remarks

While this paper reports a portion of an ongoing broader study, the focus on new/emerging engineering education researchers has provided useful insights for several stakeholder groups in the AAEE community. Reviewers are asked to note that authors appreciate detailed and specific feedback which articulates the reviewer's position, even though not all authors will act on all feedback provided. So while high quality reviews won't act as an enabler for everyone, poor quality reviews are likely to constrain all emerging researchers. Focussing on how authors describe their research methodology will continue to be a learning opportunity for developing authors and reviewers. Universities may note that authors who made substantial changes between the reviewed and final versions of their paper were those working at universities with a research group in engineering education. We posit that these research groups act to provide institutional authority to these authors in developing their academic identity and hence act to enable academics' development as educational researchers. For AAEE conference organisers and the community at large we argue that the practice versus research dichotomy is ultimately divisive. There are people in our community whose practice is the education of engineering students, those whose practice is the research of engineering education, and those who practice both. We suggest that our national conference should provide a forum for all these practitioners with a focus on providing an environment to improve the quality of publications and the continued development of researchers.

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We acknowledge those members of the AAEE community who responded so openly to this research.

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Exploring the impact of peer review on the development of engineering education researchers

Anne Gardner^a and Keith Willey^a.

Faculty of Engineering and IT, University of Technology, Sydney^a

Anne.Gardner@uts.edu.au; Keith.Willey@uts.edu.au

CONTEXT

Peer review has been the focus of an ongoing study at the last three conferences of the Australasian Association for Engineering Education (AAEE). A further development of this study has been to explore the perspective/s of the authors of these conference papers and the impact that peer review had on their development as researchers. Brew (2001, 2006) reports on the different ways that academics conceptualise their research and tells us that the way academics think about their research is strongly linked to their identity. McAlpine and various colleagues have proposed an identity-trajectory framework to describe the development of academic identity. This framework consists of three intertwined strands: intellectual, networking, and institutional, which interact over time to support or constrain an academic's development.

PURPOSE

In this paper we report using the notion of intertextual networking, part of the identity-trajectory framework, as a lens to explore the relationship between peer review and academic identity construction for engineering education authors in the AAEE community.

APPROACH

Semi-structured interviews were conducted with nineteen 'active' members of the AAEE community. Participants were asked questions relating to their conference paper, and the reviews on that paper. The identity-trajectory framework was used to analyse the interview transcripts.

OUTCOMES

Participants' responses illustrate how various aspects of responding to reviews, and writing reviews for other authors, contribute to the development of the networking and intellectual strands of their academic identity as engineering education researchers.

CONCLUSIONS

The three strands in the identity-trajectory concept intellectual, networking and institutional interact over time. Intertextual networking is a facet of the broader networking strand and the AAEE community contributes to each others' intertextual network through the peer review process. This paper demonstrates the capacity of peer review to contribute to or impede the development of an author's intellectual strand and networking strand, we urge reviewers to be mindful of this potential when writing reviews. The continued importance and relevance of the AAEE conference for the intellectual and networking strands of its community members is applicable for all researchers, irrespective of their level of development.

KEYWORDS

Peer review, identity-trajectory, engineering education researchers.

Introduction

Peer review has been the focus of an ongoing study at the last three conferences of the Australasian Association for Engineering Education (AAEE) (Willey et al 2011, Jolly et al 2011, Gardner et al 2012, Jolly et al 2012). A further development of this study has been to explore the perspective/s of the authors of these conference papers and the potential of peer review to support their development as researchers.

This is particularly relevant to our community as engineering education research is still emerging as a recognised research area in Australian universities (King, 2008, Kavanagh et al 2012). Beddoes (2011) suggests that one of the results of the emergent nature of engineering education research is that many “*leaders, such as journal editors, are longtime administrators and reformers, but not educational or social science researchers*” (p.8).

Another complicating issue is that most scholars who identify with this emerging field are engineering academics (Borrego & Bernhard, 2011). This is a complicating issue because these academics may hold research qualifications and expertise in their own stereotypical engineering field but are faced with developing new perspectives and expertise when moving into educationally related research (Beddoes 2012) and working in an interdisciplinary way in this interdisciplinary field.

Part of the difficulty engineering academics have with becoming interdisciplinary researchers could be that social research is so different to stereotypical engineering research. Jones (2011) notes that in consensus-based disciplinary classification schemes based around the work of Biglan (1973) “*high paradigmatic fields have high levels of agreement among their practitioners with regard to issues such as appropriate research topic and methods*”, such as engineering, while “*low paradigmatic fields have less agreement in relation to appropriate research questions and even less agreement on appropriate methodology for addressing these questions*” (p.11), such as education. Jones (2011) also describes other disciplinary classification schemes based around the Holland theory of occupational classification. These schemes classify individuals into six personality types which were then aligned with various academic disciplines. Again engineering and education are classified in different categories implying that some changes in outlook and practice are required for engineers to undertake educational research.

As a result of engineering education research being both emerging and interdisciplinary there is a wide variety of views as to what quality research looks like (Borrego & Bernhard 2011). The implication for authors is that:

...reviewers, and audiences, have significantly different knowledge backgrounds. Thus, authors are caught between fields and held accountable to reviewers from different fields and should expect divergent opinions over what is appropriate and accessible. (Beddoes 2011 p. 25)

Our previous research on reviews at AAEE conferences (Willey et al 2011, Jolly et al 2011, Gardner et al 2012, Jolly et al 2012) has shown that many reviews also generally lack the basic qualities of ‘good’ feedback, that of being specific and relevant (Gibbs & Simpson, 2004) and thus fail to assist researcher development.

This research looks at how the peer review of conference papers can effectively enable peer learning, and support researcher development within the AAEE community. Although peer review is required to meet government and institutional requirements for papers to be acknowledged as a research publication, we argue that our engineering education community needs to do more with the peer review process than focusing on gatekeeping and compliance. Feedback in peer review should be aimed at assisting authors to develop the standards and norms of the interdisciplinary field and develop

researchers' judgement by for example, challenging them to reflect on their perspective, data collection, and interpretation of findings. Similar arguments have been developed in relation to peer review in the domain of science education research (Eisenhart, 2002; Roth, 2002, Tobin 2002).

For engineering academics, along with our “*engineering disciplinary norms and expectations of what quality research is*” when we participate in engineering education research we also bring with us our engineering identities (Beddoes 2012 p.3). Becoming an engineering education researcher:

...demands more than just learning the rules of what to do when. It requires the construction of an identity that can include these different meanings and forms of participation... The work of reconciliation [of differing identities] may be the most significant challenge faced by learners who move from one community of practice to another...and is an on-going process... (Wenger 1998, p.160).

Developing knowledge and skills in engineering education research is a multi-faceted, complex and sometimes lengthy process that can be interpreted as the development of an academic's identity. To be a researcher in the field of engineering education means to act, talk and think like an engineering education researcher i.e. to identify as an engineering education researcher. Engineering faculties that seek to broaden their research base into engineering education need to be mindful of the impact of identity development on their academics' successful transition into this different research paradigm:

Academic literacy is about more than reading and writing; it comprises both thinking critically and taking action and thus is related to identity development. (McAlpine 2012 p. 259)

Theoretical Background

Brew (2001, 2006) reports on the different ways that academics conceptualise their research and tells us that the way academics think about their research is strongly linked to their identity. Gee (2000) contends that identity is continuously in construction and is developed in relation to others. In the academic context this can be interpreted as what type of academic activity we engage in and which academic community we look to for recognition as underpinning our developing identity as an academic (McAlpine et al.,2008). Tonso (2006) describes this by characterising identity development as ‘*thinking about oneself, performing, and being thought of as*’ a particular type of person or member of a particular community.

McAlpine and various colleagues (McAlpine et al 2010, McAlpine and Lucas, 2011, McAlpine & Amundsen, 2011, McAlpine and Turner 2012) have proposed an identity-trajectory framework to describe the development of academic identity. This framework consists of three intertwined strands: intellectual, networking, and institutional, which interact asynchronously over time as modelled in Figure 1.

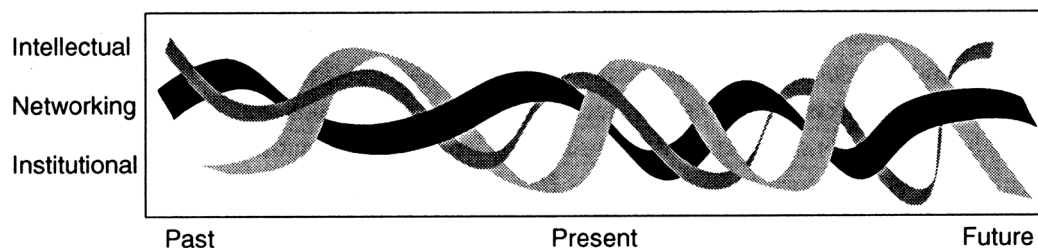


Figure 1: The interweaving of strands of identity (McAlpine & Amundsen 2011, p.178)

The intellectual strand represents “*contributions to one’s disciplinary specialism or field. The intellectual strand leaves a trail of artefacts, e.g. publications, citations, papers,*

course/curriculum design” (McAlpine & Amundsen 2011p.179) and, we suggest, reviews. The networking strand represents the range of

...local, national, and international networks one has been and is connected to, and...includes (a) research and publication collaborations with others; (b) cross-institutional course/curriculum design; (c) work with professionals...and (d) membership of disciplinary organizations [such as AAEE] and on journal boards.” (McAlpine & Amundsen 2011, p.179).

The intellectual and networking strands strongly interact with each other with the networking strand “*establishing the intellectual location for one’s contributions*” (McAlpine & Amundsen, 2011, p.180) and so are largely focussed beyond the individual institution where an academic may be employed.

The framework also includes an institutional strand which represents the interactions of the academic in their workplace. McAlpine & Amundsen (2011) found that institutions can “*support or constrain an individual’s networking and intellectual strands*” (p.180). In our context institutional support of the networking and intellectual strands could be by for example providing funding to attend the annual AAEE conference.

Of particular relevance to our research on peer review of conference papers is the notion of the ‘intertextual network’ which facilitates learning about the discipline area:

Learning through reading involved understanding how scholars in the field communicate through varied genres, e.g. papers, manuscript reviews and funding proposals. Learning the discourse was essential (e.g. how claims are made or the positioning of the researcher/author), but also how textual practices are tied to actual research practices (e.g. what is an appropriate question in a field, what is considered appropriate or essential evidence)... Learning to read–understand in the chosen field is necessary to interacting within the field... (McAlpine 2012, p 356)

Beddoes (2012) illustrates that reviewers play a part in an author’s intertextual network:

... numerous individuals are involved in bringing an article to its published version... articles are often the result of multiple and competing deliberations and negotiations. They contain knowledge and opinions not only of the authors, but also of reviewers and editors. (p.8).

This paper reports on insights obtained from using the intertextual networking concept of the identity-trajectory framework to examine the relationships between peer review and academic identity construction for engineering education authors in the AAEE community.

Approach

Our research approach is interpretive using the identity-trajectory concept as a framework or a ‘lens’ through which to view the data. This research methodology is heavily influenced by the methods used by McAlpine and colleagues in creating the identity-trajectory concept (McAlpine et al 2010, McAlpine and Lucas, 2011, McAlpine & Amundsen, 2011, McAlpine and Turner 2012).

Sampling

The identity-trajectory concept was used to determine characteristics of engineering academics that we should focus on in our research so that we build variation into the data (Corbin & Strauss, 2008). The aim of deliberately having variation in our samples is to allow for the appearance of differences in the dimensions defined by the framework so that we “*capture*” (Corbin & Strauss, 2008, p.306) as much of the complexity of our context as we can. A framework helps us ‘capture’ this variation in a systematic way.

This study focuses on engineering academics with engineering qualifications, who are also 'active' members of AAEE. In this project we are defining engineering academics as 'active' members of AAEE if they authored a paper for the 2012 AAEE conference AND at least one of the three previous years' AAEE conferences. The author list from these conferences (available in the proceedings) was used to identify potential participants and these thirty-eight academics were invited to participate in the research project. Nineteen of these authors accepted the invitation.

Participants were classified according to what type of university they work for (Group of Eight (Go8), Australian Technology Network (ATN), regional, or metropolitan unaligned as described in Table 1 – for variation in the institutional strand); and their level of expertise in engineering education research (emerging, intermediate, established – for variation in the intellectual strand).

A participant's level of experience as an engineering education researcher was determined by the number of specific types of publications they had written in the last four years (conference papers, journal papers, book chapters) along with other indicators of research activity such as being the project leader of a grant where the funding is provided through a nationally competitive process, whether they are supervising research students working on educationally related topics, and whether they were currently serving in an editorial role for an educationally related journal. Using this system, participants fell into three broad groups: emerging, intermediate, and established researchers.

Table 1: Type of university

Type of university	Description
Group of Eight [Go8]	The 'Group of Eight' (http://www.go8.edu.au/home) is a coalition of eight research-intensive universities located in state capital cities, which tend to be the oldest universities in Australia. .
Australian Technology Network [ATN]	The ATN is an alliance of five universities, each located in the capital city of a mainland state of Australia. These universities badge themselves as practice-based and their research is focussed on the needs of industry and the community.
Regional	Regional universities are those with their main campus in a regional city or town rather than a state capital city. As well as on-campus students, these universities are characterised by significant numbers of external/distance students.
Metropolitan unaligned	The metropolitan unaligned universities are those based in a state capital city, but not included in the Go8 or the ATN.

Interview Protocol

Semi-structured interviews were conducted with each participant in their campus office, or an alternative location nominated by them. Each interview took approximately an hour and occurred in the timeframe between three weeks and five months after the deadline for submission of the final version of the paper to the conference. During the interview participants were asked to re-read the reviews they received on their paper, comment on how reviews in preparing the final version of their paper, and explain any changes they had made between the draft and final versions either independently or as a response to these reviews. This generated discussion about the reviews themselves and about the changes the participants had made to their papers that were prompted by review comments.

Data Analysis

A document analysis was conducted comparing each participant's draft paper submitted for review for the 2012 AAEE conference, to the final version of their paper. The two reviews of each paper were also examined.

Transcripts were created from audio recordings of the interviews, which were then coded in NVivo 10 for a priori themes relating to identity-trajectory strands (intellectual, networking and institutional). Studying the interview transcripts we were able to find many instances relating to the intellectual strand, the networking strand and the institutional strand of participants' identity. In this paper we discuss the impact the intertextual networking processes involved in writing a conference paper, especially the peer review process, had on the intellectual strand of the participant, as we consider this to be most relevant and important to this conference community.

Intertextual networking outcomes

The networking strand encompasses the academic community beyond the participant's university and includes the AAEE community and reviewers as well as the authors of the literature they read and cite. Peer review is an element of 'intertextual networking' (Beddoes 2012) and is shown to have contributed to the intellectual development of some authors, not always by a reviewer explaining something to an author but also by questioning their method/s so that authors are motivated to better articulate their stance, as illustrated by one of our participants:

...your feedback from a reviewer might tell you... why haven't you looked at this and where's the evidence, or what's the actual outcome here?" [established, ATN]

The following quotes from participants highlight how interaction with the peer review has resulted in a change in their thinking or practice i.e. has resulted in some change to their intellectual strand:

*The reviewers picked up on things; weaknesses that I already knew were in the paper... There was one comment in particular... I thought that bloody useful, and actually **it changed the way I thought about it...** it gave me the, 'Oh now I know what I'm going to do with this paper'. So it certainly did give me the direction that I needed to complete the paper the way I wanted to. [emerging, regional]*

*There was one comment here [in a review] about the use of the extracts from focus groups. They [reviewer] weren't convinced that that was a way to show results. I'd seen other papers that had done that. So ... **it made me think...** [emerging, metropolitan unaligned]*

*That's where I think conference papers are really useful... You write it to participate in the discourse and also get participation from other people in what you're doing... or **to give someone new ideas, or to get new ideas from somebody...** its dialogue. [intermediate, regional]*

As well as influencing their intellectual strand these authors show how the review they received for their paper prompted them to re-engage with other elements of their intertextual network:

*So this one [review] was more referenced to literature So I ... dug into the paper, couldn't find it anywhere... So that... **led me to reading in a more deep way** some of the literature that I've already read... Like I read [another author's] paper again. The first time I read that I thought 'Oh, ...amazing'... Then I went back to try and find something to quote and I thought this is really a bit thin on pedagogy. **So that changed my perception...** [intermediate, ATN]*

Another way that peer reviews extend an author's intertextual networking strand is through the process of reviewing other authors' conference papers. Several

participants commented that they learn from reading the papers they are asked to review, i.e. that this type of intertextual networking also contributes to the development of their intellectual strand:

*If you're a reviewer, it's also a **learning exercise for yourself** to go oh this is a really good paper or they've taken an interesting approach or whatever...it's an educational process for the community. [established, ATN]*

*It makes **you learn about things** that because you now have to read a paper you actually read a bit more... So it is good reviewing because it just makes you read papers that you sometimes just don't get time the read - well, you do have the time if you really made the time but you don't. This just forces you to sit down and read some papers, which is always good. [emerging, metropolitan unaligned]*

*...it's good ... to read other people's work to get an **idea of what's out there**... Also to get an **idea of how other people write**... I'll criticise something then realise I've done it myself in my own paper. [emerging, Go8]*

And they learn more by reading the paper than by just listening to the presentation:

...at a conference presentation if it's the first time you hear about a paper, it just goes over your head. Even if it's a good idea. I write it down, it's still not the same as if I've read it...if I go to their presentation for a paper I've reviewed and I really enjoyed, eventually I meet that person in the lunch queue and I say I really like your paper on ... That will be a really deep connection that happens just because you've reviewed the paper. [intermediate, ATN]

This quote also shows how the conference provides an opportunity to transform elements of our intertextual network into part of our personal network i.e. at the conference we can meet the author/s of papers in our intertextual network in person.

Especially for a first time reviewer of AAEE papers, reviewing involved a 'paradigm shift' in their thinking about research, and helped them learn about the discourse of the field:

...because I'm outside of my normal field... it was a paradigm shift...in terms of familiarising myself with the field of discourse - engineering education - the whole thing was educational...quite stimulating and valuable...Personally worthwhile... I wouldn't have done it otherwise. I was there to learn about the discourse... As such, getting involved as a reviewer is quite a healthy way to engage yourself in a discourse. [emerging, Go8]

An established researcher commented that writing papers and engaging with the review process are connected, which comes back to how the intertextual network is intertwined with the intellectual development strand:

...they're all connected, and interconnected, and the fact that we can learn from others - you know I've heard people saying they're not doing reviews or they don't ever do them, and I'm saying well I think you're missing an opportunity to understand how other people have tackled the same issue, and I think we need to open our eyes and be a little bit more adventurous and brave and not be afraid to learn off our peers and give feedback to our peers. [established, ATN]

Authors also learned about reviewing by seeing other reviewers' comments (after their review was submitted) as it allowed them to benchmark their thinking:

As a reviewer, after the process is finished, I always do whatever I can to hunt down the comments from the other reviewers on the paper that I reviewed... Anonymously, of course but I still got to see what the other people thought, which was again, very interesting and illuminating for me. [emerging, Go8]

There doesn't appear to be a lot of feedback to do a review in this particular process, so without someone coming back and saying well, perhaps you were a bit harsh, or giving you a review on my review then it's whether or not they accept it, that is a very crude way of getting feedback I guess. [emerging Go8]

Both of these participants are emerging researchers, so this seeking of feedback on their reviews may be a reflection of their inexperience in our field. They are seeking assurance of their understanding or at least to compare their understanding to others, so they can evaluate differences, as part of the process of learning about the field. Conference organisers need to keep in mind this variation in expertise in our community when asking people to review papers and be prepared to sometimes make their own judgements if there is disagreement about the decision to accept or reject a conference submission.

Perceptions of the quality of the review are also dependent on the expertise of the author. To illustrate this we can see that an emerging researcher was “...fairly happy with the reviews I had this year...the reviewers and the reviews that I got have improved...” which we can contrast with a statement from an established researcher at the same university that generally review quality is poor: “...yeah, I think refereeing is ...not all that good these days”. To improve the usefulness of peer reviews we urge reviewers to be specific and relevant when writing their reviews and to clearly articulate what they mean. For example part of a review of an earlier version of this paper points to the lack of “*qualitative and quantitative analysis*” and that results are “...not shown methodologically.” The review would have helped us more if it had indicated how the reviewer thought quantitative methods would contribute to our research outcomes and what they mean by “*methodologically*”. The review concludes by saying that “...more work is needed”. While we agree with this statement, again a more specific indication of what particular work the reviewer feels should be undertaken would have contributed more to our development as researchers. As it is we were left guessing what the reviewer might have meant.

Considering the work we have undertaken so far we suggest further research in this area could investigate the effects of differences such as individual ethnicity, cultural background or gender in academic identity development. While some interview transcripts allude to one or another of these aspects, they are not the major focus of this study but would be interesting extensions

In summary our participants have shown that peer review can change their thinking or practice and can prompt them to re-engage with published literature. Furthermore, being part of the peer review process gave them an opportunity to learn from the papers they were asked to review. In these ways the review process contributed to the development of the networking and intellectual strands of their academic identity as engineering education researchers. The intentional use of peer review to contribute to each others' development as researchers has implications for lifting the profile of the engineering education community and the AAEE community in particular:

...in terms of the profile of engineering education research, I think it's really vital that we do this...as a community” [intermediate, ATN]

Conclusions

The three strands in the identity-trajectory concept are intellectual, networking and institutional which interact over time. Intertextual networking is a facet of the broader networking strand and the AAEE community contributes to each others' intertextual network through the peer review process. This paper demonstrates the capacity of peer review to contribute to or impede the development of an author's intellectual strand and their networking strand, we urge reviewers to be mindful of this potential when writing reviews. The continued importance and relevance of the AAEE

conference for the intellectual and networking strands of its community members is apparent for researchers, irrespective of their level of experience.

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Mapping the engineering education research landscape in Australia

Anne Gardner^a and Keith Willey^a.

Faculty of Engineering and IT, University of Technology, Sydney

Anne.Gardner@uts.edu.au; Keith.Willey@uts.edu.au

BACKGROUND

Engineering education research is still consolidating as a recognised research area in Australian universities. A current project funded by the US National Science Foundation is attempting to develop a taxonomy for engineering education as a research area. Our project takes a slightly different perspective by using a landscape model to describe engineering education as a knowledge domain that includes a variety of areas of endeavour.

PURPOSE

This paper is motivated by questions around the range of topics being addressed in the AAEE community and as a means of initiating a discussion about how we define, evaluate, understand and move within our research domain.

APPROACH

This paper reports data collected as part of a wider project examining the peer review process for the Australasian Association for Engineering Education (AAEE) annual conference. During semi-structured interviews nineteen participants used one or two coloured adhesive stars to locate their paper on a model of the engineering education research landscape presented in this paper. The location of the stars was then analysed in relation to various elements of the model and the explanations were coded in NVivo 10 for themes relating to the star location.

OUTCOMES

All participants could locate the topic of their conference paper on the presented model, and articulate clearly why their star belonged in the selected location demonstrating an individual understanding of the focus and outcomes of their research. Not surprisingly most stars were clustered in the 'teaching and learning of engineering' element or on one of the trajectories leading to it. This reflects that for many participants, their educational publications are inextricably linked to their practice of teaching engineering. Interestingly, there were strong voices from participants across all expertise levels and university types against a perceived move to make the annual AAEE conference focus on theoretical research. This was seen as a move towards exclusivity and a lack of acceptance for practice-based studies.

CONCLUSIONS

The landscape model presented in this paper successfully stimulated dialogue around both the nature and the areas of research in our community and allowed participants to appreciate where they are positioned in the landscape. Such a dialogue will help us define our research domain and support both colleagues and postgraduate students seeking to participate in or move within it. We suggest it can also be used to dissipate some of the tensions developing in AAEE about the standard and value of research. We argue that a practice versus theoretical research dichotomy is ultimately divisive and that our national conference should provide a forum for all authors in an environment aimed at improving the quality of publications and the development of academics wherever they are in the landscape.

KEYWORDS

Engineering education research, academic development.

Introduction

Engineering education research is still consolidating as a recognised research area in Australian universities (King 2008; Kavanagh et al 2012). A current project funded by the US National Science Foundation is attempting to develop a taxonomy for engineering education as a research area (Finelli, 2013). Our project takes a different perspective. Finding out what topics members of the AAEE community are researching will enable us to view engineering education as a knowledge domain that includes a variety of areas of endeavour. Our intention is to assist engineering education researchers to appreciate the differences in methods, frameworks and theories typically used in different parts of the landscape. Our aim is for the landscape to be used as the foundation for conversations to facilitate the social construction and subsequent understanding of the community standards and norms used to judge research quality. This will help the community to articulate and understand observed changes in an academic's research as they develop their expertise in the research area, as well as provide a language for emerging researchers to plan this development if that is what they want to do.

Currently the differences within engineering education research discussed above are not well understood. A contributing factor is that the field is both emerging and interdisciplinary resulting in a wide variety of views as to what quality research looks like (Borrego & Bernhard 2011).

Borrego (2007) cites a researcher developmental hierarchy proposed by Streveler et al (2007) as follows:

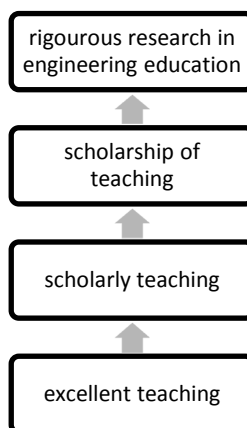


Figure 1: Levels of 'rigour' in investigation (Borrego, 2007)

This hierarchical trajectory has contributed to tension in the field of engineering education research between practice-based studies and theoretical research. This trajectory appears to preference theoretical research irrespective of the quality of the work undertaken. We would argue that theoretical research studies can be poorly conceptualised, carried out and reported and that practice-based studies that would be classified as scholarship of teaching can be well conceptualised, undertaken and reported. Furthermore, such a hierarchy does not assist a novice researcher (whether applied or theoretically focussed) to develop their expertise.

Jesiek et al (2010) report the results of discussions at workshops on engineering education research at various locations around the world. They note the perceptions of theoretical studies being preferenced over practical studies and consensus around the need for strong links between teaching practice and theoretical research:

One global colloquium group characterised engineering education research as 'stratified from local to rigorous' and they expressed concerns about the field

being overly focused on the latter. Still other colloquium participants warned that a lack of strong researcher–practitioner ties could come with a ‘danger of elitism’.(p.126)

Tension between practical studies and theoretical research in this field has also been noted in the National Research Council report (2012) on discipline-based education research in undergraduate science and engineering:

Publications intended for practitioners to support change in classroom teaching generally earn less professional recognition than research-focused journals ... High quality research papers published in journals that practitioners are less likely to read may have less influence on classroom culture.(p.2.14)

This report acknowledges that both theoretical and applied studies are “*valuable and important*”.

A wide-ranging study by Jesiek et al. (2011) based on analysis of over 800 articles presenting empirical data in a large number of publications between 2005 and 2008 found

...continued strong interest in many subjects long viewed as central facets of engineering education, including assessment, collaborative/team learning, design, and educational/instructional technologies. Further, we observe an historical shift away from research explicitly focused on teaching and toward studies that examine students and learning, global engineering education, problem- and project-based learning, and graduate outcomes/attributes. (Jesiek et al 2011, p.87)

This shift in focus could be interpreted as a function of development of the field of engineering education research. It is pleasing to note that they identified Australia as a particularly active engineering education community, along with the US and Europe. However the development of the field is a function of the development of the individual researchers in it and hence we focus on researchers and the progression of their research in our community.

This paper reports data collected as part of a wider project examining the peer review process for the Australasian Association for Engineering Education (AAEE) annual conference. It is motivated by questions around the differences in understanding of how engineering education research is defined, how its quality is evaluated and improved, what the domain looks like and the characteristics of researchers at different levels of expertise. We hope that the community will use this research as a means of initiating discussions about how we define, understand, build and strengthen our research domain.

Method

The study focuses on engineering academics at Australian universities with engineering qualifications, who are also ‘active’ members of AAEE. We defined engineering academics as ‘active’ members of AAEE if they authored a paper for the 2012 AAEE conference AND at least one of the three previous years’ AAEE conferences. The author list from these conferences (available in the proceedings) was used to identify potential participants. We wanted people to feel free to share their research experiences so excluded Sydney-based universities in deference to those academics who see universities as being in competition with each other. The remaining thirty-eight eligible academics were invited to participate in the research project. Nineteen of these authors, shown listed in Table 1, accepted this invitation.

Participants were classified according to what type of university they work for (Group of Eight (Go8), Australian Technology Network (ATN), regional, or metropolitan

unaligned, as described in Table 1) as institutional identity has been shown to influence an individual's academic identity development (McAlpine & Amundsen, 2011).

Participants were also classified according to their level of expertise in engineering education research, as intellectual development is another aspect of academic identity (McAlpine and Amundsen, 2011). A participant's level of expertise was assessed by a number of indicators including the types and number of publications they had written in the last four years (conference papers, journal papers, book chapters), whether they had been a project leader of an educational investigation or research grant where the funding was provided through a nationally competitive process, whether they are supervising research students working on educational related topics, and whether they were currently serving in an editorial role for an educationally related journal. Using this system, participants fell into three broad groups: emerging, intermediate, and established researchers.

Table 1: Participants' pseudonym, level of experience & type of university

Participants	Level of experience	Type of university	Description
Adele Evan Mark Tom	emerging	Group of Eight [Go8]	The 'Group of Eight' (http://www.go8.edu.au/home) is a coalition of eight research-intensive universities located in state capital cities, which tend to be the oldest universities in Australia.
Neil	intermediate		
Stuart	established		
Therese	intermediate	Australian Technology Network [ATN]	The ATN is an alliance of five universities, each located in the capital city of a mainland state of Australia. These universities badge themselves as practice-based and their research is focussed on the needs of industry and the community.
Rob Steve	established		
Alex Wayne	emerging	Regional	Regional universities are those with their main campus in a regional city or town rather than a state capital city. As well as on-campus students, these universities are characterised by significant numbers of external/distance students.
Sam	intermediate		
Dennis Erica	established		
Terry Mike Ian	emerging	Metropolitan unaligned	The metropolitan unaligned universities are those based in a state capital city, but not included in the Go8 or the ATN.
Nathan	intermediate		
Will	established		

Participants used one or two coloured adhesive stars (the colour was the participant's choice) to locate their paper on a model of the engineering education research landscape as shown in Figure 2 and then explain why they had stuck their star/s in the position they did. The location of the stars was then analysed in relation to the various neighbourhoods and elements of the model. Transcripts were created from audio recordings of the interviews, which were then coded in NVivo 10 for the themes in participants' explanations for their selected location.

In this paper, we discuss how participant responses were used to:

- verify and refine the range of different research areas within which members of the AEE community are working ie what the domain looks like,
- identify the characteristics of emerging, intermediate and experienced researchers.

The model (see Figure 2) represents broad aspects or topic areas of interest to the AAEE community. These broad categories were established from an overview of topic areas that people in the AAEE community have reported on in the last three AAEE conferences. One 'neighbourhood' in this landscape is the teaching and learning of engineering. This encompasses what we do in the classrooms, or workshops, or at university generally with engineering students enrolled in our subject, and the students that we do that with. We like to think that this is influenced by engineering practice, another 'neighbourhood' encompassing professional engineers practising their profession in industry. We also like to think that the teaching and learning of engineering and research into the teaching and learning of engineering is influenced by the methods and outcomes from social research particularly in learning theories, so this forms another neighbourhood on our landscape. The final area on the landscape model is what we call engineering of education, and that's where we tend to use the same skills and ways of thinking and looking at things that we've adopted or learned because we've been trained as engineers, on our subjects and in our research on our subjects. This might be for example treating issues in our subjects as problems to 'solve' or products to design and we evaluate the outcomes of this process..

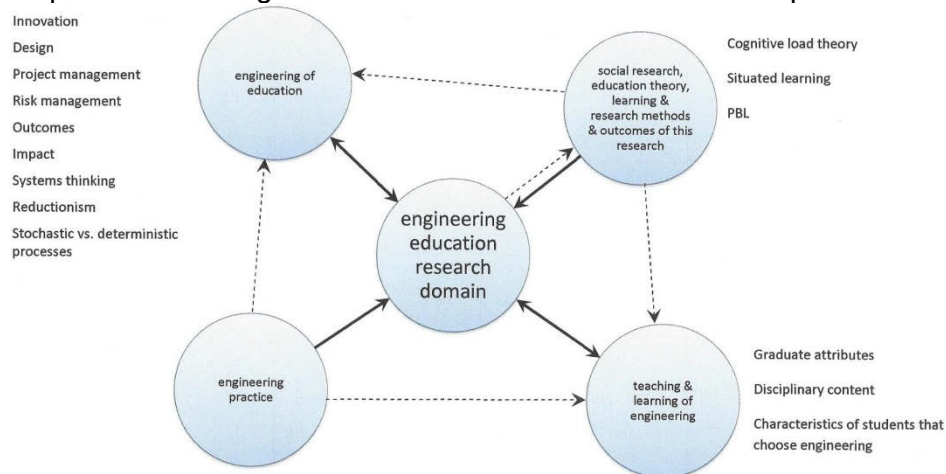


Figure 2: Engineering Education Research landscape

This model is not meant to definitively describe the engineering education research landscape, but was rather devised to provide a basis for members of the community to articulate their area/s of activity and evaluate their activity and research in terms of its characteristics rather than typical research metrics around a publication 'count' ie to start a conversation.

Outcomes & Discussion

All participants could locate the topic of their conference paper on the presented model, and clearly articulate why their star/s belonged in the selected location demonstrating an individual understanding of the focus and outcomes of their research and that the model is a good approximation of our community's landscape. Most stars were clustered in the 'teaching and learning of engineering' element or on one of the trajectories leading to it. This reflects that for many participants, their educational publications are inextricably linked to their practice of engineering teaching. There were strong voices from participants across all expertise levels and university types opposing a perceived move to make the annual AAEE conference focus on theoretical research. This was interpreted as a move towards exclusivity and a lack of acceptance for scholarship type investigations and non-theoretical research and echoes similar views reported in other geographical locations by Jesiek et al (2010).

Firstly we observe that all participants could locate the topic of their paper on the presented model, even if it took a little thinking for some of them. One established researcher (Dennis) added a region of activity (secondary school system) to the model to be able to do this, and this area will be included in future. They could also articulate why their star belonged in that location:

I think this is about teaching and learning of engineering. So it's about engineering education practice. So I think it sits here. [Mike, emerging, metropolitan unaligned]

We've brought something that was developed in engineering practice into teaching and learning to try and change the way we teach to look more like what happens in engineering practice. So that's a bit of an example of engineering of education. [Therese, intermediate, ATN]

I think it sits in two diagonally opposite corners and I think it sits quite clearly in both.... It's what we're getting the students to do, but it's about how we develop that assessment process so it's the engineering of it. It's the design of it in order to meet particular requirements. So I'd say 50 per cent in each. [Erica, established, regional]

Emerging researchers' stars are shown in Figure 3. Except for Tom, these participants were able to locate the activity area of their paper with one star, with most clustered in the 'teaching and learning of engineering' neighbourhood. These participants typically wrote about the subject they were teaching and/or managing, except for Adele and Alex who were concerned with questions not specifically related to any one subject, but general sector-wide questions, which aligns with their stars being located in the 'social research' vicinity. Mark also stuck his star near social research because he is intentionally drawing on research from the education domain to investigate the subject he is teaching. Wayne located his star on the trajectory between teaching and learning and social research because he is starting to think about incorporating some findings from educational research into his own research design. Terry's area of teaching and mainstream engineering research is a practice-oriented aspect of engineering and his identification with this area is illustrated in locating his star on the 'engineering practice' trajectory, as shown in Figure 3, even though his paper is essentially about evaluating practice in the subject that he teaches.

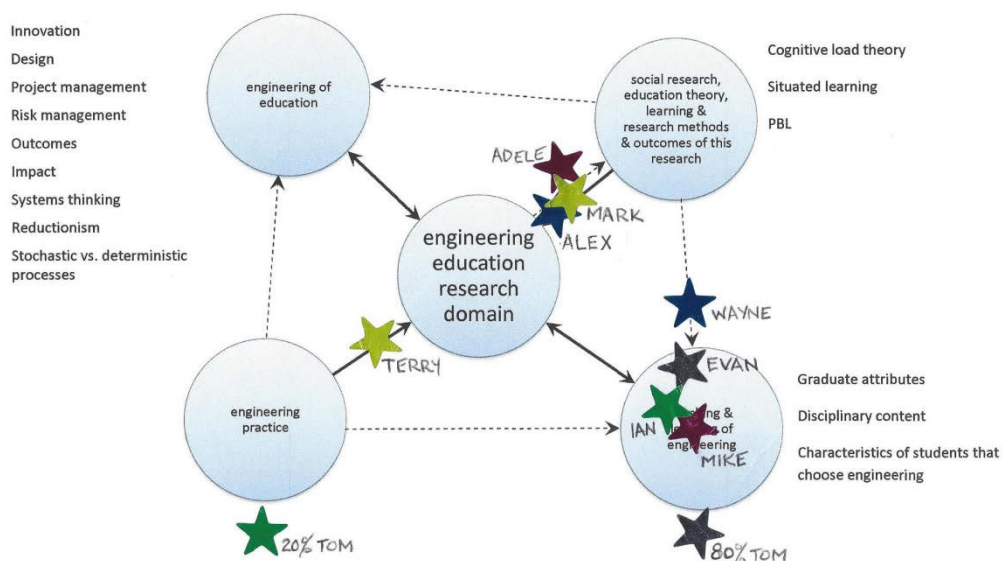


Figure 3: Where emerging researchers located their AAEE 2012 conference paper

Figure 4 shows where intermediate researchers located their stars. We note in contrast to the emerging researchers, that all of these participants, except for Sam,

used two stars to locate their paper. Also in contrast to the emerging researchers, all but one of the intermediate researchers placed at least one of their stars in the 'engineering of education' area. Stars were fairly equally clustered in the 'teaching and learning of engineering' and 'engineering of education' vicinities. This suggests to us that intermediate researchers may be addressing more integrated questions than those addressed by emerging researchers.

Established researchers (shown in Figure 5) were also generally split between two stars or placed their one star towards the middle of a trajectory between two activity areas, suggesting that they are addressing integrated questions. The exception here is Stuart who has taken a deep rather than broad approach to his research. It is also interesting that an established researcher, namely Dennis, added the activity area of secondary school system to the presented model. Apart from Stuart, these participants are involved in projects in a range of areas, or which integrate a range of areas:

...it's that big scale stuff that interests me more than at the course level...so all of these things tend to blur. [Rob, Go8]

...it's hard to actually pigeon hole because there are components that I do...I consider myself quite diverse...I move across different spaces. [Steve, ATN]

... the questions that I have are really sector wide but generally still within an engineering context. [Will, metropolitan unaligned]

I don't think that I've got any papers over the years that have been just in one of these domains.... I think most papers I've written would cross over... So yeah, I've got fingers in lots and lots of different pies. [Erica, regional]

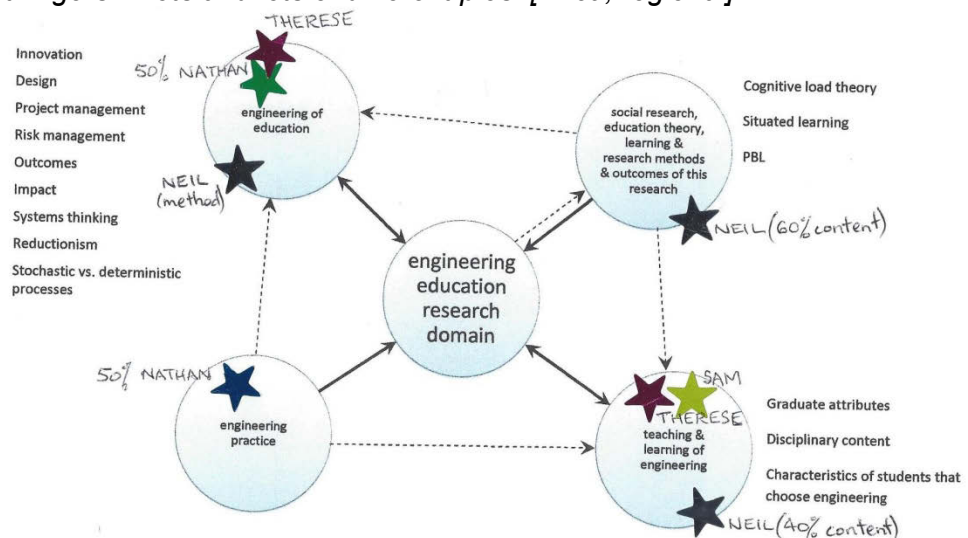


Figure 4: Where intermediate researchers located their AAKE 2012 conference paper

Figure 6 also allows us to interpret the extent of research activity in our community. This figure shows that there is much activity in the teaching and learning neighbourhood, some in the engineering practice area and some of this activity is aimed at bringing engineering practice into teaching and learning practice. What is interesting to note here is that those in the teaching and learning neighbourhood are across all levels of expertise ie emerging, intermediate and established researchers.

There were strong voices from our participants opposing what they saw as a move to make the annual AAEE conference exclusively focussed on theoretical research, which comes from conceptualising researchers' activity in a hierarchy as shown in the model in Figure 1. These calls for the continued inclusion of practice papers in the conference came from participants across all expertise levels and university types:

We want everyone to feel part of the community and to be valued for their contributions and not get into some kind of us and them...That's just not at all helpful. [Rob, established, ATN]

There's always been this idea that there's fundamentally two types of papers we see at the conference. What they call the show and tell paper and the research papers - the engineering research papers...Well, but the worry of that has been that it would divide the camp into the elitists and the apprentices, the people that aren't quite there yet, but let's patronise them for a while. I don't think it needs to be like that at all. I mean, I would hate to divide the community. I would hate to be perceived as becoming more elite. [Neil, intermediate, Go8]

This conference seemed to take the view that ... they were trying to move to a more research based place, and downplay the practice aspect...If you're reporting on practice...it tells those people that they're not valued at the conference [Mark, emerging, Go8]

...if engineering education and research doesn't inform practice in Australian universities, then it's missed the point...I got this overwhelming feeling that the people in the audience didn't feel connected to AAEE as an organisation, because they are all practitioners and AAEE seems to be running an agenda of engineering education research, which not is not necessarily related to improving practice [Mike, emerging, metropolitan unaligned]

The landscape is a starting point for a different way of characterising papers and shows the range of types of topics academics in engineering education are involved in. We suggest a more fruitful conversation for our community is discussing the characteristics of quality rather than what is the best 'type' of research to be doing. By showing the range of topics that engineering education authors are writing about, a landscape model can also be used to demonstrate that engineering education as a knowledge domain includes a variety of areas of endeavour. In the interviews reported in this paper the landscape model successfully stimulated dialogue around the nature of topics in our community and allowed people to find a home in the landscape. This dialogue is important for a knowledge domain which is still emerging as a recognised area in Australian universities (King 2008; Kavanagh et al 2012), and when government research policies propagate the view of research as a commodity:

This is particularly worrying in some of the newer disciplines and in education...where researchers may be endeavouring to establish new forms of inquiry." (Brew, p.283)

We suggest that the landscape can also be used to help researchers articulate what area/s they might want their research to be located in, and encourage an attitude that it is acceptable to be in any part of the landscape.

As noted in the NRC report (2012) theoretical research is no more important than practice-based research. Hence, the authors believe that it is possible to achieve high

quality research by staying within the teaching and learning of engineering part of the landscape, as demonstrated by some of our established researchers Erica, Dennis, Rob and Steve. More experienced researchers see their research from different perspectives and views and are aware that the impact of both variables and the investigation context is complex. Their papers typically contain focussed and critical literature reviews, and they use methods appropriate to the investigation. We argue that we should be looking to encourage improvements in quality of the studies we conduct within our community in all areas of the landscape using the characteristics of the work of our established researchers, rather than moving people to a specific area within the landscape. This could begin with an acknowledgement that the quality of the work is not dictated by the position on the landscape but rather the quality of the processes and thinking applied to the researcher's investigation. We believe this would dissipate tension arising from the perceived preferential status of theoretical research in the community.

To be a community we should be socially constructing our understanding of the accepted standards and norms in our field of research. We need a way of personally evaluating our research and what is required to make any movements or adjustments that we may choose in the level or location of the research that we undertake. The landscape has the capacity to assist the community to achieve both these goals and ultimately help us to establish our research field through more inclusive dialogue. The landscape also allows us to identify other community members working in the same vicinity and hence identify potential mentors and/or collaborators to help us develop as individual researchers and consequently the research field we work in.

Conclusions

The landscape model presented in this paper successfully stimulated dialogue around the nature of topics in our community and allowed participants to find a place to belong in the landscape. We argue that such a dialogue will help us identify our research domain and support colleagues and postgraduate students seeking to participate in or move within it. One indication of progress of a new researcher on their developmental journey is the use of multiple perspectives and dimensions in their research. A practice versus research dichotomy is ultimately divisive and our national conference should provide a forum for all authors in an environment aimed at improving the quality of publications and the development of academics wherever they are on the landscape.

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Mapping the landscape of engineering education research: an Australian perspective

Gardner, A.²

Senior Lecturer, Faculty of Engineering & Information Technology
University of Technology, Sydney
Sydney, Australia

Willey, K.

Senior Lecturer, Faculty of Engineering & Information Technology
University of Technology, Sydney
Sydney, Australia

Conference Topic: Educational Research Methods

INTRODUCTION

Engineering education research is still consolidating as a recognised research area in Australian universities [1, 2]. A current project funded by the US National Science Foundation is attempting to develop a taxonomy for engineering education as a research area [3]. Our project takes a different perspective. Finding out what topics members of the AAEE community are researching will enable us to view engineering education as a knowledge domain that includes a variety of areas of endeavour. Our intention is to assist engineering education researchers to appreciate the differences in methods, frameworks and theories typically used in different parts of the landscape. Our intention is for the landscape to be used as the foundation for conversations to facilitate the social construction and subsequent understanding of the community standards and norms used to judge research quality. This will help both the community and individuals to articulate and understand observed changes in their and their peers' research as expertise is developed, as well as provide a language for researchers, particularly those new to the field to plan, discuss and evaluate this development if they so choose.

Currently the differences within engineering education research discussed above are not well understood. A contributing factor is that the field is both emerging and interdisciplinary resulting in a wide variety of views as to what quality research looks like [4]. Borrego [5] cites a researcher developmental hierarchy proposed in [6] as shown in Fig. 1. This hierarchical trajectory has contributed to tension in the field of engineering education research between practice-based studies and theoretical research. Rightly or wrongly this trajectory has been interpreted as preferencing theoretical research irrespective of the quality of the work undertaken. We would argue that just because a research study is theoretically situated does not prevent it from being poorly conceptualised, conducted and / or reported. Conversely, many practice-based studies that the hierarchy would classify as scholarship of teaching exhibit the characteristics of what the hierarchy refers to as rigorous research. Furthermore, such a hierarchy suggests to a novice researcher (whether applied or theoretically focussed) that a single sequential path exists to improve their research.

Discussions at workshops on engineering education research at various locations around the world support a general perception that theoretical studies are preferred for publication and funding over practical studies [7]. There was also consensus around the need for strong links between teaching practice and theoretical research:

One global colloquium group characterised engineering education research as 'stratified from local to rigorous' and they expressed concerns about the field being overly focused on the latter.

² Corresponding Author: Gardner, A.

Still other colloquium participants warned that a lack of strong researcher–practitioner ties could come with a ‘danger of elitism’. [7, p.126]

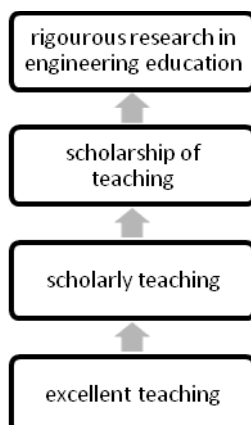


Figure 1: Levels of ‘rigour’ in investigation [5]

Tension between practical studies and theoretical research in this field has also been noted in the National Research Council report [8] on discipline-based education research in undergraduate science and engineering:

Publications intended for practitioners to support change in classroom teaching generally earn less professional recognition than research-focused journals ... High quality research papers published in journals that practitioners are less likely to read may have less influence on classroom culture.[8, p.2.14]

This paper is motivated by questions around the differences in understanding of how engineering education research is defined, how its quality is evaluated and improved, what the domain looks like and the characteristics of researchers at different levels of expertise. It is based on the premise that development of the field is a function of the development of the individual researchers within it and hence we focus on researchers and the progression of their research in our community. That such questions are relevant to our community are evidenced by recent editorials in JEE and EJEE [9, 10]. We encourage the community to use this research as a means of initiating discussions about how we define, understand, build and strengthen our research domain.

METHOD

The study focuses on engineering academics at Australian universities with engineering qualifications, who are also ‘active’ members of AAEE. We defined engineering academics as ‘active’ members of AAEE if they authored a paper for the 2012 AAEE conference AND at least one of the three previous years’ AAEE conferences. The author list from these conferences (available in the proceedings) was used to identify thirty-eight potential participants. Nineteen of these authors, shown listed in Table 1, accepted this invitation.

Participants were classified according to what type of university they work for as institutional identity has been shown to influence an individual’s academic identity development [11]. Participants were also classified according to their level of expertise in engineering education research, as intellectual development is another aspect of academic identity [11]. A participant’s level of expertise was assessed by a number of indicators including the types and number of publications they had written in the last four years (conference papers, journal papers, book chapters), whether they had been a project leader of an educational investigation or research grant where the funding was provided through a nationally competitive process, whether they are supervising research students working on educational related topics, and whether they were currently serving in an editorial role for an educationally related journal. Using this system, participants fell into three broad groups: emerging, intermediate, and established researchers.

A model of the engineering education landscape (see Figure 2) was developed showing general aspects or topic areas of interest to the AAEE community. The categories were established from an overview of topic areas that people in the AAEE community have written about in the last three AAEE conferences. One 'neighbourhood' in this landscape is the teaching and learning of engineering. This encompasses what we do in the classrooms, or workshops, or at university generally with engineering students enrolled in our subject, and the students that we do that with. We suggest that this is influenced by engineering practice, another 'neighbourhood' encompassing professional engineers practising their profession in industry. We also suggest that the teaching and learning of engineering and research into the teaching and learning of engineering is influenced by the methods and outcomes from social research particularly in learning theories, so this forms another neighbourhood on our landscape. The final area on the landscape model is what we call engineering of education, and that's where we tend to use the same skills and ways of thinking and looking at things that we've adopted or learned because we've been trained as engineers, on our subjects and in our research on our subjects. This might be for example treating issues in our subjects as problems to 'solve' or products to design and we evaluate the outcomes of this process.

This model is not meant to definitively describe the engineering education research landscape, but was rather intended to provide a catalyst for members of the community to develop their research literacy building a language to articulate their area/s of activity and to assess and evaluate this activity and research in terms of its characteristics rather than typical and often misleading research metrics such as publication 'count'. We have since modified the model by removing the central circle as it was interpreted by some as being a separate domain rather than the parent activity within which the four specified neighbourhoods are all immersed, but present here the model as used with our participants.

Participants used one or two coloured adhesive stars (the colour was the participant's choice) to locate their paper on the landscape model and then explain why they had stuck their star/s in the position they did. The location of the stars was then analysed in relation to the various neighbourhoods and elements of the model. Transcripts were created from audio recordings of the interviews, which were then coded in NVivo 10 for the themes in participants' explanations for their selected location.

The landscape model was also used in a workshop at the 2013 AAEE conference. Posters produced by participants and recordings of the discussion of two groups at the workshop provide us with additional data. One group recorded were those who located their research work in the social science neighbourhood of the landscape. This group had members with a mixture of expertise levels from emerging to established. The other recording was of a group who located their research in the teaching and learning neighbourhood and who were all emerging researchers.

In this paper, we discuss how participant responses were used to verify and refine the range of different research areas within which members of the AAEE community are working i.e. what the domain looks like, and identify the characteristics of emerging, intermediate and experienced researchers.

Table 1: Participants' pseudonym, level of experience & type of university

Participants	Level of experience	Type of university	Description
Adele Evan Mark Tom	emerging	Group of Eight [Go8]	The 'Group of Eight' (http://www.go8.edu.au/home) is a coalition of eight research-intensive universities located in state capital cities, which tend to be the oldest universities in Australia.
Neil	intermediate		
Stuart	established		
Therese	intermediate	Australian Technology Network [ATN]	The ATN is an alliance of five universities, each located in the capital city of a mainland state of Australia. These universities badge themselves as practice-based and their research is focussed on the needs of industry and the community.
Rob Steve	established		
Alex Wayne	emerging	Regional	Regional universities are those with their main campus in a regional city or town rather than a state capital city. As well as on-campus students, these universities are characterised by significant numbers of external/distance students.
Sam	intermediate		
Dennis Erica	established		
Terry Mike Ian	emerging	Metropolitan unaligned	The metropolitan unaligned universities are those based in a state capital city, but not included in the Go8 or the ATN.
Nathan	intermediate		
Will	established		

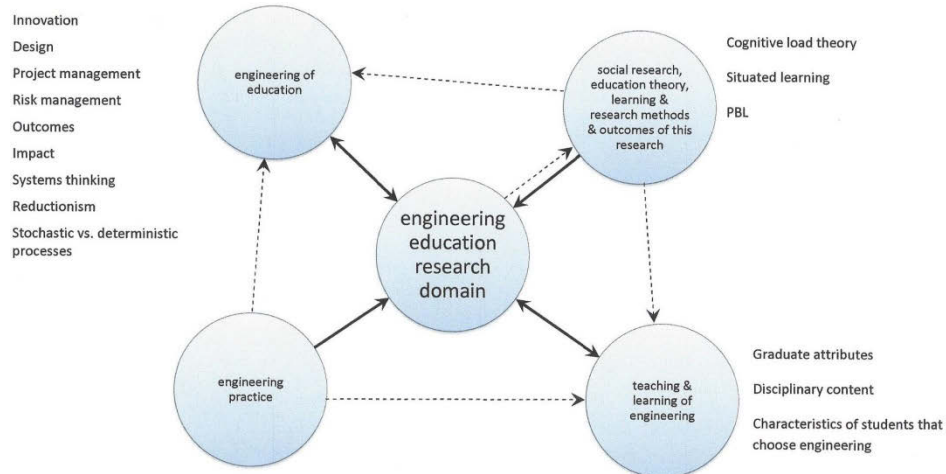


Figure 2: Engineering Education Research landscape

FINDINGS AND DISCUSSION

All interviewed participants could locate the topic of their conference paper on the presented model, although for some this required some thought and reflection. One established researcher (Dennis) added a region of activity (secondary school system) to the model to be able to do this, and this area will be included in future. They could also clearly articulate why their star/s belonged in the selected location demonstrating an individual understanding of the

focus and outcomes of their research and that the model represents a good approximation of our community's activity landscape:

I think this is about teaching and learning of engineering. So it's about engineering education practice. So I think it sits here. [Mike, emerging, metropolitan unaligned]

We've brought something that was developed in engineering practice into teaching and learning to try and change the way we teach to look more like what happens in engineering practice. So that's a bit of an example of engineering of education. [Therese, intermediate, ATN]

I think it sits in two diagonally opposite corners and I think it sits quite clearly in both.... It's what we're getting the students to do, but it's about how we develop that assessment process so it's the engineering of it. It's the design of it in order to meet particular requirements. So I'd say 50 per cent in each... [Erica, established, regional]

Most stars of both the interviewed and workshop participants were clustered in the 'teaching and learning of engineering' element or on one of the trajectories leading to it. This reflects that for many participants, their educational publications are inextricably linked to their practice of engineering teaching.

The stars of emerging researchers' are shown in Figure 3. Except for Tom, these participants were able to locate the activity area of their paper with one star, with most clustered in the 'teaching and learning of engineering' neighbourhood. These participants typically wrote about the subject they were teaching and/or managing, except for Adele and Alex who were concerned with questions not specifically related to any one subject, but general sector-wide questions, which aligns with their stars being located in the 'social research' vicinity. Mark also stuck his star near social research because he is intentionally drawing on research from the education domain to investigate the subject he is teaching. Wayne located his star on the trajectory between teaching and learning and social research because he is starting to think about incorporating some findings from educational research into his own research design. Terry's area of teaching and mainstream engineering research is a practice-oriented aspect of engineering and his identification with this area is illustrated in locating his star on the 'engineering practice' trajectory, as shown in Figure 3, even though his paper is essentially about evaluating practice in the subject that he teaches.

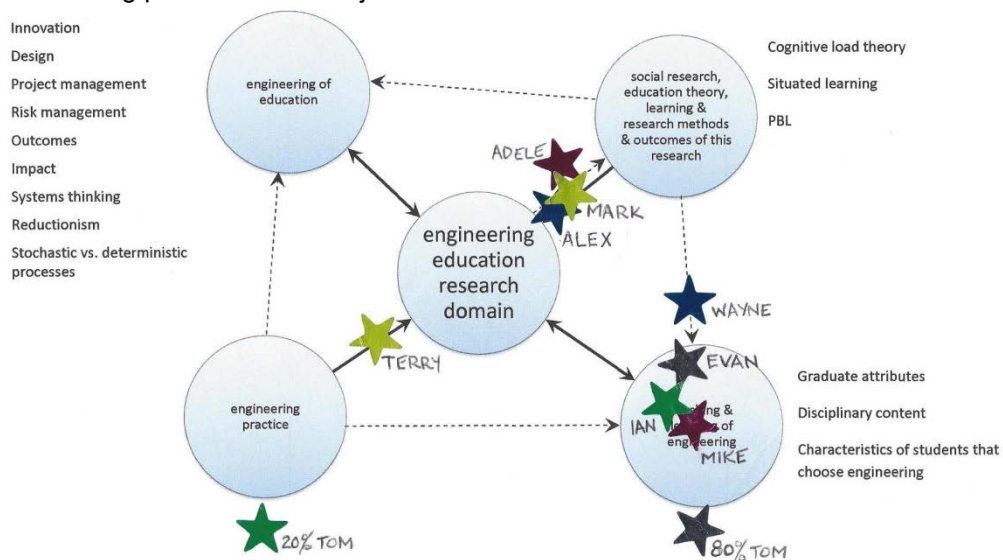


Figure 3: Where emerging researchers located their AAEE 2012 conference paper

Interestingly, Adele, Alex, and Mark who located their stars on the social science trajectory all worked closely with colleagues from a social science background in undertaking the research reported in their papers. We suggest that this strongly influenced their choice of research question, method and interpretation. Wayne collaborated with an established researcher whose wider perspective also moved him out onto the trajectory to the social research vicinity of the landscape. Given the positive developmental influence of these collaborations it is not surprising

that the emerging researchers at the 2013 conference workshop were actively seeking mentors or an educational research guide:

I would like to have the Dummies Guide to Educational Research. [emerging, ATN]

I would like to get some collaborations going with someone who really does some educational research,,, to formulate my survey question better and evaluating properly what we've already done.[emerging, regional]

However they were able to assist each other by identifying a useful person at the conference or making a resource available:

You should talk to [name of another conference delegate]...

I have a USB from a good workshop on that – I'll bring it tomorrow and you can download it to your laptop...

Figure 4 shows where intermediate researchers located their stars. We note in contrast to the emerging researchers, that all of these participants, except for Sam, used two stars to locate their paper. Also in contrast to the emerging researchers, all but one of the intermediate researchers placed at least one of their stars in the 'engineering of education' area. Stars were fairly equally clustered in the 'teaching and learning of engineering' and 'engineering of education' vicinities. This suggests to us that intermediate researchers may be addressing more integrated questions than those addressed by emerging researchers.

Established researchers (shown in Figure 5) were also generally split between two stars or placed their one star towards the middle of a trajectory between two activity areas, suggesting that they are addressing integrated questions. The exception here is Stuart who has taken a deep rather than broad approach to his research. It may seem surprising that the emerging researchers did not locate their stars in the social research neighbourhood. Recalling that they were asked to indicate the dominant location for one particular paper, this is perhaps not so surprising. Established researchers may be using the methods of social research to achieve a particular outcome and it is the outcome that is foremost in their mind. It is also interesting that an established researcher, namely Dennis, added the activity area of secondary school system to the presented model. The established researchers were generally involved in projects in a range of areas, or which integrate a range of areas requiring them to exercise multiple perspectives, discernment and judgement:

...it's that big scale stuff that interests me more than at the course level...so all of these things tend to blur. [Rob, ATN]

...it's hard to actually pigeon hole because there are components that I do...I consider myself quite diverse...I move across different spaces. [Steve, ATN]

... the questions that I have are really sector wide but generally still within an engineering context. [Will, metropolitan unaligned]

I don't think that I've got any papers over the years that have been just in one of these domains.... I think most papers I've written would cross over... So yeah, I've got fingers in lots and lots of different pies. [Erica, regional]

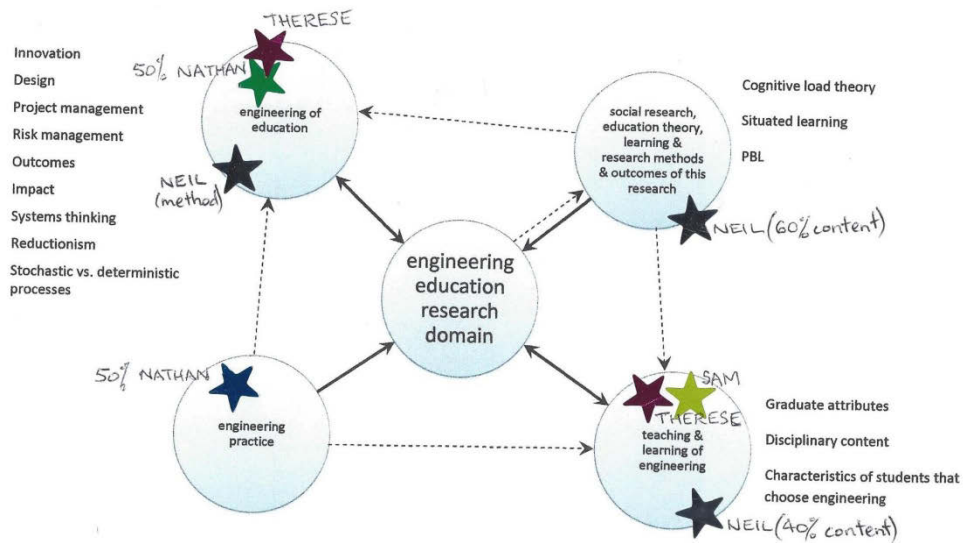


Figure 4: Where intermediate researchers located their AAEE 2012 conference paper

Figure 6 shows the location of stars of all the participants interviewed. Most stars are clustered in the 'teaching and learning of engineering' element or on one of the trajectories leading to it. As previously stated this reflects that for many participants their educational research is inextricably linked to their practice of engineering teaching. What is interesting to note here is that those in the teaching and learning neighbourhood are across all levels of expertise ie emerging, intermediate and established researchers and that even those identifying with the social research vicinity at the 2013 AAEE conference workshop are "looking for change in teaching practices" as a result of their research. We argue that this conviction that research should be applied or implemented comes from our engineering discipline background, as Faculty of Education researchers that we have worked with are often content to develop theoretical understandings and leave it to others to interpret or identify how they can be adapted in practice. We are not advocates of our community becoming social science 'clones'. In the same way that we use the findings of science in our engineering work, we should use the findings of social science in our engineering education work. Engineering education researchers should allow their perspectives and skills to flavour their research providing perspectives and insights that often differentiates their work from educational research in engineering.

There were strong voices from our interviewed participants opposing what they interpreted as a move to make the annual AAEE conference focus more on theoretical research as a means of improving the quality of research within the community as suggested by the hierarchical shown in Figure 1. This was perceived as a move towards exclusivity and a lack of acceptance for scholarship type investigations and non-theoretical research and echoes similar views reported in other geographical locations [7]. These calls for the continued inclusion of practice papers in the conference came from participants across all expertise levels and university types:

We want everyone to feel part of the community and to be valued for their contributions and not get into some kind of us and them... That's just not at all helpful. [Rob, established, ATN]

There's always been this idea that there's fundamentally two types of papers we see at the conference. What they call the show and tell paper and the research papers... the worry of that has been that it would divide the camp into the elitists and the apprentices, the people that aren't quite there yet, but let's patronise them for a while. I don't think it needs to be like that at all. I mean, I would hate to divide the community. I would hate to be perceived as becoming more elite. [Neil, intermediate, Go8]

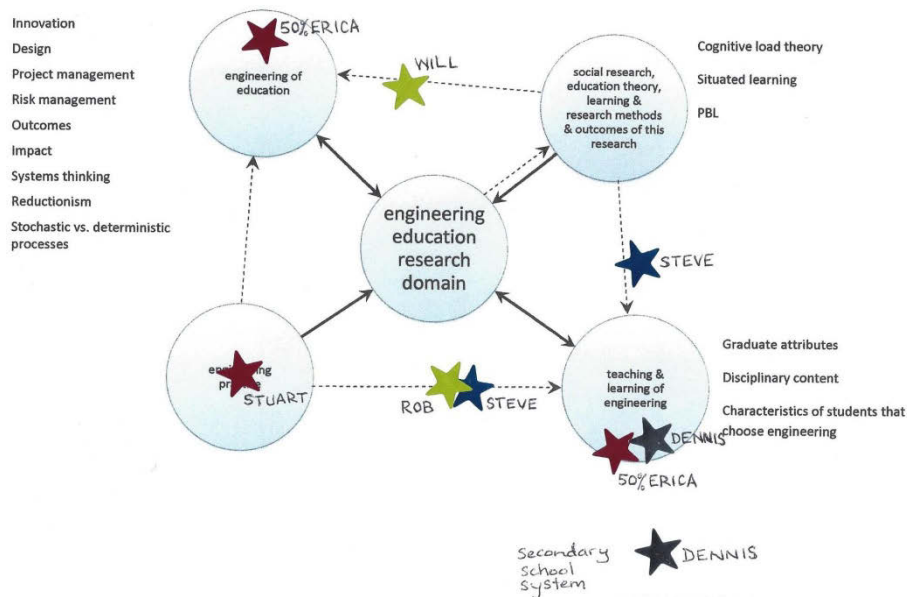


Figure 5: Where established researchers located their AAEE 2012 conference paper

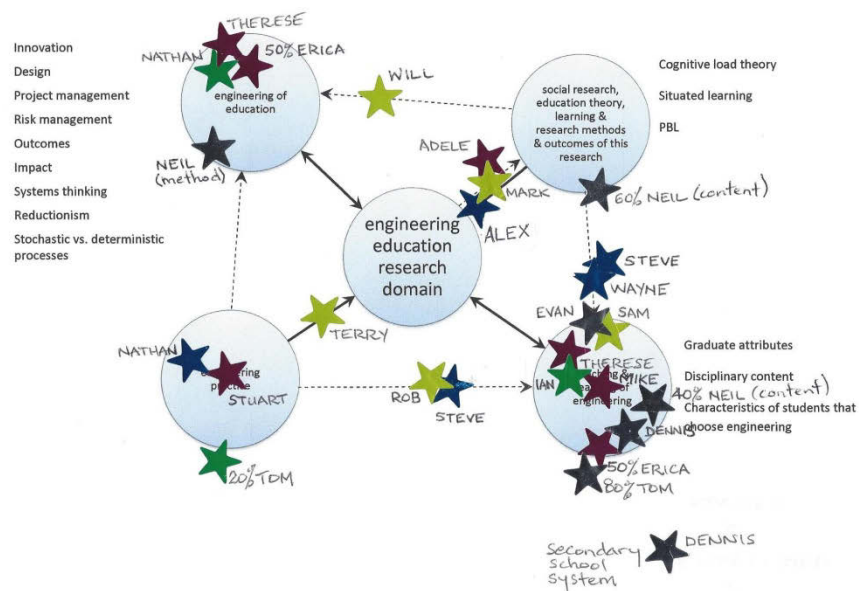


Figure 6: Where all researchers located their AAEE 2012 conference paper

This conference seemed to take the view that ... they were trying to move to a more research based place, and downplay the practice aspect...if you're reporting on practice...it tells those people that they're not valued at the conference [Mark, emerging, Go8]

This was reinforced at the 2013 conference workshop with one group asking:

How do we create an engineering education system where all people feel equally welcome to participate?

The landscape is an initial step in conceptualising the engineering education landscape of our community. We suggest our community would be better served by discussing, understanding and embracing the characteristics of research quality rather than focusing on the type of research that is being undertaken. For participants' perceptions of what characterises 'quality' research we direct the reader to a companion paper at this conference 'Authors' perceptions of peer review of conference papers and how they characterise a 'good' one.' The landscape allows us to conceptualise engineering education as a knowledge domain that includes a variety

of areas of endeavour. It allows community members to find a home within the landscape, instilling a sense of belonging and acceptance and an understanding of how they can contribute.

The landscape can also be used as the foundation for conversations to facilitate the social construction and subsequent shared understanding of the community standards and norms expected of the different endeavours and what constitutes quality research developing one's research literacy. This dialogue is important for a knowledge domain which is still emerging as a recognised area in Australian universities [1, 2] being necessary to allow informed judgements about research quality to be both made and understood. Such dialogue is also important for emerging researchers to learn the language of educational research since it is through learning this language that we frame out thoughts.

The authors share the view noted in an NRC report [8] that theoretical research is no more important than practice-based research. Furthermore we believe that high quality research can be achieved within the different parts of the landscape as demonstrated by some of our established researchers Erica, Dennis, Rob and Steve's research focusing on the teaching and learning of engineering. Hence in contrast to the model shown in figure 1 we propose a developmental model that combines the landscape model with an understanding of the characteristics exhibited in quality research as demonstrated by established researchers. We suggest that such a model would encourage improvements in quality of the studies in all areas of the landscape, rather than the perception that improvement can be achieved by adopting a specific approach or can only be achieved by moving to a particular area within the landscape.

We suggest that open discussion and engagement with such a model would also help both the community and individuals to articulate and understand observed changes in their and their peers' research as expertise is developed, as well as facilitate development of a language for researchers, particularly those new to the field to plan, discuss and evaluate this progression. This would also relieve the tension that has arisen from the perceived preferential status of theoretical research. An initial step would be an acknowledgement by our community that the quality of the work is not related to the position on the landscape nor the type of research but rather the quality of the processes, methods thinking and interpretation applied in the researcher's investigation.

To be a community we need to socially construct our understanding of the standards and norms in our field of research. We need a way of personally evaluating our research and what is required to make any movements or adjustments that we may choose in the level or location of the research that we undertake. Our developing model has the potential to assist the community to achieve both these goals and ultimately help us to establish our research field through more inclusive dialogue. The landscape also allows us to identify other community members working in the same vicinity and hence identify potential mentors and/or collaborators to help us develop as individual researchers and consequently the research field we work in. One of the comments from a participant at the AAEE 2013 workshop was the realisation of "*what a rare event it is – feeling like people will help me with my research*" and another "*appreciated the mentoring, sharing issues and hearing some wisdom come back*". The comments made by both interview and workshop participants reinforced the importance of the annual conference for researchers at all levels of expertise with across-the-board comments highlighting the difficulties of being a lone active engineering education researcher in their institution:

It's a big thing for me coming to this here, for my first time, so many people are doing so many things but I've got no other way that I'd know about that...

SUMMARY

The landscape model presented in this paper stimulated dialogue around the nature of topics and research in our community and allowed participants to find a place to belong. We argue that such a dialogue will help us identify, develop and grow our research domain and support those seeking to participate in or move within it. We propose a developmental model that combines the landscape with active pursuit of the characteristics exhibited in quality research. We found that one indication of progress of an emerging researcher on their developmental journey is their use of multiple perspectives, interpretations and dimensions in their research.

We suggest that such a model would encourage improvements in quality of the studies in all areas of the landscape, rather than the perception that improvement can be achieved by adopting a specific approach or type of research. A practice versus research dichotomy is ultimately divisive and does little to assist researchers develop their expertise. We believe national conferences should provide a forum for all authors in an environment aimed at improving the quality of research, publications and the development of academics wherever they are on the landscape.

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Authors' perceptions of peer review of conference papers and how they characterise a 'good' one

Gardner, A.³

Senior Lecturer, Faculty of Engineering & Information Technology
University of Technology, Sydney
Sydney, Australia

Willey, K.

Senior Lecturer, Faculty of Engineering & Information Technology
University of Technology, Sydney
Sydney, Australia

Conference Topic: Educational Research Methods

Introduction

Peer review has been the focus of an ongoing study at the 2010, 2011 and 2012 conferences of the Australasian Association for Engineering Education (AAEE) [1 – 3]. We found that the opportunity to use the peer review process to induct people into the field and improve research methods and practice was being missed with almost half of the reviews being rated as 'ineffectual'. The results also highlight the lack of a shared understanding in our community of what constitutes quality research. The study has been extended to explore the AAEE authors' perspective/s of the potential of peer review to support their development as researchers.

This is particularly relevant to our community as engineering education research is still emerging as a recognised research area in Australian universities [4, 5]. Another complicating issue is that most scholars who identify with this emerging field are engineering academics [6] who may hold research qualifications and expertise in their own stereotypical engineering field but are faced with developing new perspectives and expertise when moving into educationally related research [7].

As a result of engineering education research being both emerging and interdisciplinary there is a wide variety of views as to what quality research looks like [6, 8]. The implication for authors is that their work can generate divergent opinions which can be difficult to interpret and/or reconcile for the final version of their paper.

A broad objective of this research is to help members of the AAEE community to better understand themselves and their peers as they struggle with the new ideas, methods etc involved in social/educational research compared to positivist perspective of most engineering research. In better understanding themselves and their peers this transition can hopefully be better supported. More specifically the findings of this project can inform future strategies of professional associations such as AAEE and SEFI in regards to both supporting members in becoming engineering education researchers and in managing their annual conferences to that end.

BACKGROUND

Part of the difficulty that engineering academics have with becoming the interdisciplinary researchers they need to be is that social research is so different to stereotypical engineering research. Jones notes that in consensus-based disciplinary classification schemes "*high*

³ Corresponding Author: Gardner, A.

paradigmatic fields have high levels of agreement among their practitioners with regard to issues such as appropriate research topic and methods”, such as engineering, while “low paradigmatic fields have less agreement in relation to appropriate research questions and even less agreement on appropriate methodology for addressing these questions” [10, p.11], such as education. Alise [11] showed that there are differences between academic disciplines with regard to preferred research methods with engineering in the disciplinary classification more likely to use quantitative methods and education in the classification more likely to publish research using qualitative and mixed methods.

Researchers attribute this preference for quantitative research to our formal training as engineers which influences expectations and norms for engineering education publications where generally, quantitative and positivist research is dominant [6, 8, 12, 13, 14]. However, although we may start from a positivistic, quantitative perspective, there is evidence that engineers can learn to incorporate methods from other research traditions:

Research on primarily U.S. engineering education researchers indicates that they are more comfortable with quantitative research approaches, but are open to qualitative methods when faced with the complexity of studying human beings in classrooms and similar settings... [6, p. 23].

Thompson suggested that *“through interactions with faculty members graduate students are encouraged, reinforced, and rewarded for their display of attributes salient to the academic discipline, and thus academic environment” [15, p.428].* So postgraduate and, to a lesser extent, undergraduate engineering education acts to socialise participants to the context of engineering research which is different to the context of educational research. For engineering academics wanting to change their practice to engineering education research, not only do they have to negotiate the differences inherent in a different type of discipline, they usually don't have the socialisation process of being a graduate student to become familiar with them. This process is, instead, undertaken through engagement with the engineering education research community, and peer review is an important instance of this engagement.

DATA COLLECTION AND ANALYSIS

This study focuses on engineering academics with engineering qualifications, who are also 'active' members of AAEE. In this project we are defining engineering academics as 'active' members of AAEE if they authored a paper for the 2012 AAEE conference AND at least one of the three previous years' AAEE conferences. The author list from these conferences (available in the proceedings) was used to identify thirty-eight potential participants. Nineteen of these authors accepted our invitation.

Participants were classified according to what type of university they work for (Group of Eight (Go8), Australian Technology Network (ATN), regional, or metropolitan unaligned) as described in Table 1, and their level of expertise in engineering education research. A participant's level of expertise as an engineering education researcher was determined by the number of specific types of publications they had written in the last four years (conference papers, journal papers, and/or book chapters) along with other indicators of research activity such as being the project leader of a grant where the funding is provided through a nationally competitive process, supervising postgraduate research students working on educationally related topics, and currently serving in an editorial role for an educationally related journal. Using this system, participants fell into three broad groups: emerging, intermediate, and established researchers.

After ethics approval, semi-structured interviews were conducted with each participant in their campus office, or an alternative location nominated by them, and took approximately an hour. During the interview participants were asked to explain the various roles they enact in bringing their research to publication (e.g. learner, collaborator, editor) and explain any changes they had made between the draft and final versions of their 2012 AAEE conference paper, especially in response to the paper's reviews. This generated discussion about their research, how they write about their research, and the peer review process.

Transcripts were created from interview audio recordings which were then coded in NVivo 10 for inductively generated themes [16]. This analysis began with the transcript of the first interview and continued as each interview was conducted. It was through this parallel interview/analysis

method that we noticed the frequency that participants mentioned ‘quality assurance’ as a reason for having peer reviews of conference papers. This prompted us to specifically ask in the remaining interviews what the participant meant by ‘quality’ in a conference paper. Our analysis became focussed on their answers to the following questions:

- What is the purpose of peer review?
- What do we mean by quality in the context of a conference paper?
- What are the characteristics of a quality review on a conference paper?

Quotes from our participants are included as the major data source in this research. Participants are indicated by a pseudonym, their level of expertise and the type of university they work at.

Table 1: Categorisation of participants by expertise and university

Type of university	Description
Group of Eight [Go8]	The ‘Group of Eight’ (http://www.go8.edu.au/home) is a coalition of eight research-intensive universities located in state capital cities, which tend to be the oldest universities in Australia. .
Australian Technology Network [ATN]	The ATN is an alliance of five universities, each located in the capital city of a mainland state of Australia. These universities badge themselves as practice-based and their research is focussed on the needs of industry and the community.
Regional	Regional universities are those with their main campus in a regional city or town rather than a state capital city. As well as on-campus students, these universities are characterised by significant numbers of external/distance students.
Metropolitan unaligned	The metropolitan unaligned universities are those based in a state capital city, but not included in the Go8 or the ATN.

FINDINGS AND DISCUSSION

Purposes of peer review

All participants gave multiple reasons for having a peer review process. Their responses are listed below with the number of participants who referred to that reason given in brackets:

- to provide feedback to authors to help them to improve their paper (11),
- to assure the quality of papers in the conference proceedings (11), and hence
- lift the profile of engineering education community and the conference (5),
- to keep out inappropriate papers ie gatekeeping (5),
- to comply with government regulations for what is ‘counted’ as a publication (3),
- to provide validation to authors that their paper meets the required standard (1) and,
- to have members of the community engage with each others’ papers (1).

The value of the numbers in brackets in the list of bullet points above are not significant in themselves, but indicate how commonly participants mentioned that reason for having peer review. Together the list indicates the range of reasons that participants mentioned, rather than attributing relative importance to each aspect.

However, we can see that providing feedback to authors to improve the paper was seen as a reason for peer review equally as frequently as the quality assurance aspect of peer review. This view was shared across emerging, intermediate and established researchers at all university types:

I guess the purpose of that is to ultimately assist the author to do a better job and improve the final paper. [Alex, emerging, regional]

...the review process should be about making the paper better... and that's my approach, when I review a paper. It's about making it better. [Adele, emerging, Go8]

I suppose one of the main purposes of the review is to improve the quality of the conference papers. [Nathan, intermediate, metropolitan unaligned]

...the other option is hopefully to improve the quality of the papers. [Rob, established, ATN]

Our participants told us that having a peer review process drives authors to write better papers and design better research which will lift the profile of the engineering education community and the AAEE conference:

I think the reviews should be there so that total [word deleted] doesn't get published. Because they do become public documents of the society. They're there for people to access and use however they will in the future... [Mark, emerging, Go8]

...if you don't have a proper review process you just don't write the papers as well. You don't think as much about your own papers, you don't review the literature in such a deep way, you don't construct your argument so well, and so on... So the depth of the quality of the research is much improved by having a really effective review process. So, in terms of the profile of engineering education research, I think it's really vital that we do this. This is something that we can do as a community that will help catch up the lost ground compared to the more technical disciplines that aren't doing this. [Therese, intermediate, ATN]

...there are so many people going to engineering education conferences thinking that oh, all I have to do is talk about how I teach. I struggle with people coming into it trying to make them understand that the same rules and standards apply to the technical researchers, to the educational research... so the reviews are great for people coming into the area to be reminding them of the process and ensuring that they are actually conscious of what's happening, so that we're not just having papers presented at conferences and people getting recognition for putting up something that's not new or innovative or adding something to the community. [Erica, established, regional]

While participants mentioned the gatekeeping function of peer review the views ranged from the pragmatic:

At one level it's eliminating papers that are clearly inappropriate and I've had those experiences in the past, particularly from overseas delegates. [Rob, established, ATN]

to the more sinister aspects where peer review is seen as potentially censoring/blocking new ideas or research methods. We note that this was more commonly an issue for established researchers, who are more likely to be using a variety of perspectives and methods in their research:

... and the review process is - well it is sort of gatekeeping in a sense...first of all we keep out ideas that we're not comfortable with. We don't want people to upset the apple cart too much. So there's definitely an element of that. [Stuart, established, Go8]

I think as well - not just improving the quality - but I think they can focus the work that's done, and I don't know if that's necessarily a good thing. But certainly the criteria that we used ...in 2012, tended to focus on one type of work over another... [Will, established, metropolitan unaligned]

Three participants mentioned that we have peer review because peer reviewed conference papers are counted under government requirements as contributions for determining the funding paid to universities, and hence valued by our universities:

...the other reason is that the government actually gives a small amount of funding to the universities for each paper that they publish. There's different dollars for different categories, obviously journal and conference. But in both journal and conference, there's peer reviewed, non-peer reviewed. [Tom, emerging, Go8].

One of our participants commented that peer review validates for the author that their paper meets a standard. While this is feedback to the author it is not feedback to improve the paper but an indication that the paper has met the standard:

...make sure that the quality of the work is of a standard - is of a level where it can be sort of benchmarked against other people's work - sort of give you confidence that what you do is not rubbish... [Steve, established, ATN]

Another identified role of peer review is to motivate members of the community to engage with each others' papers:

I think it's a very important part of engaging the community with each other's papers. ... suddenly I find myself reading five papers of a different field and thinking that's a great idea, that could help with this... So I think reviewing conference papers is a very important part of mixing the ideas throughout the community ... I think it's an important part of sharing of ideas and absorbing those ideas into your own work after the conference has finished. A large part of what I retain from a conference will come from the papers that I've reviewed. [Therese, intermediate, ATN]

Although peer review is required to meet government and institutional requirements for papers to be acknowledged as a research publication, we argue that our engineering education community needs to do more with the peer review process than this gatekeeping and compliance. In the absence of the typical postgraduate socialisation process, feedback in peer review should be aimed at assisting authors to develop the standards and norms of the interdisciplinary field and develop researchers' judgement by for example, challenging them to reflect on their perspective, data collection, analysis, and interpretation of findings. Similar arguments have been developed in relation to peer review in the domain of science education research [17, 18, 19]. Our participants see the provision of feedback to improve the paper as equally as important as assuring the quality of papers at the conference. We ask reviewers therefore to keep this function of peer review in mind when writing their reviews, as well as thinking about the review process as a professional development opportunity for themselves. Since reviewers are typically sourced from the whole community rather than just those who submitted conference papers, the review process is also a way to keep everyone involved in the conversation. In this way the peer review process can be used to build a sense of community to ultimately improve the body of work and hence the standing of the research domain.

Characteristics of a quality conference paper

The two most commonly mentioned reasons for peer review both relate to quality. This motivated us to find out what our participants actually mean by quality in relation to a conference paper. As with the question of what reviews are for, participants usually mentioned multiple characteristics of quality which allowed us to identify the following aspects of a 'good' paper:

- the paper would be of benefit to others:

... you should say something that's of importance to the audience that you're presenting to. That's the most fundamental thing... [Tom, emerging, Go8]

... I try to think of a conference paper - what use is this to somebody? What do I want to get out of this conference paper, other than just racking up the publication count? [Sam, intermediate, regional]

- the paper cited literature which provided background to the work and identified a question to be addressed:

Not just listing other studies but saying how they relate to the paper and using them to identify a "hole" in the literature. [Ian, emerging, metropolitan unaligned]

...how well is it grounded in ongoing discussions? In other words, referencing literature... there's literature in engineering education, there's literature in education in general, there's literature in cognitive psychology - whatever and whatever... but I think of them more in the context of a paper, as what discussions am I drawing on in order to then make my point? In that way, what discussions am I contributing to? ... [Will, established, metropolitan unaligned]

- sound methodology is described

I'd be looking for whether it was sound in what they've done, their methodology... [Mike, emerging, Go8]

...it's the quality of the design and of the methodology. So does the issue align with the question, align with the approach...Is the logic train within the methodology and the approach sound? Or are there big gaps? [Will, established, metropolitan unaligned]

- there is a clear explanation of what was done and the structure supports the explanation

...the quality of your exposition. So for a suitably knowledgeable person, how easy is it for them to pick up my paper, read it, understand it and perhaps even implement it, if they felt inspired to do so. [Tom, emerging, Go8]

...you've thought through the way your paper is structured and the way your presentation is going to be structured, so that it's going to be useful to other people. [Sam, intermediate, regional]

- conclusions are supported by evidence:

In a lower quality paper authors will "... make conclusions which aren't supported by anything... and I think some evidence, whether it's statistical or not, still needs to be provided otherwise it's just an editorial." [Evan, emerging, Go8]

... the person's not just expressing their opinion, they've actually done a bit of work to substantiate it. That's probably really what it is. [Terry, emerging, metropolitan unaligned]

- the language was of a professional standard

...carefully crafted and polished language [Ian, emerging, metropolitan unaligned]

Can I read it and understand what the authors are actually saying? Regardless of the quality of what they're saying, can I actually read it and go I can follow the logic? I can follow what you're actually saying. Or, is it just so badly written that it takes me a longer time to break it down?...I think the most important aspect of quality is the level of writing. [Will, established, metropolitan unaligned]

In the previous section we called on reviewers to keep the purposes of peer review in mind when they write reviews on draft papers. We now call on authors to assess their own papers as to whether they possess the characteristics of a high quality paper as outlined in this section. As in all assessment processes though, the expected standard of performance then becomes the issue to be clarified. That differences in the expected standard exist in our community is evidenced by the comment of an established researcher in respect of her draft paper compared to the reviewers' decisions:

...sometimes I'll put in a paper and I'll think oh, that's going to get hammered. It's crap, but I've run out of time and at least using the reviewing process will give me an opportunity to re-write it. Then it's really sad when it comes back with this is good, accept that - you think what? How did that happen? [Erica, established, regional]

Characteristics of a quality review

Our participants both write reviews and receive reviews on their own papers, so when discussing the review process they often alluded to characteristics of what makes a 'good' review. This is not 'good' in the sense of positive, but rather is useful to the author. These characteristics include:

- starts with a positive statement about some aspect of the paper:

... but saying something really positive like that at the start, you're just more open to what they're saying after it. If you start straight away on a negative, it just taints your view of how you read everything else. [Sam, intermediate, regional]

So when my reviewer had written the focus of the paper is very clear within an interesting question posed, I was eating out of his hand and everything else he said about the paper I just thought yes, yes, yes. So that really helped set my mood up for being open to the critique that came after that first very nice comment. **[Therese, intermediate, ATN]**

- suggests relevant references:

Perhaps we could look up on who to read. That would be brilliant sort of feedback and that's the sort of feedback that would be very well received and definitely acted upon. That would instil a level of curiosity. You'd think, okay, there's a lot of people we haven't read. Let's follow this up. **[Neil, intermediate, Go8]**

Sometimes you get recommendations to look at a different body of work, which are really useful, and that purely depends on the reviewer. **[Sam, intermediate, regional]**

- critiques methodology and data collection:

...often the feedback is around your methodology and your data collection... there are so many different ways and different methodologies of collecting data and writing it up and analysing it, often you're a bit blinkered I think sometimes in how you try to present it, or how you synthesise it. So it's good...as an author and as a reviewer as well, to try to critically analyse what other people have done.....your feedback from a reviewer might tell you... why haven't you looked at this and where's the evidence, or what's the actual outcome here? **[Steve, established, ATN]**

- frank about weaknesses in the paper:

...the reviews that say well I just plain don't understand this is actually quite valuable because it means that you can address it... every paper where I've had fairly strong critique I've recognised that the final paper has been just so much stronger based on that feedback ... it's that wakeup call that you need... **[Erica, established, regional]**

- specific in suggesting solutions to paper deficiencies:

But it's often very difficult when they make a general statement, and you think, well, which bit of the text are you referring to?...I have to say, with all the papers I got, it was, okay, you've made a particular comment - where is that relevant? Which section? - is it there, or is it two pages over that really needed that clarification? That's what I find frustrating, is knowing exactly where their particular comments are relevant... **[Adele, emerging, Go8]**

...specific advice on what to do regarding specific problems... But when you get reviews that just say, this is bad, this should be better... this doesn't do this, and point out the problems... without suggesting any solutions, then that's not very constructive... **[Neil, intermediate, Go8]**

- reviewers should explain their opinion:

... then you get, excellent... I actually find ... excellent, as the sole comment, actually sometimes more frustrating. Because you think, well, could you actually tell me why it was excellent so that I know what I did well? What was good about it, so that I can do it again? **[Adele, emerging, Go8]**

- critiques written expression, spelling and grammar:

I think the chance for someone to step back unemotionally and assess the clarity of the statement, clarity of the argument ... certainly it gives another perspective where you think you've expressed it as clearly as it needs to be, but someone else obviously doesn't understand it, some aspect of it, and so it's good to then in your re-writing try to make it so much more generally understandable that anyone should be able to read it, as long as they've got a half decent background in the field. **[Wayne, emerging, regional]**

A common comment from emerging researchers in relation to reviews was their difficulty in interpreting what the reviewer meant. This highlights the need for reviewers to clearly articulate their thinking. Authors will find it difficult to improve their paper in line with a reviewer's comments if these comments don't clearly explain what the reviewer means. Established researchers also referred to interpreting reviewers' comments but usually it was in the context of

interpreting reviews for their less experienced colleagues, rather than reviews on their own papers.

SUMMARY

This paper examines the individual's experience of the peer review process to explore implications for the wider engineering education research community. A thematic analysis of interview transcripts showed that providing feedback to authors in reviews was mentioned equally as frequently as the role of quality assurance of the conference papers.

We used responses from participants from various levels of expertise and types of universities to identify what were for them the elements of a quality conference paper and a quality review. For a conference paper these included that it should be relevant, situate itself relative to existing literature, state the purpose of the research, describe sound methodology used with a logically developed argument, have conclusions supported by evidence and use language of a professional standard. A quality review should start on a positive note, suggest additional literature, critique the methodology and written expression and unambiguously explain what the reviewer means.

The lists of characteristics of a good paper and a good review share elements such as attention to relevant literature and methodology. There is also substantial overlap between how our participants characterise quality papers and reviews and the review criteria used for the AAEE conference, and for such publication outlets as the European Journal for Engineering Education (EJEE) and the Journal of Engineering Education (JEE). This suggests some level of agreement in the community about the elements that indicate quality. However, we need to continue discussions about what we mean by 'sound' methodology and 'good' evidence as well as establishing some shared language and understanding of the standards required in regard to the review criteria.

The results of this study represent the first steps in improving our shared understandings of what constitutes quality research in engineering education for our community, and how we might better convey that in offering constructive advice to authors when writing a review of a conference paper. Since the peer review process has implications for the development of individual researchers in the field and hence for the field overall, it seems reasonable to ask reviewers to pay attention to how they write reviews so that they create the potential for engineering academics to successfully transition into this different research paradigm.

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Framing the experience of emerging researchers in engineering education

ANNE GARDNER and KEITH WILLEY

Faculty of Engineering & IT; University of Technology, Sydney

PO Box 123, Broadway, NSW 2007

Abstract: Our research investigates the developing academic identity of engineering academics within the Australasian Association for Engineering Education (AAEE) community. This paper reports the responses of nine ‘emerging’ authors from three types of Australian universities to the peer reviews of their AAEE 2012 conference papers. Identity-trajectory was used to analyse interview transcripts by focussing on the various elements of this framework of academic identity development. The findings and discussion focus on those aspects of the reviews and the authors’ circumstances that appear to either enable or constrain their development as engineering education researchers. The study finds that authors belonging to a discipline-based educational research group made substantial changes to their papers before final submission and we argue that these research groups support these authors in developing their academic identity as an engineering education researcher.

Keywords: peer review, engineering education research, engineering education researcher, academic identity.

1. Introduction and background

Peer review has been the focus of an ongoing study at the 2010, 2011 and 2012 conferences of the Australasian Association for Engineering Education (AAEE). A rationale for this focus has been that the community could leverage the peer review process to provide better quality advice to each other and hence support each others’ development as researchers. This is particularly relevant to our community as engineering education research is still emerging as a recognised research area in Australian universities [1, 2] and while many engineering academics hold research qualifications and expertise in their own engineering field, they are faced with developing new perspectives and expertise when moving into educationally related research. At the 2012 AAEE conference, 53% of authors from the Australasian community have a first degree in engineering, so examining the transition from engineering academic to engineering education researcher is relevant to a major group of stakeholders in AAEE. Another group of stakeholders are the universities at which these academics are employed. Their interest is twofold - in developing academics’ skill and expertise in research and the potential flow-on effect of a positive impact on teaching and learning.

This research looks at whether the peer reviews that authors received enabled peer learning and supported researcher development within the AAEE community. Traditionally conferences have provided an opportunity to participate in dialogue on the author’s work in a shorter timeframe than has usually occurred for journals, and a common practice has been to turn conference papers into journal articles in the light of feedback received on the conference presentation. Previous REEN symposia, like the one that is the focus of this special issue, have recognised the importance of such dialogue by emphasising discussion in sessions rather than presentation. Such a focus was attempted at the 2012 and 2013 AAEE conferences. However, with typical practice being only minimal discussion time at most conferences, the comments of anonymous reviewers of the submitted paper may be the only developmental help many authors get from conference attendance. Although peer reviews are required to meet government (eg. Department of Education, Employment and Workplace Relations (DEEWR) and the Department of Innovation, Industry, Science and Research (DIISR)) and institutional requirements to be acknowledged as a research publication, we argue that our engineering education community needs to do more with the peer review process than focusing on gatekeeping and compliance, leveraging it to provide constructive developmental feedback. This is particularly relevant since very few AAEE members undertake formal research study, including a higher degree, in engineering education – the traditional way of socialisation into a research domain. This feedback should be aimed at assisting authors to acquire the standards and norms of the discipline and develop researchers’ judgement [3].

Many engineering academics are faced with developing new perspectives and expertise when moving into social research. The integration of educational research perspectives into an engineering academic’s research is a multi-faceted, complex and sometimes lengthy process that can be interpreted as the development of multiple aspects of their academic identity. Engineering faculties that seek to broaden their research base into engineering education need to be mindful of the impact of identity development

on their academics' successful transition into this different research paradigm. Arguably emerging and/or novice researchers have the furthest to 'go' in this transition and thus are an interesting group to focus on. This paper reports how nine 'new/emerging' authors from three types of Australian universities responded to the peer reviews of their AAEE 2012 conference papers. The findings and discussion focus on those aspects of the reviews and/or these authors' contexts that appear to either enable or constrain their developing identity as engineering education researchers.

2. Theoretical framework

McAlpine and various colleagues [4-9] have proposed an identity-trajectory framework to describe the development of identity: "Identity-trajectory emphasizes the desire to enact personal intentions and hopes over time; to maintain a momentum in constructing identity despite challenges and detours; and to imagine possible futures" [4, p.139]. This conceptualisation of identity acknowledges the central nature of individual agency and the influence of personal circumstances to the decisions people make about their academic work. These decisions are a result of each person's past and current personal context, agency and academic development which interact to create their 'horizons for action'. These are defined by what each person regards as possible and desirable.

The academic elements of this identity-trajectory consist of three intertwined strands: intellectual, networking, and institutional, which interact asynchronously such that each trajectory will vary "individually in length size and impact, and will change over time" [4, p. 139]. We argue that to investigate engineering academics' development as educational researchers we need a model that acknowledges the changing and discursive nature of identity construction which is accounted for when using identity-trajectory by, for example, paying attention to the context-specific characteristics of working as an academic, or by studying the way that engineering academics interpret their past experiences as contributing to their present situation and/or their future intentions.

The intellectual strand represents "contributions to one's disciplinary specialism or field. The intellectual strand leaves a trail of artefacts, eg publications, citations, papers, course/curriculum design" [6, p. 179]. The networking strand represents the range of

...local, national, and international networks one has been and is connected to, and...includes (a) research and publication collaborations with others; (b) cross-institutional course/curriculum design; (c) work with professionals...and (d) membership of disciplinary organizations [such as AAEE] and on journal boards.[6, p.179]

The networking strand has both *interpersonal* and *intertextual* elements. Interpersonal elements of networking include interactions with colleagues either face-to-face or through personal communication channels eg email, Skype. Intertextual elements of networking include interactions with various texts especially reading to create "...links between papers with 'spoke' to each other and to their own research" [9, p.11]. The intellectual and networking strands strongly interact with each other with the networking strand "establishing the intellectual location for one's contributions" [6, p. 180] and so are largely focussed beyond the individual institution where an academic may be employed.

In contrast the institutional strand represents the interactions of the academic in their workplace. McAlpine and Amundsen [6, p. 180] found that institutions can "support or constrain an individual's networking and intellectual strands" and that this strand accounts for "... how the structural features of the workplace mediate, positively as well as negatively, the development of the networking and intellectual strands of academic work" [9, p. 14]. The importance of the institutional support in regard to research is reported by other researchers [10 - 12] who found that efficacy is an important factor relevant to faculty productivity. They argue that "because institutions gain from productive faculty, it follows that institutions will benefit from investing resources to give faculty the tools they need to be efficacious in doing research" [11, p.60]. They also found that departmental support was consistently and strongly predictive of efficacy for research which is consistent with Wood's 1990 findings that:

Departmental support was also an important factor in predicating efficacy, which further underscores the implication that faculty members need to see their departments and institutions as supportive of their efforts and development of research skills and tools. [12, p. 60]

In our context for example one form of institutional support for the networking and intellectual strands would be by providing funds to attend the annual AAEE conference.

The strands acknowledge the influence of the interplay between the individual (both cognitive and metacognitive processes in the intellectual strand and importance of agency) and the social (networking strand), and the individual and the structural (both in the institutional strand and the structures of knowledge) in developing identity. The appeal of the identity-trajectory concept for this research is that the strands acknowledge these tensions in relation to dominant aspects of the academic context. Another appealing aspect of the framework is that the journey of each academic is just that – their individual trajectory, the details of which will differ from everyone else’s since, as Taylor reminds us “...there is no such thing as a standard academic career...” [13, p. 30]. However, there are sufficient commonalities in the stages of progress to make some generalised observations.

3. Method of our study

Our study focussed on engineering academics who are ‘active’ members of AAEE. In this project we are defining engineering academics as ‘active’ members of AAEE if they authored a paper for the 2012 AAEE conference AND at least one of the three previous years’ AAEE conferences. The author list from these conferences was available from the proceedings. Nineteen members of AAEE were interviewed for the overall project. Participants were classified according to what type of university they work for (Group of Eight (Go8), regional, or metropolitan unaligned, as described in Table 1); and their level of expertise in engineering education research (emerging, intermediate, or established).

A participant’s level of expertise as an engineering education researcher was determined by a number of indicators including the number of specific types of publications they had written in the last four years (conference papers, journal papers, book chapters) along with other indicators of research activity such as being the project leader of a grant where the funding is provided through a nationally competitive process, whether they are supervising research students working on educationally related topics, and whether they were currently serving in an editorial role for an educationally related journal. Using this system, participants fell into three broad groups: emerging, intermediate, and established researchers. The emerging researchers were the group that had co-authored less than ten AAEE conference papers since 2009, no more than two journal papers in this time frame, no books, were not project leader for any externally funded projects, not supervising PhD students in educationally related topics and were not serving as editor or associate editor for any educationally related journals.

This paper reports the results from the nine participants who represent emerging researchers. The pseudonyms for these participants are listed in Table 1 below, along with an outline of the type of university where they were employed at the time of the interview. These participants have experience in stereotypical engineering research areas including hydrology, structural engineering, combustion, mechanical design, control systems, and environmental engineering.

Table 1: Participants’ type of university

Type of university	Description	Participants
Group of Eight [Go8]	The ‘Group of Eight’ (http://www.go8.edu.au/home) is a coalition of research intensive universities which tend to be the oldest universities in Australia.	Adele Evan Mark Tom
Regional	Regional universities are those with their main campus in a regional city or town rather than a state capital city. As well as on-campus students, these universities are characterised by significant numbers of external/distance students.	Alex Wayne
Metropolitan unaligned	The metropolitan unaligned universities are those based in a state capital city, but not included in the Go8 or the Australian Technology Network.	Ian Mike Terry

A document analysis was conducted comparing each participant’s draft paper submitted for review for the 2012 AAEE conference, to the final version of their paper. The two reviews of each paper were also

examined. A semi-structured interview was conducted with each participant in their campus office, or an alternative location nominated by them. Each interview took approximately one hour and occurred in the timeframe between three weeks and five months after the deadline for submission of the final version of the paper to the conference. During the interview participants were asked to re-read the reviews they received on their paper, comment on how helpful they had found these reviews in preparing the final version of their paper, and discuss any changes they had made between the draft and final versions. This generated discussion about the reviews themselves, about the changes the participants had actually made to their papers that were prompted by review comments, and about their educational research in general.

Participants were also presented with the engineering education research landscape model shown in Figure 1. This model was developed by the authors of this paper from examination of the range of papers submitted to the 2010, 2011 and 2012 AAEE conferences. One ‘neighbourhood’ in this landscape is the teaching and learning of engineering. This encompasses what we do in the classrooms, or workshops, or at university generally with engineering students enrolled in our subject. We like to think that this is influenced by engineering practice, another ‘neighbourhood’ encompassing professional engineers practising their profession in industry. We also like to think that the teaching and learning of engineering and research into the teaching and learning of engineering is influenced by the methods and outcomes from social research particularly in learning theories, so this forms another neighbourhood on our landscape. The final area on the landscape model is what we call engineering of education, and that's where we tend to use the same skills and ways of thinking and looking at things that we've adopted or learned because we've been trained as engineers, on our subjects and in our research on our subjects. This might be for example treating issues in our subjects as problems to ‘solve’ or designing an activity, product or artefact to promote a desired outcome then evaluating its application and subsequently refining its design.

This model is not meant to definitively describe the engineering education research landscape, but was rather devised to provide a basis for members of the community to articulate their area/s of activity. Participants used a coloured adhesive star to locate their 2012 AAEE conference paper on this model, and then explained why they had stuck their star/s in the position they did. This information was intended to be used in two ways. The first of these is to use responses from individual participants to provide additional information about their academic identity since “...the need to research particular issues grows from the contexts in which the researcher operates...” [14, p. 11], so the area that they publish in is likely to be one that they identify with. The second intention is to use responses from all the participants to investigate the range of different areas that members of the AAEE community are working on and the characteristics of researchers at different levels of expertise. This second use of the data will be addressed in a future publication.

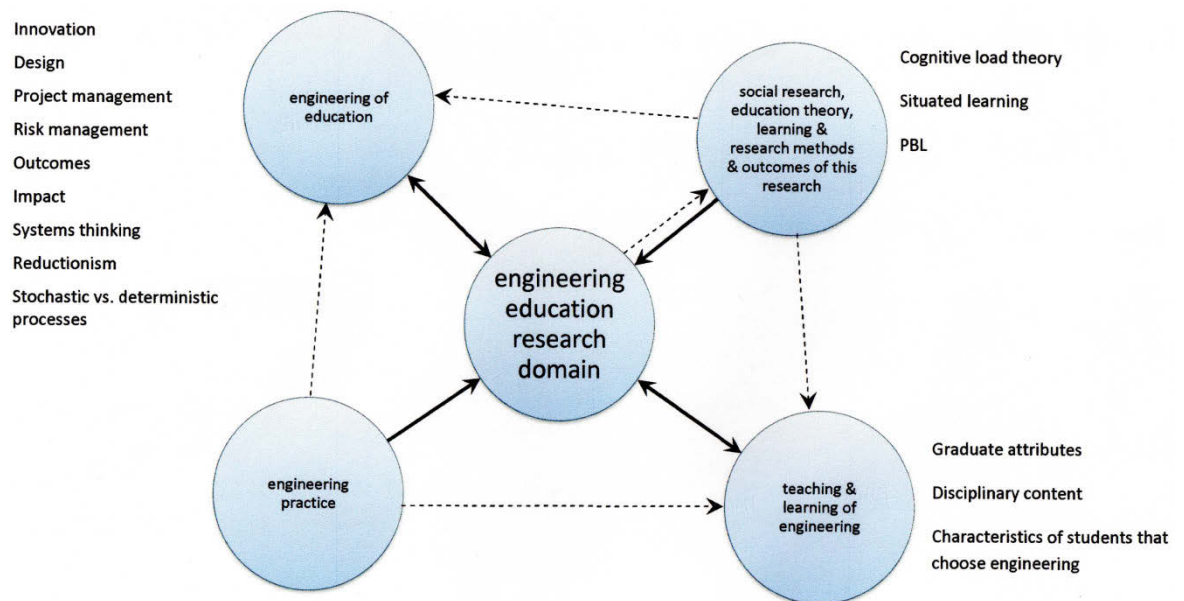


Figure 1: Engineering Education Research landscape

Transcripts were created from audio recordings of each interview, which were then coded in NVivo 10 for a priori themes relating to elements of the identity-trajectory model (intellectual, networking and institutional strands, personal context, time-related narrative, evidence of agency, and horizons for action).

Quotes from participants indicate their pseudonym and the type of university at which they are employed. Some quotes were edited slightly to preserve the anonymity of our participants, while still maintaining the integrity of meaning.

4. Findings

Our researcher classification system was supported by responses from our participants where they self-identified as being new or newish to engineering education research:

I'm really, really out of my depth, but that's okay.... There's something there for me to learn, and that will be great. [Adele, Go8]

My background is not as a researcher, it's something I'm just learning to do. [Alex, regional]

...trying to identify whether or not I'm doing it correctly... I also haven't been teaching for very long so I need to learn more about all the different fields. [Evan, Go8]

...in that paradigm, I very much class myself as a beginner. [Tom, Go8]

In relation to the reviews there are two aspects to the feedback: the decision and the comments. Authors used both to interpret the reviewers' opinion of their paper. Of the nine authors we are discussing in this paper, five had papers with the decision to 'accept with minor changes' and four had papers with 'accept subject to major changes' as the decision. A comparative examination of the reviewed version and the final published version of each paper (Table 2) shows that Adele, Evan, Mike, Ian and Mark made minor changes to their papers after review, while Alex, Wayne, Terry and Tom made more substantial changes. The interesting finding here is that Alex and Wayne made substantial changes to their papers even though the decision was 'accept with minor changes' and Ian and Mark made minor changes even though the decisions on their papers were 'accept with major changes'.

We will first comment on each participant and their response to their paper's review before discussing the main themes identified.

Table 2: Comparison of review decision with changes made to draft paper.

Participant	Review decision: Accept with minor/major changes	Changes to published paper were minor/major
Adele	Minor	Minor
Alex	Minor	Major
Evan	Minor	Minor
Mike	Minor	Minor
Wayne	Minor	Major
Ian	Major	Minor
Mark	Major	Very minor
Terry	Major	Major
Tom	Major	Major

Adele has a fractional appointment at a Go8 university which she began after significant experience in industry. Adele's paper was accepted subject to minor changes and there were very minor changes between the reviewed version and the published version of this paper. These changes related to

formatting, abbreviating terms and numbering tables. There are slight differences in the Background sections but these amounted to tightening the writing rather than any change of ideas or the way in which they were expressed or described. Both reviews of this paper were overwhelmingly positive and pointed to the need for the minor abbreviation and table numbering changes which were made for the final version. One reviewer did attempt to engage at a deeper level by asking questions about the categories in the survey but there was no response to this in the final paper. While the quality of the originally submitted paper was high, which elicited the positive reviews, for many of the review criteria the only response from the reviewers was one word: "Excellent". While positive, this did not assist the author in further improving their paper, and Adele commented she would have appreciated some elaboration on this one word to find out what was 'Excellent' about it so that she could do it again: "*I actually find, sometimes, excellent, as the sole comment, ... more frustrating. Because you think, well, could you actually tell me why it was excellent so that I know what I did well? ... so that I can do it again?*" Adele also mentioned that if reviewers have difficulties with something in her paper she would appreciate knowing exactly where in the paper the problem is ie the more specific reviewers can be, the better: "*... a particular comment - where is that relevant? Which section? ... is it there, or is it two pages over that really needed that clarification? That's what I find frustrating...knowing exactly where their particular comments are relevant to*". Adele placed her star on the arrow pointing to the social research neighbourhood (see Figure 2) on the landscape model. She commented that this was an unusual area for her, with her previous educational papers fitting between teaching and learning and engineering of education.

Alex also placed her star in the social research neighbourhood of the landscape model "*...because it's very much looking at social research theory and how can we put it into that educational domain.*" This paper is related to her PhD which she began 12 months prior to the interview. Previous to that her publications were more aligned with the teaching and learning area. Like Adele, Alex came to academia from industry, but without research experience in her engineering speciality, and is now working at a regional university. Alex began a PhD "*because I decided I'd probably be sticking around academia for a little while and if you're going to do that you need to have a PhD*", but only after finding a research area that she was interested in. Both reviews of Alex's paper have a generally positive tone even though the theoretical nature of the paper and the theory discussed are not commonly found in AAEE conference papers: "*It's a funny paper because it's a discussion paper or a theoretical background paper... It's not a collect some data and analyse it and here's my results type paper.*" Both reviews also ask for an illustration of how the theory could be applied to the engineering education domain. This prompted what we regard as substantial changes to the last page and a half of Alex's paper where she completely deleted a table and its explanatory paragraphs and replaced them with suggested ways of using the theory in engineering education. Alex found suggestions from the reviewers helpful in improving the paper: "*So what I did do, and what the reviewer suggested was outline how I would apply this theoretical background to a project...Which makes a lot more sense when you're then reading the paper... So yeah, it certainly did give me the direction that I needed to complete the paper the way I wanted to.*"

Evan had recently (in the previous six months) changed from part-time tutor to full-time academic at a Go8 university, so has not been an academic for very long. This change coincided with enrolling in a PhD because "*I'll need to do a PhD to progress...*". Evan made minimal changes to his draft paper – two instances where a short phrase was added to clarify the rest of the information in that sentence, as requested by his Reviewer 1 - before final submission stage, and did not address most issues raised by the reviewers, which he conceded in his interview: "*I think I made a few tweaks and just read over it, but I don't think I made huge changes*". This behaviour is consistent with his comments that his main reason for publishing was to meet the expectations of being an academic: "*because I am an academic then I must publish*". He placed his star in the teaching and learning area of the landscape (see Figure 2) since his paper describes a teaching and learning project Evan was involved in: "*It's a project I ran, just one where it was my responsibility and I figured I need it published*".

Like Evan, Mike placed his star in the teaching and learning area of the landscape (see Figure 2). He locates his educational research – not just this paper - there because "*...it informs my practice. I don't like the idea of educational research for its own sake... if engineering education and research doesn't inform practice in Australian universities, then it's missed the point...*". Mike is an academic of approximately twenty years standing, currently working at a metropolitan unaligned university. The reviews on Mike's paper were contradictory e.g. one reviewer expressing reservations about the methodology while the other reviewer commented "*the methodology strikes me as rock solid*". While an experienced author may be able to discern feedback from such contradictory reviews, it is more difficult for an emerging researcher

to interpret and learn from these contradictions. Changes to the final version of the paper include short responses to some of the issues/questions raised by the reviewers, however, many of Reviewer 1's concerns remain unaddressed. This may be in part because of the difficulty in addressing issues of methodology after a study has taken place or because they are out of the control of the author, as in Mike's case: *"the first [review] I wasn't so happy about, possibly because he brought out things which I think were separate to what I could control here..."*.

Wayne's reviews were very brief, mainly mentioning typographical errors and data presentation issues such as the possibility of changing the graphs to tables. Consequently Wayne's response to the reviewers' comments in his final submission was to reformat some graphs in a table. We can understand that Wayne did not find his reviews very helpful and Wayne's experience raises questions in regard to the level of expertise of reviewers in the AAEE community. *"Thinking of my experiences of publishing in the education conferences, as opposed to the [stereotypical engineering research field] papers ... I've had 100 per cent success with getting things accepted in the education conferences..."*. The decision of 'accept with minor changes' and the comments Wayne's paper received combined with his previous 'success' at educational conferences contribute to his perception that he is a competent educational researcher. Interestingly despite the positive reviews the changes to Wayne's paper from the reviewed to the final version were more substantial than the changes made by Adele, Evan and Mike on their papers. Wayne wrote his paper with another engineering academic and his interview suggests that the changes in the final paper came more from his co-author (an 'established' engineering education researcher at another Australian university) than the reviews: *"certainly [the co-author] and I had a bit of back and forth"*. His previous educational papers would fit in the teaching and learning area but this current paper sees him starting to move towards the social research vicinity (see Figure 2), a move he said is largely driven by his co-author mentor.

Ian wrote this paper to comply with dissemination requirements associated with project funding from his university and volunteered that writing conference papers was for him all about building a *"track record"*. The review decision of Ian's paper was 'accept with major changes'. Both reviewers called attention to grammatical, punctuation and formatting errors, which were addressed in the final version of the paper. Ian said that he appreciated this feedback – possibly because English is a second language for him. Reviewer 1 commented on two other aspects of the paper which Ian addressed by deleting one phrase from a sentence in one part of the paper, and adding some proposals for future work. Reviewer 2 provided a much more detailed and useful review than Reviewer 1. This reviewer challenged some of the conclusions in the reviewed paper, which Ian dealt with by removing the unjustified conclusions from the final version. Reviewer 2 mentioned ten issues in relation to the argument of the paper - three of these issues were addressed in the final paper, one issue was addressed by removing the phrase in question, but there did not appear to be a response in the final paper to the remaining issues mentioned by this reviewer, and hence we would not say that the 'major changes' asked for were actually delivered. Ian located his paper in the teaching and learning part of the landscape model (Figure 2).

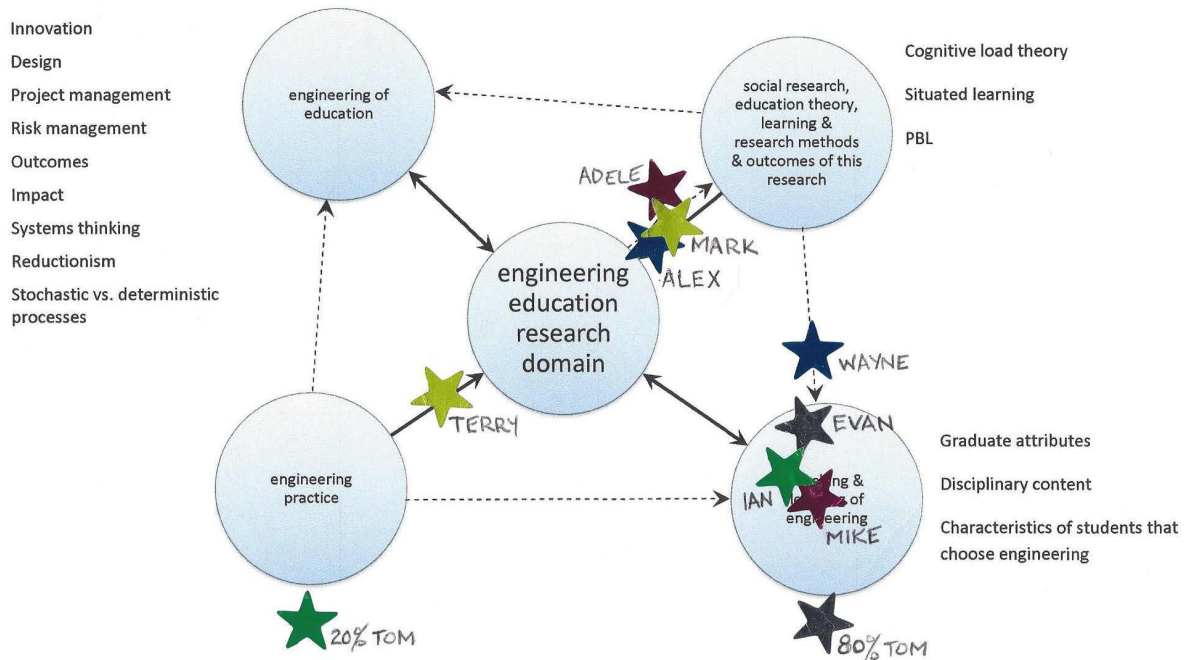


Figure 2: Participant located stars on the Engineering Education Research landscape

As in Ian’s case, Mark’s paper describes work undertaken with internal university funding and while Mark acknowledges the usefulness of a conference paper as “...something you put on your CV” the paper helped to clarify ideas and insights into the project: “We didn’t set out to write a conference paper. We set out to try and think about how do we solve this problem? Then the conference gets announced and you say oh yeah, we can tell people about what we’re doing on that particular problem...”. Mark’s paper was accepted subject to minor changes. Reviewer 1 wrote that “the results are of importance to any engineering educator dealing with reflective practice”. This positive tone is in contrast to Reviewer 2 who wrote a short paragraph concluding that the paper was not really relevant in an engineering education conference and suggested a general learning conference might be more appropriate. Reviewer 2’s other main criticism was with the “careless” English expression of the reviewed paper. The only changes made for the final version of the paper were the typographical errors mentioned by Reviewer 1 and Mark conceded that “the extent to which the paper was revised in view of the review was quite small”. On the landscape diagram he placed his star on the trajectory heading towards the social research circle. Mark has many years of experience as an engineering academic and has had a management role in the past in his Faculty. He indicated that in his future work he is aiming to do more of the three areas of teaching and learning, engineering of education, and social research; and less of engineering practice.

Terry’s area of teaching and mainstream engineering research is a practice-oriented aspect of engineering and his identification with this area is illustrated in locating his star on the engineering practice trajectory, as shown in Figure 2, even though his paper is essentially about evaluating practice in the subject that he teaches. Terry has significant experience teaching in this area and works at a metropolitan unaligned university. Substantial changes were expected in Terry’s paper since the decision was ‘accept with major changes’. Reviewer 1 expressed serious misgivings with the methodology and its description. His final paper did include a fuller description of the details of the method used but did not address a major questioning of the appropriateness of the data collection method, or the English expression and formatting deficiencies noted by reviewers. For a paper with a ‘major changes’ decision it is noteworthy that much of the reviewed version remains unchanged in the final version – this may come down to Terry’s attitude that: “... whether they say major changes or minor changes, to me I don’t think it’s a huge difference”.

Tom had not previously published an educationally related paper but has significant research and publication experience in his own engineering speciality. On the landscape diagram Tom placed one star in the teaching and learning vicinity with a value of 80% and one star in the vicinity of engineering practice with a value of 20%. Tom’s paper for the 2012 AAEE conference was ‘accepted with major changes’ which was in contrast of the ‘reject’ decision his paper received in 2011. Tom’s final paper had substantial changes compared to the reviewed version, including a change in structure to improve the

description of the event which was the focus of his paper. The detailed discussion and reformatting were in response to reviewers' comments which suggested that more detail of the evaluation evidence was required. So I would agree that Tom did make major changes to his paper, but most of these changes were Tom's ideas: *"I actually think it's a more interesting paper as a result of that re-organisation, but that was my idea. Didn't come from the reviewers."*

5. Discussion

In this section of the paper we discuss how the responses of these emerging researchers illustrate the various aspects of identity-trajectory and highlight aspects of their academic practice that either enable or constrain their development as engineering education researchers.

5.1 Academic strands

As described in the theoretical framework section earlier in this paper, the academic elements of identity-trajectory consist of three interweaving strands: intellectual development, networking, and institutional. Participants' explanations of their responses to peer review of their conference paper illustrate aspects of these strands.

5.1.1 Intellectual strand

The intellectual strand is referenced by the comments that many participants make relating to research perspectives, methodologies and tools which is perhaps not surprising in a group transitioning to a different research paradigm. As suggested by Borrego [15], to assist the development of emerging researchers making the transition to engineering education research, reviewers and mentors need to focus on their understanding of methodology, especially data collection and data analysis. Examining the reviews for the papers written by these emerging researchers, we could see that reviewers often asked for issues of methodology to be addressed, especially in relation to type of data collected and how it is analysed:

... they were saying that there's an unacknowledged possibility of the Hawthorne Effect. [Evan, Go8]

There was one comment here [in a review] about the use of the extracts from focus groups. They [reviewer] weren't convinced that that was a way to show results. I'd seen other papers that had done that. So whether it was useful or not, it made me think... [Terry, metropolitan unaligned]

Amongst these emerging researchers, the dominant view is that the only really 'rigorous' way to conduct research is to use quantitative methods. They then experience difficulties when they realise the limitations of quantitative methods in helping them to understand the types of phenomena they want to investigate. The "raw data" is in the form of "numbers" and "some sort of evidence" referred to below is, in this participant's mind, unquestionably quantitative in nature to qualify as 'evidence':

...so you've got numbers, whatever, you've got the raw data that is there and you've got to look through it and - ultimately what you're trying to do is identify patterns... how you can compare one variable versus another an ultimately then see if you can find a pattern which then explains the overlying thing that you are investigating". [Wayne, regional]

...I think it's important. It's very hard to make conclusions otherwise. There's a lot of things within education which feel right but may not be right and without some sort of evidence to back it up then it's hard to know which way you should really act...I think generally though that it [statistical analysis] is needed. [Evan, Go8]

These quotes from our participants provide evidence of the difficulty of the transition from engineering researcher to engineering education researcher. The dominance of quantitative research perspectives and methods has also been noted by Beddoes:

Despite being an interdisciplinary research area...positivist contributions from fields like psychology are ...more readily accepted without great effort on the part of authors than are critical qualitative approaches... [16, p.8]

This preference for quantitative research has been attributed to our formal training as engineers which influences expectations and norms for engineering education publications where generally, quantitative and positivist research is dominant [15, 17 – 20]. However, although we may start from a positivistic, quantitative perspective, there is evidence that engineers can learn to incorporate methods from other research traditions:

Research on primarily U.S. engineering education researchers indicates that they are more comfortable with quantitative research approaches, but are open to qualitative methods when faced with the complexity of studying human beings in classrooms and similar settings... [17, p. 23].

Such dissatisfaction is evident in the following comment on using surveys for data collection where the participant can see a limitation in statistically analysing survey results, but is still looking to “*measure something real*”:

If you look at my surveys here, the mean is always bigger than three, maybe sometimes it's up to four, which is sort of agree. So it's always above neutral... So you've got this mean around 3.6, around four, but it's a standard deviation of one, which means that there is a big spread... and I don't know how you get around that kind of thing. So that's a problem when you come to numerical stuff. If this was an experiment it wouldn't be a very good experiment, because it's sort of telling you a trend, but there is a lot of noise... it all comes down to their perception. It's nothing real. But I don't know how you measure something real. [Mike, metropolitan unaligned]

Alex and Terry, both working at universities with engineering education research centres, are our deviant cases in that they are using qualitative research methods on a regular basis. Alex knows this is different to the standard paper submitted to an AAEE conference:

It's a funny paper because it's a discussion paper or a theoretical background paper and again, it's coming from the PhD work that I'm looking at. It's not a collect some data and analyse it and here's my results type paper. [Alex, regional]

We get the sense that this change in how engineering academics think about educational research and research methods is a process. Most of our emerging researchers do not use a theoretical framework which is in contrast to our intermediate researchers who tend to compare their results to a nominated framework, and our established researchers who typically have a variety of frameworks that they can apply in their research.

5.1.2 Networking strand

As mentioned earlier, the networking strand has both *interpersonal* and *intertextual* elements. It encompasses the academic community beyond the participant's university, with the interpersonal including the AAEE community and reviewers and the intertextual element including the authors of the literature they read and cite. Our emerging researchers refer to elements of their intertextual network:

I've also just recently enrolled in a PhD so reading more literature and trying to absorb it and understand what it means and analyse it. It is something I'm trying to get better at and become better at... [Alex, regional]

*...I found a textbook that was *Methods in Qualitative Research* or something like that. It's basically a book of what's the problem you have? Here are some recommended methods, and this is how you apply them. So it's a perfect book that every time I'm doing qualitative research why did I use it, I get that book, I quote it, sort of as such-and-such suggests this is the ideal tool for this situation* [Terry, metropolitan unaligned]

Peer review is an element of this ‘intertextual networking’ [21] and is shown to have contributed to the intellectual development of most of these emerging researchers. The following quotes from participants highlight how interaction with the peer review has resulted in a change in their thinking or practice ie has resulted in some change to their intellectual strand:

The reviewers picked up on things, weaknesses that I already knew were in the paper...There was one comment in particular... I thought that ... useful, and actually it changed the way I thought about it... it gave me the, ‘Oh now I know what I'm going to do with this paper’. So it certainly did give me the direction that I needed to complete the paper the way I wanted to. [Alex, regional]

Look, having other people's views on what you've written is useful. Whether it be agree or disagree or otherwise, it provides some level of providing another perspective ... or an idea that you really should be thinking about something else... [Mark, Go8]

Another way that peer reviews extend an author's intertextual networking strand is through the process of reviewing other authors' conference papers. Several participants commented that they learn from reading the papers they are asked to review, ie that this type of intertextual networking contributes to the development of their intellectual strand, as well as reading the reviews of their own paper:

It makes you learn about things that because you now have to read a paper you actually read a bit more... So it is good reviewing because it just makes you read papers that you sometimes just don't get time the read - well, you do have the time if you really made the time but you don't. This just forces you to sit down and read some papers, which is always good. [Terry, metropolitan unaligned]

...it's good ... to read other people's work to get an idea of what's out there... Also to get an idea of how other people write... I'll criticise something then realise I've done it myself in my own paper. [Evan, Go8]

When I say review I mean I've actually reviewed other people's papers but you play that same role. In fact reviewing other people's papers is very useful when you come back to your own paper. You then go - put the same hat on and look at it from that perspective, yeah. So actually yeah, you learn both ways. What you apply to your own work you can then apply to other people's and vice versa. What you learn by reviewing other people's work comes back to what you do with your own.[Alex, regional]

Alex and Evan's comments in particular illustrate the potential learning benefit from reviewing other papers for a novice researcher.

Peer review for the conference is not the only aspect of the networking strand illustrated by these emerging researchers, the interpersonal element of the networking strand was also illustrated. Wayne brings attention to his interpersonal network by conceding that the changes in his final paper came more from his co-author (an experienced engineering academic at another university) than the reviews:

certainly [the co-author] and I had a bit of back and forth...If I was the sole author I would not have done that because I thought the graphs told the story, but I guess this is why you share with other people and they have different perspectives.

However, our emerging researchers commented much more on the intertextual element of their networking strand than the interpersonal. We suggest this is a reflection of their status as emerging researchers which we expect will change as their expertise develops and they participate more in the research domain, meeting more fellow researchers at other universities both in Australia and overseas.

Many participants could articulate the links for them between participating in the conference, a significant networking event, and the development of their research. For emerging researchers this is mainly about learning about the research domain:

I also learn about what others do and I guess that's by attending conferences and not just about the writing... [Evan, Go8]

that writing a paper "... means I go to conferences, so therefore I learn - but also it forces me to look into the background of what I do to better understand it. What other people have done and I guess you don't really want to submit a paper if you don't understand the background. Probably also that because there is the outlet of the paper that I look more into what I do. I do investigate, I look at the statistics more carefully, I look at the values about what's happening I guess. I guess when you explain to someone else what you do it helps you to understand what you don't know, not what you do know."[Evan, Go8]

So, the stuff I do with the XXXX room, that came out of reading someone's paper. I thought, that's interesting, and then they came here and I heard them speak, and I thought, that's interesting. I was able to quiz them... about how that really worked - because you said this in your paper, but come on, tell me how that really worked. You think, okay, I can work with that, that's translatable to - and that's what I like about conferences, is that you have the ability to quiz people about what they've written, and try and pick out what's really, really relevant to you, which is easier to do verbally...[Adele, Go8]

The comments in this section and the previous one on the intellectual strand demonstrate how strongly the intellectual and networking strands interact with each other with the networking strand "establishing the intellectual location for one's contributions" [6, p.180]. These two strands are largely focussed beyond the individual institution where an academic may be employed. However, the institutional environment is also important in supporting or constraining the development of academic identity.

5.1.3 Institutional strand:

Institutionally related comments were overwhelmingly related to the pressure to write papers that 'count' towards the university's ERA ranking. This was seen in a negative light by most participants along with the changing environment within universities in which the work that academics do is dictated more by administrators than by the needs of research or teaching:

But I think the university really values numbers. It's again, another issue that I have - always struck me - centres of higher learning use the most base measure to measure their quality. The number of publications and the amount of dollars that you've put in grants, which is - because it's easy to do. [Mike, metropolitan unaligned]

It's very important to the university that we are researchers and that we have research publications and reportable research publications, whatever that means. ... Being a researcher is so important ... it seems to me to be a lot more emphasis is put on the research outputs than the teaching outputs. Again probably because it's more easily measurable and easy to quantify... It's interesting because being a regional university with a focus on teaching, you would think we'd have found a better way of doing it by now. Yet there's still this emphasis on research. If you want to be promoted you need to research. [Alex, regional]

Well, essentially, the university values academic publications...The number count, the quality count. They actually don't care about ... dissemination. ...I actually don't think the university cares too much about the impact that we make on engineering education. I think they just care - well, they just care about the metrics...it's the how many people, how'd you get cited, was it peer reviewed...it's more to do with what we call the administrivia of the university these days..” [Adele, Go8]

Most participants commented that despite producing publications for the university to count, engineering education related publications were seen to be second-class and in some places not considered as 'real' research which can be a disincentive for researchers to continue. This perception of the research area as not real research means that authors in that area are also looked down on as not capable researchers which can impact on identity constructs as well:

...the school operates a sort of database for research categories and for collecting information and whatever. Engineering education is not one of the options for recording information - or recording performance - research performance on that... it's more through ignorance rather than design. They're not saying oh well, we've thought about engineering education and we're not going to do it. Or we're not going to put it on our list of important things. It's just that it never even crossed their mind in the first place. [Mark, Go8]

We get presentations from our Office of Higher Degrees in Research about what is a reportable... anything that has learning or teaching associated with it, they tend to view fairly cynically when they're trying to determine whether it's real research. If you were testing concrete beams or something, it must be real research. But if you're not they seem to apply almost different standards because they can't quite cope with qualitative and the quantitative difference, I suspect... this seems to be a common thing. Maybe we see it in Engineering Education because we see both sides of the coin. We see the technical researchers and what they do, and say well we're just as rigorous, but we seem to have different standards applied to us... we have to justify our status much more strongly [Alex, regional]

Some universities actively support engineering education related research with two universities having already established a discipline specific research centre. This institutional support has benefits for both the development of authors' networking strand (supporting them to attend the conference) and/or their intellectual strand (providing resources at their university to support developing expertise):

The school will fund you to go to AAEE conference, at the moment. So they funded four or five of us to go and we wouldn't get funded to go to another conference....[Head of School] funds four to five people every year to go to AAEE, which he doesn't fund any other conferences. We all got \$2000 this year. [Mike, metropolitan unaligned]

Alex's developing identity as an engineering education researcher is supported at the regional university where there is a named research group in the engineering faculty for disciplinary education research. The research group gives institutional authority to the development of Alex's intellectual and networking strands ie her intellectual, networking and institutional strands would be mutually supportive. Similar arguments are reported in the study into institutionally supported identities of engineering students [22] and into institutionally supported (or not) interdisciplinary identities of engineering students and academics [23]. Alex acknowledges her development as a researcher which includes better appreciation of what reviewers are saying “I've improved myself as a writer and researcher...”

Similar to Alex, Wayne and Terry also made major changes for their final paper. Wayne works at the same university as Alex, and Terry works at a metropolitan unaligned university which also has a disciplinary specific educational research group. Even though Wayne and Terry's

interaction with these research groups may be different to Alex's, having an active research group on campus would provide institutional authority to them developing their intellectual and networking strands of identity in engineering education:

...the previous discipline leader was actively encouraging people to do research into education. Our previous dean was quite keen on it as well... So I guess you do have support because (a) there's people here I can talk to about it and (b) it is actually encouraged by people at senior levels. [Terry, metropolitan unaligned]

Actually for Terry we suggest that wanting to be seen to be an active member of the research group provided some of the motivation for him to write this paper for the AAEE conference: "...I've explicitly been told if you're a part of a research group you're going to find it easier to get promotions...".

The institution can also influence whether academics engage in engineering education because of the other individuals who work there. This is demonstrated by Alex's choice of research area for her PhD:

I came from industry before I came here so I had no research background when I came here. So I'm developing it through engineering education... I guess when I started as an academic it was clear that I had to develop a research area. I would look around. I've got a construction background so I thought about construction type research. It came down to who I wanted to work with I think, as well as my interest... I became quite passionate about my teaching and wanted to improve it. So that stemmed an interest in what's going on in the research area in that. But then also I get on very well with [engineering colleague at the same university] who's running the [engineering education research group].... So I was very happy to work with all those people as well as it follows my interest as well. Construction interested me as well but there was no one I wanted to work with at this university in the construction area. Which was a big disincentive for a long time until I discovered this whole engineering education thing. So yeah, that was a big factor. Being a novice researcher I obviously had to have a mentor of some sort to get into the whole research thing. The construction mentors just didn't - or I didn't see eye to eye with them so I couldn't see myself working with them.

And Mark's comment that the type of research he is doing now is a function of his collaborator who works at the same university that he does:

...it's partly to do with the particular research collaborations that I've got at the moment....

For Evan (Go8) and Mike (metropolitan unaligned) their educational research is inextricably linked to their practice of teaching engineering students which is illustrated on the engineering education research landscape (see Figure 2) where they placed their stars in the 'teaching and learning of engineering' circle. The final papers from both of these authors did not address all the issues raised by their respective reviewers. We also note that these academics work at universities without disciplinary educational research groups and neither seem to have a strong mentor, as Wayne does.

However, the institutional influence is not necessarily uniform even at the one institution ie the local Department level environment can have a stronger influence for an individual academic than the University view (if there is one). Note that while Alex may benefit from the local Faculty-based research group she still feels her work is under-appreciated by the university-wide structures such as the Office of Higher Degrees in Research. The following three comments are from different academics in different engineering departments at the same university. One appears to have no trouble having his engineering education research accounted for, while the others in different Departments struggle to find validation of their publications or grant proposals:

...the only question my university asks in relation to a paper - if you want to have it counted by the bean counters - was it peer reviewed or not? That's the only question they ask... So, in that sense, yeah, the bean counters are counting AAEE papers, for the University. In terms of telling the world this is what our academics have done, yeah, they [count them]. They're peer reviewed... the other reason is that the government actually gives a small amount of funding to the universities for each paper that they publish ... that's what the University cares about. [Tom]

Evan is in a specific unit at the same university with "primarily education specialists so their research requirements are less, but their teaching ones are higher". He commented that in regard to the work of the unit being valued "some is, some isn't; probably not so much the research at this point."

Mark at the same university commented that: "...one of the issues that's faced is this thing about the importance or role of engineering education, both within the institution as a legitimate area to do

research in...The legitimacy of engineering education as something worth researching. Which arises in various aspects from whether there is somewhere to record your efforts ...where you might seek research funds, so for example, if you seek research funds from...the Office of Teaching and Learning - or its predecessor...the University's Research Office refuses to deal with those submissions, because it's not research. So you float around the University looking for someone important to sign your application.. they haven't got a mechanism for receiving your application, signing it and then passing it on. ...the Research Office have got a very good means of putting things in front of someone important to sign off as a university signatory. But it's not research like ARC or ... industry funding sources. So that's a bit of a battle. I don't know if other universities are similar."

Tom's view is different to Evan and Mark's experience. This may be due to their different agency in regard to their academic practice, that is their ability to leverage institutional structures in their favour, or just that Tom has not been working in this field as long as Mark so has not met the same barriers yet.

5.2 Temporal references

The previous researcher comments have shown that the intellectual, networking and institutional strands are interdependent. Another aspect of the identity-trajectory framework is the temporal frame of reference ie that this development of the academic strands occurs over time. Our engineering academics make the importance of a timeframe apparent by the use of past events in framing their current situation. Interpreting past events and experience and incorporating them into their personal narrative is demonstrated by researchers from all university types:

I came from industry before I came here so I had no research background when I came here. So I'm developing it through engineering education... I guess when I started as an academic it was clear that I had to develop a research area. I would look around. I've got a construction background so I thought about construction type research. It came down to who I wanted to work with I think, as well as my interest... I became quite passionate about my teaching and wanted to improve it. So that stemmed an interest in what's going on in the research area in that. [Alex, regional]

...but I worked in industry before coming back to uni. Only over the last few years have I been teaching... [Evan, Go8]

But I know that one thing that I have struggled with in the last 15 years is that when I was at university, I was very, very good at knowing what to do and I did it... I'd left school at Year 10 and done TAFE and then ... where I worked put me through university. So I was very focussed. I knew I was here to get a degree. Not wasting time.... I'd been at TAFE and we'd spent a lot of time saying why are we doing this? By the time I got to uni, the students were saying the same thing. [Mike, metropolitan unaligned]

... I've had a strong research background before coming here where I've been doing research only for over a decade, doing nothing but research... so my introduction was down in the practice side of things. Well it was just I guess welcome to education research kind of thing...I did a little bit of research and got a little bit of evidence to go with it so it wasn't just a show and tell paper. But that's where I started...So whereas there's a whole richness to this environment of social interactions, how does that affect the team dynamics, how does it affect the team performance results and the interplay we've got with the distributed teams, the localised teams, and how I've done that just has so many questions that you can ask. ...So that's why I've found myself in that area... [Wayne, regional]

Actually, I don't know if this is of any use to you but my PhD was actually in probabilistic design, which is where you treat all of your variables as distributions, and that's to design quality products and things like that. So quality control is something that's in my mind and so I guess I just think a bit that way. [Terry, metropolitan unaligned]

and also looking forward to what is planned for the future:

I've done largely quantitative and a smattering of qualitative and it's really necessary at some point I've got to force myself to use a much more purely qualitative method to collect some information. [Wayne, regional]

Where I've come from what I was doing previously, dabbling - I shudder when I think back to like the Adelaide AAEE Conference [2009]... I'm trying to think what I was writing about...It was very much a show and tell.... It's been an interesting progression since then. One of these days

I'll line up the papers and go, yeah. To be able to see the progression....To say well I have moved on... sometimes you think, oh I'm not where I want to be. But then I am closer than I used to be. [Alex, regional]

I mean next year I might put something into the conference. I remember, what's his name, Allen Johnston, he's a guy who runs consulting courses on academic success; I think he gave a ratio of one journal paper for every three conference papers or something like that. So I might review that at the end of this year and think about what I want to do next year. [Terry, metropolitan unaligned]

5.3 Agency

Another important aspect of identity-trajectory is an individual's agency. This relates to their ability to set a goal and intentionally move towards it despite institutional or personal constraints. Our participants demonstrated agency in a variety of areas within the structures of their universities, in relation to their academic practice.

We could argue that choosing to site their academic practice in engineering education demonstrates agency since it is not a mainstream research area for engineering academics. Evan and Alex have recently enrolled in PhD's in this research domain. Both cite the need to have a PhD to progress in academia and identified engineering education as an area aligned to their interests:

I started doing some casual tutoring because I had my own business and I'm not very good at marketing so I needed some extra income and I figured it was something I could do and then I just enjoyed it and felt that there was room for improvement, so I thought I could contribute to the area. So I started getting more involved in different projects found a niche and then I'll need to do a PhD to progress. [Evan, Go8]

I've sort of said, okay I'll play the game, I'll enrol in a PhD. But I'm going to do something I'm interested in and aligns with the teaching I'm doing...I decided I'd probably be sticking around academia for a little while and if you're going to do that you need to have a PhD. I get sick of people ... who look down their nose at you somehow. You're somehow inferior because you don't have that PhD. Somehow you can't be as good. So if nothing else I want to be able to say, look I've got the piece of paper, go away. Obviously it's something you have to do if you're going to be in this industry. It took me a while, I resisted doing it for a whole lot of personal reasons for a long time. It just wasn't the right time.... Now is the right time - well is it ever the right time? But it's a better time than it was. I'm interested in engineering education hence now let's enrol in the engineering education PhD if that makes sense. [Alex, regional]

While Evan and Alex are both enrolled in PhDs in engineering education their different responses to the reviews of their papers may be explained by the way they see themselves. Both reported undertaking their postgraduate program because it is expected that an academic has a PhD. While compliance with this expectation seems to be the main issue for Evan, Alex sees her PhD as intentional development of a 'possible self' identity [24] as an engineering education researcher which aligns with where she located her star in Figure 2.

For others their agency is enacted by prioritising their teaching or administrative role over their research since "if you want to be promoted you have to research" [Alex, regional]. This type of agency reflects the finding that "...managing one's own and others' competing intentions occasionally involved resisting work practices as well as the expectations of others" [9, p.7].

I do what I think is the right thing to do. Not necessarily the thing I should do. So I don't necessarily get ahead because I don't publish, because I don't do all the things that I know I should be doing... I'm not sure why now my attitude has changed, that I do what I think is the right thing to do, rather than - and I look for reasons to justify why that's the right thing to do. Rather than doing the things that I really know I should be doing. [Mike, metropolitan unaligned]

Adele exhibits another type of agency by intentionally working with people from different backgrounds on projects that will stretch her knowledge and skills:

I work with people who often have quite different views on the world, so you get really different perspectives. That's actually something I find - like [UQ engineering colleague] and I have just completely - we teach in completely different parts of the curriculum, but that's actually really powerful, because we actually - when we do work together, we have quite different views on it, so often that means I get forced to look at things differently. Whereas if I was just doing my own thing, I think you sort of get - you know, you just get, that's what I'm going to do and I'm going to be comfortable. But working with other people can really sort of challenge you and take you out of your comfort zone. [Adele, Go8]

Wayne demonstrated agency by finding an experienced researcher at another university to co-author his paper and in doing so act as a research mentor.

Other participants demonstrated agency in the way they responded to the reviewers' comments:

...we ignored that review, because it was of no help whatsoever... [Mark, Go8]

I probably would have thought differently if the second person said very much the same thing... [Terry, metropolitan unaligned]

The reviewers picked up on things, weaknesses that I already knew were in the paper... There was one comment in particular... I thought that ... useful, and actually it changed the way I thought about it... it gave me the, 'Oh now I know what I'm going to do with this paper'. So it certainly did give me the direction that I needed to complete the paper the way I wanted to. [Alex, regional]

Variation in the quality of reviews does not always help emerging researchers improve their paper – contradictory comments from reviewers can be difficult to interpret but also allows the author to use the positive review to support their decision to ignore the negative review.

Tom's experience was interesting as his paper was rejected for the 2011 AAEE conference, he demonstrates agency by reworking it for the 2012 conference, for which it was accepted, rather than accepting the initial rejection. His reasoning for resubmitting the paper was that:

...as an author, I rejected the reviewers. That's not unusual for me. I've routinely rejected the reviewers' recommendations. I've numerous times written to editors in chief, and had reject recommendations turned into publish... I go right to the top. I tell the Editor in Chief, this decision is wrong. This is why it's wrong. You should publish me. I've had numerous reversals of decisions. I was writing one this morning actually before you came.

So I'm fairly confident in my - a person who has a fair amount of confidence, and value my own opinions. I'm not bashful. So when I got 2011, I thought you You are just thinking research, research, research. Research is fine. I want this other category; I insist there is this other category. So I resubmitted, and I was quite willing to spin the paper the way it needed to be, to fit the criteria. That's how determined I was to present the paper.

The core problem is I don't have a research finding. So in that sense that whole debate is artificial, being totally frank and sincere. I'm being forced to - I'm being evaluated on a playing field that I don't wish to enter. I want to compete on a different playing field, please.

Our emerging researchers demonstrated agency in various ways in line with their personal intentions.

5.4 Personal context influencing decisions on academic work

McAlpine [8] highlights that attention to personal contexts is essential to understanding the academic experience. Personally related references were often intertwined with references to the past, since it's their personal history participants are talking about. Most participants had an emotional reaction, either positive or negative, to the reviewers' comments, but personal circumstances have, more importantly, influenced some participants' decision to pursue an academic career and its timing. For example Alex waited until her husband had finished his PhD before she began hers, and then chose to work in an area of interest with someone that she wanted to work with, and Adele's fractional appointment at the university was in response to her significant leadership role in a national professional association. For other participants their personal relationships were evident in their comments such as Wayne describing a competition between himself and his wife, and Tom commenting that his daughter would like the coloured stars used in the landscape model.

I started doing some casual tutoring because I had my own business and I'm not very good at marketing so I needed some extra income and I figured it was something I could do and then I just enjoyed it and felt that there was room for improvement, so I thought I could contribute to the area. So I started getting more involved in different projects found a niche and then I'll need to do a PhD to progress [Evan, Go8]

I'm the bloke they go to if they want something proof read, or if they want something written, some programming done. Mostly proofing, I've done a lot of proof reading for people here... It's not just proof reading, it is proper editing I've done as well because I guess I've got a wide interest base, so a wide knowledge base, so I've got a fairly good grasp of most things I come across, and I've always been excellent at English and my wife and I have competitions - we're both really good at our grammar and

spelling and all those things that make up correct writing. So yes, I've been useful with that and occasionally, if people want something, if they want a computer code written or whatever, I've done so much programming for my research that it's easy for me to bash out something for someone in 15, 20 minutes and away they go and they've got a graph or they've got some numbers or whatever it is that they were needing. [Wayne, regional]

Should get my daughter to do this for me. She'd be right into the coloured stickers. [Tom, Go8]

It was difficult to separate the personal comments because they were usually intertwined with another aspect of the model such as referencing the past, agency of horizons for action. This reinforces to us how pervasive the personal aspects of our academic life are.

5.5 Horizons for action

Horizons for action are generated through personal agency from past experiences and the intertwining of the personal and the academic strands. For most of our participants the horizon for action mentioned relates to their envisaged participation in engineering education as a researcher and author. The limit/s they impose on themselves as researchers are based on and in their view of themselves as engineering academics and the engineering research paradigm and are strongly linked to the development of the intellectual strand of their identity-trajectory:

I don't know where AEE is going in future. I don't know where I'm going in terms of contributing to it...I think if it was going to become a significant part of my research effort, I would have to go into this sort of field, and become some sort of expert in engineering education research, which involves the sort of methodologies that I can see that you are using. Which I respect - I have friends who have got PhDs in Sociology and Philosophy and other areas. So I respect those methodologies, I just don't happen to know too much about them myself. So I would need to go in that sort of area to become a more deeply engaged engineer education researcher. But I'm probably not going to... [Tom, Go8];

Probably, only because I think it's too difficult for me to go into that area. I'm not sure that I could go into that area. I could say I'd like to go into this - use some of the same modelling and simulation type stuff to be able to inform. But the trouble with all the - this is the problem I see with modelling, when you get into this area and water research - is the non-modellists say well, this is a model. It's not real. the problem with the model is it will only ever tell you what you've told it. [Mike, metropolitan unaligned]

If I was moving to education research in general I'd probably feel as though I need to have a high level of qualifications in education to understand the theoretical background of things like that. So although there is the opportunity there, I don't necessarily know if I'm likely to take it, simply because I'd say, well, where am I going to publish. If there was a journal of interdisciplinary education research then I'd say, oh okay, that's the area. But to publish a paper like that in just a generic education research journal it would just be a lot of work to make sure I'm familiar with the theories within that journal and stuff like that... [Terry, metropolitan unaligned]

We find it interesting that these three participants intend to stay in engineering education because if they were to move into general education research they would have to learn about learning theories and different methodologies - which implies that they think they don't need to be familiar with broader research perspectives to undertake research in engineering education. For Tom, Mike, and Terry, above, as well as Ian and Evan their educational research is inextricably linked to their practice of teaching engineering students. The final papers from these authors did not address all the issues raised by their respective reviewers. We also note that Terry is the only one of these academics that works at a university with a disciplinary educational research group and none of them seem to have a strong experienced researcher to mentor them, as Wayne does.

Contrasting with this finding are Alex, Adele, Mark and Wayne i.e. the participants who located their stars on the trajectory towards the social research vicinity on the landscape model (see Figure 2). It is interesting to note that Alex, Adele and Mark are all collaborating with a colleague with some type of social science discipline background and Wayne was working with an established researcher as a mentor. We speculate that working with these colleagues has broadened their horizons from the engineering disciplinary base. This reinforces the potential of the networking and institutional strands to impact the intellectual strand since for Mark his collaborator is within his university while for the others their collaborator is outside their own university.

Another horizon referred to by our emerging researchers relates to their perception of how being identified as being active in the engineering education field will impact on their chances for promotion:

I have accepted that I will not ever be a professor, and I'm actually okay with that... I don't know whether he [new Head of School] actually understands the reality, because you know, I've been a 60 per cent fraction with a full-time teaching load for 10 years, who never had any protected teaching time....So, all the new male staff that have been put on in the last six years have all had a half teaching load for two years. I never had that. It actually - I would be better off being a crappy teacher, because I would get less teaching. So, I'm now 80 per cent and I'm teaching two courses full-time. So, I will have taught 1,000 students this year, and I'll teach the same next year - more than that. I'll teach probably 800 in the first semester and 500 in the second semester. So, the reality is, I'm effectively now teaching focused without being called teaching focused, and my head of school is okay with that. But I think he still thinks I can get promoted... I don't know, I think women are actually better at saying, you know what, stuff it, I like it [teaching]- which is really good until they go through a school restructure and then you're vulnerable. [Adele, Go8]

But the Head of School in my performance review said that I should focus on one thing or the other, either in my [stereotypical engineering] research or in my education and that that would allow me to strengthen my position. So not in the school, but strengthen my research... So now it's making me think well, I don't think I should be putting all my eggs in the education basket because if they make me redundant then I've got no [stereotypical engineering research area]. I may not be able to get an education research role at my age now at somewhere else. [Mike, metropolitan unaligned]

Both Adele and Mike believe that being identified as active in engineering education will impact negatively on their chances of promotion and security of employment. For Mike this perception is acting to limit his activity in engineering education as a research area.

These findings support the results suggested in our earlier studies (Jolly et al 2011, Willey et al 2011a,b) and highlight the importance of quality reviews and the need for new researchers to collaborate and/or be mentored by someone with more experience. Not all participants received quality reviews on their paper, indeed, we reviewed all of our participants' papers ourselves and found aspects of each that we would have included in a review if we were writing it, but which were not mentioned in the formal reviews provided. Positive reviews of poor research can also stifle development and reinforce emerging researchers' misconceptions about the quality of their work (for example Wayne's comment about his 100% acceptance rate). To foster improved research it is important that reviewers have both the knowledge and skill to challenge authors in a constructive way, although we acknowledge that regardless of the quality of the review there are some authors who will not make the recommended changes to their paper. We suggest that more transparency in the review process would assist reviewer development by for example, once the review process is complete, making all reviews for a particular paper available to the reviewers who reviewed it, or making exemplar reviews available to reviewers. This would allow reviewers to compare opinions and hence facilitate the development of a shared understanding of the standard of work acceptable in the community. It would also allow reviewers to see how other academics write reviews and so induct them into the review process which would otherwise typically occur during their postgraduate studies.

There were several strong voices from these participants opposing what they saw as a move to make the annual AAEE conference exclusively focussed on research:

I got this overwhelming feeling that the people in the audience didn't feel connected to AAEE as an organisation, because they are all practitioners and AAEE seems to be running an agenda of engineering education research, which is not necessarily related to improving practice [Mike, metropolitan unaligned].

Now I think there is a place in the conference to people to report on practice. If you're reporting on practice, the purpose and the design and the method and blah, blah, blah, is irrelevant...this is all very well if you happen to want to write a research paper. But if you want to write a - if you want to tell the people about something else, which could be quite interesting to a lot of people at the conference, then it doesn't - it tells those people that they're not valued at the conference. I'm not sure if that was the intention or not. This conference seemed to take the view that we wanted to - that they were trying to move to a more research based place, and downplay the practice aspect. I think that was - my

understanding as when - that by providing this, they're - what they were trying to do is to draw out the - and give preference to the research. [Mark, Go8]

Most of these emerging researchers wrote papers about their teaching practice. These types of papers are about what we do (practice) while others are about how we think about what we do (research). How we think about what we do may change what we do and what we do may influence how we think about what we do ie they have a symbiotic relationship, and we believe our national conference should continue to be an outlet where both such papers are included. However, whether the paper is ostensibly about practice or research, it should demonstrate the characteristics of good scholarship as argued by Tom:

A lot of these distinctions around this is research... the second category was being disparagingly described as a paper that was - this is what we did and the students liked it. That was the box for that category of paper, that we might call scholarly teaching practice. Well, perhaps that's the case in the really weak ones? That they just say this is what did and the students were happy, so can I have a paper please? That's poor scholarship.... So as an editor, I'd have no qualms in kicking that out. Say come back next year when you've learnt how to write properly. Give us a decent motivation; give us a decent literature review. Give us some reason for why you think your program was a success, other than the fact that you improved your student evaluation surveys. That's what I would say to the authors of such a paper, and hopefully they would come back next year and they'd have a much better paper. [Tom, Go8]

6. Concluding remarks

Using identity-trajectory to focus on emerging engineering education researchers has provided useful insights for several stakeholder groups in the AAEE community. Reviewers are asked to note that authors appreciate detailed and specific feedback, even though not all authors will act on all feedback provided. So while high quality reviews won't act as an enabler for everyone, poor quality reviews are likely to constrain emerging researchers. Focussing on how authors describe their research methodology will continue to be a learning opportunity for developing authors and reviewers. Universities may note that authors who made substantial changes between the reviewed and final versions of their paper were those working at universities with a research group in engineering education. We posit that these research groups act to provide institutional support to the development of both the intellectual and networking strands of academic identity and hence act to enable academics' development as educational researchers for potential publication and grant outcomes in the institution's interest. Institutional environments also impact our researchers' horizons for action, although this effect is mediated by the individual's agency. For AAEE conference organisers and the community at large we argue that the practice versus research dichotomy is likely to be counterproductive to both growing the numbers in the community and developing the expertise of members in the community, since practice is the typical pathway into it for engineering academics. We suggest that our national conference should provide a forum to support the transition of these practitioners with a focus on providing an environment to encourage quality scholarship in our publications and the continued development of research expertise.

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The role of peer review in identity development for engineering education researchers

Peer review has been the focus of an ongoing study at a series of recent annual conferences of the Australasian Association for Engineering Education (AAEE). A further development of this study has been to explore the perspective/s of the authors of these conference papers and the impact that peer review can have on their development as researchers. This paper uses the identity-trajectory framework to illustrate relationships between peer review and academic identity construction for engineering academics in the AAEE community. Participants' responses illustrate how various aspects of responding to reviews, and writing reviews for other authors, contribute to the development of the networking and intellectual strands of their academic identity. This study demonstrates the importance of peer reviews for the successful transition of members of the engineering education community into this different research paradigm.

Keywords: peer review, academic identity, identity-trajectory, engineering education researchers, conference papers.

Introduction

Peer review has been the focus of an ongoing study at the 2010, 2011 and 2012 conferences of the Australasian Association for Engineering Education (AAEE) (references to be inserted after review). A further development of this study has been to explore the perspective/s of the authors of these conference papers and the potential of peer review to support their development as researchers.

This is particularly relevant to our community as engineering education research is still emerging as a recognised research area in Australian universities (King 2008; Kavanagh, O'Moore, and Jolly 2012). Beddoes (2011, 8) suggests that one of the results of the emergent nature of engineering education research is that many 'leaders, such as journal editors, are longtime administrators and reformers, but not educational

or social science researchers'. This has implications for both the creation and interpretation of review criteria and hence influences what is published and what isn't.

Another complicating issue is that most scholars who identify with this emerging field are engineering academics (Borrego and Bernhard 2011). These academics may hold research qualifications and expertise in their own stereotypical engineering field but are faced with developing new perspectives and expertise when moving into educationally related research (Beddoes 2012).

As a result of engineering education research being both emerging and interdisciplinary there is a wide variety of views as to what quality research looks like (Borrego and Bernhard 2011). The implication for authors is that '...reviewers, and audiences, have significantly different knowledge backgrounds. Thus, authors are caught between fields and held accountable to reviewers from different fields and should expect divergent opinions over what is appropriate and accessible' (Beddoes 2011, 25).

Although peer review is required to meet government and hence institutional requirements for papers to be acknowledged as research, we argue that our engineering education community needs to do more with the peer review process than focusing on gatekeeping and compliance. Feedback in peer review should be aimed at assisting authors to develop the standards and norms of this interdisciplinary field and develop researchers' judgement by for example, challenging them to reflect on their perspective, data collection, and interpretation of findings. Similar arguments have been developed in relation to peer review in the domain of science education research (Eisenhart 2002; Roth 2002; Tobin 2002).

For engineering academics, along with our 'engineering disciplinary norms and expectations of what quality research is' (Beddoes 2012, 3) when we participate in

engineering education research we also bring with us our engineering identities. The importance of our identity in becoming an engineering education researcher is highlighted by Wenger (1998, 160) who says this:

...demands more than just learning the rules of what to do when. It requires the construction of an identity that can include these different meanings and forms of participation... The work of reconciliation [of differing identities] may be the most significant challenge faced by learners who move from one community of practice to another...and is an on-going process....

Developing an academic identity as an engineering education researcher is a multi-faceted, complex and sometimes lengthy process. Swann, Johnson and Bosson (2009) report on the importance of a supportive community in identity formation in the workplace. Our research looks at how the peer review of conference papers supports researcher identity development within the AAEE community. This paper examines the relationships between the peer review process and academic identity construction for individuals, both as reviewee and reviewer, and implications of this development for the wider engineering education research community.

Background

Part of the difficulty engineering academics have with becoming the interdisciplinary researchers they need to be is that social research is so different to stereotypical engineering research. Jones (2011, 11) notes that in consensus-based disciplinary classification schemes 'high paradigmatic fields [such as engineering] have high levels of agreement among their practitioners with regard to issues such as appropriate research topic and methods', while 'low paradigmatic fields [such as education] have less agreement in relation to appropriate research questions and even less agreement on appropriate methodology for addressing these questions'.

Alise (2007) showed that there are differences between academic disciplines with regard to preferred research methods with engineering in the disciplinary classification more likely to use quantitative methods and education in the classification more likely to publish research using qualitative and mixed methods. The dominance of quantitative research perspectives and methods has also been noted by Beddoes (2011, 8): ‘Despite being an interdisciplinary research area...positivist contributions from fields like psychology are ...more readily accepted without great effort on the part of authors than are critical qualitative approaches...’.

This preference for quantitative research has been attributed to our formal training as engineers which influences expectations and norms for engineering education publications where generally, quantitative and positivist research is dominant (Borrego 2007; Koro-Ljungberg and Douglas 2008; Borrego, Douglas, and Amelink 2009; Douglas, Koro-Ljungberg, and Borrego 2010; Borrego and Bernhard 2011). However, although we may start from a positivistic, quantitative perspective, there is evidence that engineers can learn to incorporate methods from other research traditions: ‘Research on primarily U.S. engineering education researchers indicates that they are more comfortable with quantitative research approaches, but are open to qualitative methods when faced with the complexity of studying human beings in classrooms and similar settings...’ (Borrego and Bernhard 2011, 23).

Supporting this is the suggestion from Land (2012, 177) that working in an interdisciplinary way is a ‘threshold concept’ for many academics:

The journey toward a more interdisciplinary mode of thinking and practising is likely to be instigated or provoked... by an encounter in the preliminal state with a form of ‘troublesome knowledge’...the ontological shift experienced within the liminal space will also incur - and require – a loosening or weakening of

disciplinary identity...producing a postliminal state marked by a changed use of discourse.

Brew (2001, 2006) reports on the different ways that academics conceptualise their research and supports the idea that the way academics think about their research is strongly linked to their identity. Other researchers confirm this link between research, writing about research and academic identity: ‘...research has often been seen as central to academic identities...’(Taylor 2008, 39), the role of researcher is ‘...key to identity, learning and belonging for most academics’ (McAlpine, Jazvac-Martek, and Gonsalves 2008, 122), and for academics writing is ‘...the key site of contemporary scholarly practice and the performance of scholarly identity...’ (Barnacle and Mewburn 2010, 434).

Disciplinary identity is usually constructed through the socialisation processes inherent in completing a postgraduate research degree in the field of interest.

Thompson (2003, 428) suggested that ‘through interactions with faculty members graduate students are encouraged, reinforced, and rewarded for their display of attributes salient to the academic discipline, and thus academic environment’. So postgraduate and, to a lesser extent, undergraduate, engineering education acts to socialise participants to the context of stereotypical engineering research. For engineering academics wanting to change their practice to engineering education research, not only do they have to negotiate the differences inherent in a different type of discipline, in Australia they usually don’t have the socialisation process of being a graduate student in engineering education to assist them. This process is, instead, undertaken through engagement with the engineering education research community.

2.1 Identity-trajectory

McAlpine and colleagues (McAlpine, Amundsen and Jazvac-Martek 2010; McAlpine and Lucas 2011; McAlpine and Amundsen 2011; McAlpine and Turner 2012; McAlpine, Amundsen & Turner 2013a,b) have proposed an identity-trajectory framework to describe the development of academic identity. This framework consists of three intertwined strands: intellectual, networking, and institutional, which interact asynchronously over time as modelled in Figure 1.

[Figure 1 here]

The intellectual strand represents ‘contributions to one’s disciplinary specialism or field.

The intellectual strand leaves a trail of artefacts, e.g. publications, citations, papers, course/curriculum design’ (McAlpine and Amundsen 2011, 179) and, we suggest, reviews.

The networking strand encompasses the academic community beyond the participant’s university and includes both an ‘interpersonal’ and ‘intertextual’ element.

The intertextual element of networking for our participants includes the AAEE community and reviewers as well as the authors of the literature they read and cite. It represents the range of

...local, national, and international networks one has been and is connected to, and...includes (a) research and publication collaborations with others; (b) cross-institutional course/curriculum design; (c) work with professionals...and (d) membership of disciplinary organizations [such as AAEE] and on journal boards.” (McAlpine and Amundsen 2011, 179).

The intellectual and networking strands strongly interact with each other with the networking strand ‘establishing the intellectual location for one’s contributions’ (McAlpine & Amundsen, 2011, 180) and so are largely focussed beyond the individual institution where an academic may be employed.

However, the framework also includes an institutional strand which represents the interactions of the academic in their workplace. McAlpine and Amundsen (2011, 180) found that institutions can ‘support or constrain an individual’s networking and intellectual strands’. In our context institutional support of the networking and intellectual strands would be by, for example, providing funding to attend the annual AAEE conference.

Of particular relevance to our research on peer review of conference papers is the notion of the ‘intertextual network’ which facilitates learning about the discipline area:

Learning through reading involved understanding how scholars in the field communicate through varied genres, e.g. papers, manuscript reviews and funding proposals. Learning the discourse was essential (e.g. how claims are made or the positioning of the researcher/author), but also how textual practices are tied to actual research practices (e.g. what is an appropriate question in a field, what is considered appropriate or essential evidence)... Learning to read–understand in the chosen field is necessary to interacting within the field (McAlpine 2012, 356).

Beddoes (2012, 8) also illustrates that reviewers play a part in an author’s intertextual network:

... numerous individuals are involved in bringing an article to its published version... articles are often the result of multiple and competing deliberations and negotiations. They contain knowledge and opinions not only of the authors, but also of reviewers and editors.

The appeal of the identity-trajectory concept is that it was developed in an academic context so specifically relates to academic identity development, i.e. the strands relate to dominant aspects of the academic context. In this paper we discuss the direct interaction between the intertextual networking process of peer review of a conference

paper and the intellectual strand of the participants' identity development, as well as the more indirect interaction with the institutional strand.

Our Study

Our research approach is interpretive using the identity- trajectory concept as a framework or a 'lens' through which to view the data.

This study focuses on engineering academics with engineering qualifications, who are also 'active' members of AAEE. In this project we are defining engineering academics as 'active' members of AAEE if they authored a paper for the 2012 AAEE conference AND at least one of the three previous years' AAEE conferences. The author list from these conferences (available in the proceedings) was used to identify potential participants. We wanted participants to feel free to share their research experiences so excluded universities in our own city in deference to those academics who see universities as being in competition with each other. The remaining thirty-eight eligible academics were invited to participate in the research project. Nineteen of these authors accepted the invitation. These authors came from a variety of university types, at a range of locations from Rockhampton in the north to Hobart in the south and Perth in the west, and with a mixture of levels of experience as educational researchers.

Participants were classified according to what type of university they work for (Group of Eight (Go8), Australian Technology Network (ATN), regional, or metropolitan unaligned as described in Table 1 – for variation in the institutional strand); and their level of expertise in engineering education research (emerging, intermediate, established – for variation in the intellectual and networking strands).

A participant's level of expertise as an engineering education researcher was determined by the number of specific types of publications they had written in the

previous four years (conference papers, journal papers, and/or book chapters) along with other indicators of research activity such as being the project leader of a grant with funding awarded through a nationally competitive process, supervising research students working on educationally related topics, and serving in an editorial role for an educationally related journal. Using this system, participants fell into three broad groups: emerging, intermediate, and established researchers.

[Table 1 here]

Fourteen of our nineteen participants have a PhD in a stereotypical engineering disciplinary area such as structures, hydraulics, control theory, manufacturing and mechanical engineering. Of the remaining five, at the time of the interviews, three (2 x emerging & 1 intermediate) were undertaking a PhD in an engineering education related topic, one established researcher had completed a PhD in an engineering education related topic and one established researcher was able to argue that the engineering education related research he had undertaken was equivalent to a PhD in his successful promotion to Professor.

Semi-structured interviews were conducted with each participant in their campus office, or an alternative location nominated by them. Each interview took approximately an hour and occurred in the timeframe between three weeks and five months after the deadline for submission of the final version of their paper to the 2012 conference. During the interview participants were asked to re-read the reviews they received on their paper, comment on how helpful they had found these reviews in preparing the final version of their paper, and explain any changes they had made between the draft and final versions. This generated discussion about the reviews

themselves and about the changes the participants had actually made to their papers that were prompted by review comments, or independent of the review comments.

Transcripts were created from audio recordings of the interviews, which were then coded in NVivo 10 for a priori themes relating to identity-trajectory strands (intellectual, networking and institutional).

Findings and discussion

Responses from our participants supported our researcher classification system since it aligned with their perceptions as they self-identified as being at a particular level of expertise:

Being a novice researcher... [emerging, regional];

So I'm in the midpoint of my transition from one to the other. Not generating too many new ideas in the technical research area anymore [intermediate, ATN].

Studying the interview transcripts we were able to find many instances of how the peer review process had impacted on the author's intellectual strand, as well as whether and how their institution supports their identity construction as a researcher in the engineering education field (reference to be inserted after review). The discussion below focuses on the impact of the peer review process as part of the intertextual network, on the development of researchers' intellectual and institutional strands.

4.1 Intellectual strand

The intellectual strand is referenced by the comments that many participants made relating to research perspectives, methodologies and tools. Participants noted that reviewers' comments made them think differently about a variety of aspects of their paper including:

- how they structured it:

The reviewers picked up on things, weaknesses that I already knew were in the paper... There was one comment in particular... I thought that [expletive deleted] useful, and actually it changed the way I thought about it... it gave me the, 'Oh now I know what I'm going to do with this paper'. So it certainly did give me the direction that I needed to complete the paper the way I wanted to [emerging, regional];

When it was finished I still can see weaknesses in the paper, but I think at the end of the day it was the length of the paper that stopped me from being able to put in the depth, but that's what a paper is. So hopefully I've added enough in to deal with what the reviewers, well to deal with any other reader that would have had the same issues that the reviewer would... So I really did need to add a whole new section based on what they - they said minor changes but in the end it was a significant, well I think it was a significant addition which meant I had to take chunks out as well [established, regional];

- the literature used:

So this one was more referenced to literature on teaching sustainability and the illustrating concept would be helpful. So I thought I'd done that, dug into the paper, couldn't find it anywhere. Thought yeah, I can see that [intermediate, ATN];

- the research methods used and how to write about them:

There was one comment here [in a review] about the use of the extracts from focus groups. They [reviewer] weren't convinced that that was a way to show results. I'd seen other papers that had done that... it made me think [emerging, metropolitan unaligned];

...particularly the one I'm looking at here where they were talking about methodology and they just listed a whole heap of things that they were meant to have and I thought that's a fair point, I should have put that in [emerging, metropolitan unaligned];

So I did take up on that suggestion and I went and acquired the student survey written comments and categorised them. So in the next version there's a little table that has - so I went through and categorised them...and it turned out it was kind of interesting ... how the students' comments fell [established, ATN];

- written expression and formatting:

So I think I got an essence from this reviewer 1, where I kind of needed to have a look at it again and while it wasn't a throw the whole lot out and start again, it was certainly critically evaluating each paragraph and wasn't explaining things as well as it needed to be [emerging, regional];

When I get these kinds of reviews I have to sit back and go what have we not conveyed here. We clearly haven't told this story well enough that the reviewer just went off in this direction [established, ATN]; and

- future research:

Sometimes those things are hard to measure, and I think we all knew that before, but ...we wanted a starting point, and I think we put something down on paper, and the review did help us I think, refine and reflect on where we wanted to go ... [established, ATN].

As well as influencing their intellectual strand, the review they received prompted them to re-engage with other elements of their intertextual network and think more critically about their sources:

So this one [review] was more referenced to literature.... So I ... dug into the paper, couldn't find it anywhere... So that...led me to reading in a more deep way some of the literature that I've already read...Like I read [another author's] paper again. The first time I read that I thought 'Oh, ...amazing' ... Then I went back to try and find something to quote and I thought this is really a bit thin on pedagogy. So that changed my perception [intermediate, ATN].

Another way that peer reviews extended our participants' intertextual networking strand is through the process of reviewing other authors' conference papers. Several participants commented that they learn from reading the papers they are asked to review, i.e. that reviewing prompts further interweaving of the intellectual and networking strands:

If you're a reviewer, it's also a learning exercise for yourself to go oh this is a really good paper or they've taken an interesting approach or whatever...it's an educational process for the community [established, ATN];

It makes you learn about things that because you now have to read a paper you actually read a bit more... So it is good reviewing because it just makes you read papers that you sometimes just don't get time the read - well, you do have the time if you really made the time but you don't. This just forces you to sit down and read some papers, which is always good [emerging, metropolitan unaligned];

...it's good ... to read other people's work to get an idea of what's out there... Also to get an idea of how other people write... I'll criticise something then realise I've done it myself in my own paper [emerging, Go8];

And they learn more by reading the paper than by just listening to the presentation:

...at a conference presentation if it's the first time you hear about a paper, it just goes over your head. Even if it's a good idea. I write it down, it's still not the same as if I've read it...if I go to their presentation for a paper I've reviewed and I really enjoyed, eventually I meet that person in the lunch queue and I say I really like your paper on ... That will be a really deep connection that happens just because you've reviewed the paper [intermediate, ATN].

This comment also demonstrates how the conference provides an opportunity to transform elements of our intertextual network into part of our interpersonal network ie at the conference we can meet the author/s of papers in our intertextual network in person.

Especially for a first time reviewer of AAEE papers, reviewing involved a 'paradigm shift' in their thinking about research, and helped them learn about the discourse of the field:

...because I'm outside of my normal field... it was a paradigm shift...in terms of familiarising myself with the field of discourse - engineering education - the whole thing was educational...quite stimulating and valuable... I was there to learn about the discourse... getting involved as a reviewer is quite a healthy way to engage yourself in a discourse [emerging, Go8].

An established researcher commented that writing papers and engaging with the review process are connected, which again comes back to how the intertextual network is intertwined with the intellectual development strand:

...they're all connected, and interconnected, and the fact that we can learn from others - you know I've heard people saying they're not doing reviews or they don't ever do them, and I'm saying well I think you're missing an opportunity to understand how other people have tackled the same issue, and I think we need to open our eyes and be a little bit more adventurous and brave and not be afraid to learn off our peers and give feedback to our peers [established, ATN].

Authors also learned about reviewing by seeing other reviewers' comments (after their review was submitted) as it allowed them to benchmark their thinking:

As a reviewer, after the process is finished, I always do whatever I can to hunt down the comments from the other reviewers on the paper that I reviewed... Anonymously, of course but I still got to see what the other people thought, which was again, very interesting and illuminating for me [emerging, Go8];

There doesn't appear to be a lot of feedback to do a review in this particular process, so without someone coming back and saying well, perhaps you were a bit harsh, or giving you a review on my review then it's whether or not they accept it, that is a very crude way of getting feedback I guess [emerging Go8].

Both of these participants are emerging researchers, so this seeking of feedback on their reviews may be a reflection of their lack of confidence in our field, and/or their eagerness to know more.

Perceptions of the quality of the review are also dependent on the expertise of the author i.e. on the sophistication of their intellectual strand. To illustrate this we can see that established researchers think that generally review quality is poor:

...yeah, I think refereeing is ...not all that good these days [established regional];

...sometimes I'll put in a paper and I'll think oh, that's going to get hammered. It's crap, but I've run out of time and at least using the reviewing process will give me an opportunity to re-write it. Then it's really sad when it comes back with this is good, accept... you think what? How did that happen? [established, regional];

Some of the reviews that I've seen sometimes I'm really surprised at ... I'm thinking good grief, come on, surely we can take a slightly wider view of the world. We don't have to be so narrow minded. I think there's an element of that [established, Go8];

which we can contrast with statements from emerging and intermediate researchers' perceptions that review quality is improving:

...fairly happy with the reviews I had this year...the reviewers and the reviews that I got have improved... [emerging, regional];

...and I have to say, I thought the standard of the reviews were probably the best I've seen [emerging, Go8].

Yeah, the quality of my paper improved more with these reviewer comments than any other conference paper I've ever written [intermediate, ATN].

The various aspects of reading and writing reviews activated the further intertwining of the intellectual and networking strands of academic identity and engaged our participants at their different stages of development.

4.2 Institutional strand

Most participants commented that despite producing publications for the university to 'count', engineering education related publications were seen to be second-class and in some places not considered as 'real' research which can be a disincentive for researchers to continue. This perception of the research area as not real research means that authors in that area are also looked down on as not capable researchers which can impact on identity constructs as well:

We get presentations from our Office of Higher Degrees in Research about what is a reportable... anything that has learning or teaching associated with it, they tend to view fairly cynically when they're trying to determine whether it's real research. If you were testing concrete beams or something, it must be real research. But if you're not they seem to apply almost different standards because they can't quite cope with qualitative and the quantitative difference, I suspect... this seems to be a common thing. Maybe we see it in engineering education because we see both sides of the coin. We see the technical researchers and what they do, and say well we're just as rigorous, but we seem to have different standards applied to us... we have to justify our status much more strongly [emerging, regional].

An intermediate researcher believes engineering education is regarded as real research at the university where they work, but the interweaving of intellectual and institutional strands is illustrated with the questioning of qualitative research methods at the end of this comment:

It is because of our previous dean. He in fact set up the engineering side, the [engineering education research group]; he supported it greatly. I don't know if it's seen by other researchers as real research. It's seen by other people as a form of research. Most researchers still don't think of it as strong because they don't think

that surveys are a scientific approach to do research.... You can interpret the data; that's something else. Data interpretation occurs anywhere. But it's how you obtain the data. By interviews or question/answering. I also question that [intermediate, metropolitan unaligned].

As indicated by this intermediate researcher, some universities actively support engineering education related research with two universities among those represented by our participants having already established a discipline specific research centre. Institutional support has benefits for both the development of authors' networking strand (supporting them to attend the conference) and/or their intellectual strand (providing resources at their university to support developing expertise):

The school will fund you to go to AAEE conference, at the moment. So they funded four or five of us to go and we wouldn't get funded to go to another conference....[Head of School] funds four to five people every year to go to AAEE, which he doesn't fund any other conferences. We all got \$2000 this year [emerging, metropolitan unaligned];

...the previous discipline leader was actively encouraging people to do research into education. Our previous dean was quite keen on it as well... So I guess you do have support because (a) there's people here I can talk to about it and (b) it is actually encouraged by people at senior levels [emerging, metropolitan unaligned];

The background to this paper is that I was part of a writing group. We'd meet once a week for 10 weeks or 12 weeks ...So we're set tasks to do every week ...Some of us had collaborators in the group; some of us didn't... So we'd exchange ideas within that group as well; assimilate ideas... it was run by the people in the [faculty] education research group [intermediate, metropolitan unaligned];

...we have a very large engineering and science education research group, ...so most of the other people in the faculty, even if they don't directly do engineering education research, they're at least aware that other people are doing it. That it's...contributing to the research quantum of the university... So yes, engineering

and science education is valued, certainly by the faculty and I think by the university, because it brings in papers and stuff [established, metropolitan unaligned].

Hardre et al (2011) and Bailey (1999) report that efficacy is an important factor in faculty productivity. They argue that 'because institutions gain from productive faculty, it follows that institutions will benefit from investing resources to give faculty the tools they need to be efficacious in doing research' (Bailey 1999, 60) such as training in technology tools and methods. They also found that departmental support was consistently and strongly predictive of efficacy for research which is also consistent with Wood's (1990, 60) findings that:

...academic faculty believe in and value academic autonomy... in choice of research topics and scholarly pursuits. The implication of these findings is that administration and policy should provide for and support academic autonomy and choice for faculty. Departmental support was also an important factor in predicating efficacy, which further underscores the implication that faculty members need to see their departments and institutions as supportive of their efforts and development of research skills and tools.

Our study suggests that this is more important for our emerging and intermediate level researchers as they transition into this emerging research domain from a stereotypical engineering academic background. Established researchers have more institutional credibility by virtue of the research output they have already created. As, typically, Associate Professors and Professors they can activate more institutional capital than researchers at the Lecturer or Senior Lecturer level. However, because of the emerging nature of the research domain this support is often dependent on the attitude of a local leader with strong views on the subject e.g. a Departmental or School Head, or a Dean, and that once this person goes, support for educational research within that unit can go

with them.

One way that institutions can support research is to support research writing. While McAlpine (2012) suggests that institutions should support the development of their research students' intertextual network with specific pedagogical strategies, Murray (2013, 90) calls on universities to explicitly support writing for all academics:

It is not sufficient, therefore, for individuals to engage with writing; institutions must engage with writing too, not only by acknowledging the role of engagement with writing but also by acknowledging the role of writing in academic work. For those with responsibility for developing research capacity, the implication of this study is that they should not assume that new researchers in all disciplines should be left to find their own way to make writing part of their work.

In the context of engineering education research in Australia we suggest that such institutional resources are unlikely to be forthcoming, except perhaps in the few universities with specific research groups, and a more practicable way to facilitate such development is through the production of conference papers for the AAEE conference. Murray (2013, 87) found that academics talk about disengaging with other academic activities in order to write and for many this was difficult, but this process was helped by engaging in 'relationships with others who write'. Without institutional engineering education research groups, the AAEE community is important as the space where individuals will find these other academics who write about engineering education.

4.3 Wider implications

Our study shows how various aspects of responding to reviews, and writing reviews for other authors, contribute to the development of the intellectual and networking strands of participants' academic identity as engineering education researchers. The peer review process is valued by them as it drives writing and even research design and helps

learning in our field:

...if you don't have a proper review process you just don't write the papers as well. You don't think as much about your own papers, you don't review the literature in such a deep way, you don't construct your argument so well, and so on and so on. So the depth of the quality of the research is much improved by having a really effective review process... So, in terms of the profile of engineering education research, I think it's really vital that we do this. This is something that we can do as a community... [intermediate, ATN];

I think as well it's about improving the work that's going on within the community, beyond the actual paper. So if you know that in order to get published in this community, you need to have done this and done this and done this. Then I think that that would push more people to finding out how to do that better, before they even get to writing the text...if I have to be able to describe the method and the literature that I've drawn from, and state some sort of conclusion that is in some ways saying something to someone else in a different context, then I'm going to think differently about what I do [established, metropolitan].

The intentional use of peer review to contribute to each others' development as researchers also has implications for lifting the profile of the engineering education community and the AAEE community in particular:

If we want to get taken seriously as a valid research sector, we as a community need to be responsible for the quality of what we put in... All you need are a couple of really crappy papers in the conference proceedings, and it's enough to undermine. You know, people go, that was crap. So, I think...if we want to get taken seriously, we have to be our own quality control meter [emerging, Go8];

Since the peer review process has implications for the identity development of both individual researchers in the field and for the field overall, we encourage reviewers to pay attention to how they write reviews and try to provide constructive advice for the author/s, rather than just producing artefacts of compliance. The review process for conference papers is one way for novice researchers to experience the expertise of

established researchers – this is especially valuable for novice researchers who are geographically or institutionally isolated from other members of the community. We challenge established researchers to be leaders and grow the community rather than being elitist.

We also recommend making all reviews available to all reviewers once they have submitted their review. This allows reviewers to benchmark their thinking with the other reviewers which would be especially useful for our emerging researchers. This process is practised in some journals.

While we have concentrated on the members of the AAEE community transitioning from stereotypical engineering research areas into engineering education research, we acknowledge that this community also enjoys the participation of researchers with disciplinary backgrounds other than engineering. What effect our peer review process has on their academic identity is still to be explored.

Conclusions

Identity-trajectory has provided an informative framework to understand the inter-relationships between the intellectual, networking and institutional aspects of academic identity construction for members of the engineering education community in Australia. For most of our participants the usual disciplinary socialisation process of completing a postgraduate research degree in the field is not practicable and this process is, instead, undertaken through engagement with the engineering education research community. The AAEE community contributes to each others' intertextual network strand of academic identity through the peer review process. This study demonstrates how the intertwining of networking, intellectual and institutional strands means that the peer review process also impacts these strands of academic identity. As a result we encourage established researchers to demonstrate some leadership and use their reviews to grow the expertise of the community of engineering education researchers rather than

producing artefacts of compliance.

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Table 1: Participants' level of expertise and type of university

No. of participants	Level of expertise	Type of university	Description
4	emerging	Group of Eight [Go8]	The 'Group of Eight' (http://www.go8.edu.au/home) is a coalition of eight research-intensive universities located in state capital cities, which tend to be the oldest universities in Australia.
1	intermediate		
1	established		
1	intermediate	Australian Technology Network [ATN]	The ATN is an alliance of five universities, each located in the capital city of a mainland state of Australia. These universities badge themselves as practice-based and their research is focussed on the needs of industry and the community.
2	established		
2	emerging	Regional	Regional universities are those with their main campus in a regional city or town rather than a state capital city. As well as on-campus students, these universities are characterised by significant numbers of external/distance students.
1	intermediate		
2	established		
3	emerging	Metropolitan unaligned	The metropolitan unaligned universities are those based in a state capital city, but not included in the Go8 or the ATN.
1	intermediate		
1	established		

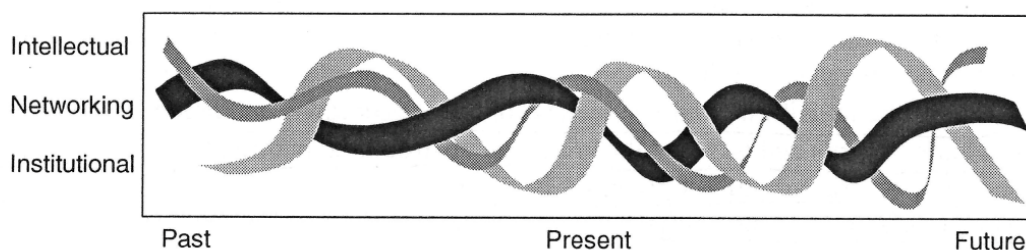


Figure 1. The interweaving of strands of academic identity. (McAlpine and Amundsen 2011, 178).