

Engineering education research groups in Australia: Implications for Australasian engineering educators

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***Abstract:** Learning and teaching innovation is becoming more necessary in engineering, particularly with the new Engineers Australia Stage 1 Competencies and the ‘voucher’ system starting in 2012. There is also increasing pressure on academics to undertake research and publish. In Australia, a small number of groups have formed to meet these challenges and help engineering academics develop their education research practices. However while these groups have developed in and are focused on their local context, the factors that influenced their creation and support or hinder their growth have implications for similar groups in future. This paper aims to compare and contrast three such groups to identify essential elements of engineering education research groups in Australasia. Three case studies are presented from the perspective of the coordinators of the groups, along with a thematic analysis conducted across the three cases.*

Introduction

The realities of teaching and learning engineering in Australia mean that the quality of student’s learning experiences, staff teaching practices, and learning and teaching environments are under increasing scrutiny. With the ‘voucher’ system to aid student mobility between institutions in Australia being introduced from 2012, students will have new power to ‘vote with their feet’ if they are dissatisfied with their learning experiences. This will occur against the backdrop of revised Engineers Australia Stage 1 Competencies and the establishment of TEQSA (Tertiary Education Quality and Standards Agency).

At the local level, many Australian institutions are engaged in curriculum renewal with a strong focus on increasing the quality of student learning. Part of this is in response to the engineering profession seeking to promote a change in the culture of professional education from within—from one with an emphasis on traditional, passive and technical aspects to one that is more active, engaged, personal and professional (Johnson, 1996; King, 2008). It is also a response to resource implications, such as the ‘triple challenge’ (Ehrmann, 1996) with its inherent contradictions: to increase participation and access, improve quality, and reduce cost-per-student.

Given this context, with multiple pressures pointing towards (and some might argue in addition mitigating against) high quality student learning, Faculty leaders are looking for ways to strengthen student learning through innovation in engineering degree programs. One such approach looks to staff engagement in education research and scholarship—often relying on the expertise evident in extensive Scholarship of Learning and Teaching (SoTL) literature (building on Boyer (1990) and beyond)—to strengthening student learning. While there are divergent views on what does and does not constitute SoTL, those within the SoTL community would position engineering education research and scholarship as SoTL (see University of Wisconsin, 2011). It has been said that experience and innovation become scholarship when three things happen (Shulman, 1999):

- Learning and teaching practices are articulated and made public;
- This becomes an object of critical review and evaluation by members of one's community; and
- Members of one's community use, build upon, and develop their experiences and innovations

In engineering education research, SoTL activities can be placed on a continuum from individual staff inquiry to large scale, multi-campus research projects (Chang & Mann 2010). However, existing university support for engineering SoTL activities can be patchy and may not be attuned to the contextual needs of engineering academic staff. What is required are engineering education research groups to be established that can cater for local staff needs in their projects to strengthen student learning.

This paper presents three case studies of engineering education research groups from around Australia and will examine the research question: What are the essential elements of a 'successful' engineering education research group in Australia? It is argued that all engineering faculties / schools should have an engineering education research group to support individuals to research and thereby strengthen their own teaching and learning practices.

Methodology

In order to identify the essential elements of a 'successful' engineering education research group within Australia, a case study approach was used (Yin 1984, Flyvbjerg 2011). This was chosen as it enables a rich description of individual groups while appreciating the context in which they are situated. Three groups were identified within Australia that: a) focused on helping academic staff undertake education research and b) that had shown 'success' in meeting their initial aims and generating significant outcomes. Note that no formal evaluations have been conducted on any of the three groups. Success is based on outcomes against goals, the reflections of the leaders / coordinators of the groups and the satisfaction of the relevant managers (e.g. Deans of faculties).

The leaders or coordinators of the groups each wrote a description (case) for their group based on evidence of processes and outcomes as well as their reflections. The cases were written using a set of prompting questions to help focus the cases around what were believed to be salient issues for the groups, including the aim of the group, the number and types of members, the structure of the group and formal roles, the level of support received, the types of activities run and the challenges encountered. A summary of each of the three cases is presented in this paper. These cases were then analysed for similarities and differences to identify essential elements of a successful engineering education research group in Australia.

Three Cases of Engineering Education Research Groups

Three cases were used as the basis for the comparative case study: the Engineering and Science Education Research (ESER) group at Swinburne University of Technology, the Engineering Education Research Group (EERG) at the University of Southern Queensland, and the Future Engineering Education Directions (FEED) group at CQUni.

Engineering and Science Education Research (ESER) group - Swinburne

The Engineering and Science Education Research (ESER) Group aims to strengthen student learning by enabling academic staff to conduct and publish educational research and scholarship. It formally started in February 2010 after the Associate Dean, Learning and Teaching (ADLT) and the university's centralised leader in Scholarship of T&L proposed to the Dean of the Faculty of Engineering and Industrial Sciences (FEIS) to formalise an engineering and science education research group with significant long-term funding. The ESER Group brings together 25 academic staff from the Faculty of Engineering and Industrial Sciences and other faculties and groups across the university interested in engineering and science education research.

The ESER group has a leader (the AD(L&T) of FEIS) and two coordinators, one the Education Research Coordinator of FEIS and the other the Academic Development Advisor for FEIS. Both the coordinators have official workload to coordinate the group and organise and run activities; two days in total between the two coordinators. Their roles involve gauging members' needs to develop and

facilitate a program of activities in education research, including administrative aspects (room bookings, email notices etc), academic development aspects (developing program, planning specific activities, facilitating these), reporting aspects (collecting reportables and reporting these to Faculty senior leadership), networking aspects (networking with colleagues at other institutions and within AAE).)

ESER receives strong formal support from Dean and Senior Management and has a significant budget for activities and events, including guest speakers, running activities, specialist targeted workshops on aspects of education research and publication run by external facilitators, and support to attend engineering education conferences. The group also runs its own SEED funding program, supporting small education research projects within FEIS.

The group is structured as a Community of Practice (Wenger *et al* 2002; Wenger 1998), and has active members who attend regular weekly activities and who are actively engaged in education research, and potential members who are interested in improving their teaching practices and attend activities sporadically. Attendance is voluntary and based on members' interest and availability. These weekly 1 hour sessions cycle through a program of active workshops (once every five weeks), followed by journal club (to read and engage with education research literature), writing group (to undertake short structured writing activities), invited speakers (to engage with others undertaking education research) and research discussion sessions (where members discuss their current research projects). In 2011 we have added the Friday Writing Space, an additional weekly activity where members can bring their current academic writing project and write in the company of others.

The ESER group has also organised larger events and development opportunities, including a research retreat day—where participants were introduced to education research by forming cross-disciplinary teams to analysis a common data set, and a twelve-week journal writing course, facilitated by a consultant, to develop participants skills to write a journal paper (which they aim to complete by the end of the course).

The major challenges we encountered have included organisational memory that similar past initiatives have failed, causing hesitancy. In this case we consciously spoke in ways to manage people's expectations, and adopted strategies to aim to mitigate similar negative outcomes. In addition, we encountered the misconception that SoTL is a "soft" research option requiring little effort or rigour, characterised by an assumption that SoTL involves simply describing one's practice with no requirement to engage with relevant literature, learning theories, critical reflection, research methods etc. When faced with this attitude, we injected examples of rigour and complexity into our descriptions; and in interactions with the research group, illustrated rigorous SoTL through example papers in journal club. A further barrier or complication is the institutional drive to publish in journals with high national rankings, although this has eased somewhat with the recent decision to scrap the journal ranking system.

Engineering Education Research Group (EERG) - USQ

The Engineering Education Research Group (EERG) aims to enhance and inform the learning and teaching practices in the faculty through quality scholarship and research. The group was formed in mid 2007 with a small amount of seed funding and a lot of support and encouragement from the Dean of the Faculty. The support from senior management was critical in establishing the credibility of the group and its work. Initially the group reported directly to the Dean but it has since moved to sit under the Associate Dean Learning and Teaching.

The group strives to develop the scholarship and research profile of staff in the area of learning and teaching, helping staff to develop a rigorous approach to evaluation, interventions and measuring outcomes. Through these processes the group aims to develop and strengthen the research profile of faculty through publications and grants. The group provides a collegial framework to foster cross-disciplinary collaborations within Faculty of Engineering and Surveying (FoES) and also with key areas and faculties across the university. It provides a supportive avenue to introduce early career researchers to the scholarship of learning and teaching, as well as providing experienced researchers the support they need to further their work. The group has 53 members including staff from FoES, the

Library, Faculty of Education, Faculty of Science and Learning and Teaching Support. The group is moving to a two-tiered membership (full and associate). Not all members are active participants in education research and scholarship but nevertheless find the group activities useful.

The group has fairly informal structure. There is a 'Director', who has a very small workload allocated for this role, with this position supported by volunteers who undertake organisation of a variety of activities. The Director organises meetings, special events, research activities and administrative aspects. A volunteer from the group coordinates the professional development calendar of activities for learning and teaching. The group meets monthly to decide on activities which include journal writing, evaluation of learning and teaching strategies, workshops on research tools (e.g. NVivo), discussions on ethics applications, research methods etc. A monthly seminar series also gives members an opportunity to report on current research activities or to run a more informal session to seek assistance and feedback on their research. The group has also recently run an engineering education symposium that attracted approximately 60 representatives from across all Queensland universities. The aim of the symposium was to establish greater links between universities and academics undertaking engineering education research. There is a budget to support early bird registration at education conferences for active members, professional development workshops (research and learning and teaching) and other relevant development events.

The major challenges have been progression to rigorous education research and recognition. Like many institutions the integrity and rigour of engineering education was questioned and to some extent is still. There is a small percentage of the group who produce 'show and tell' papers and who are not interested in progressing to *research*. In addition to this, it is necessary to *lower the first step* into education research. This was supported by linking professional development to scholarship e.g. you are going to introduce this development/ innovation/technology/revitalisation into your course, what is the outcome? Understanding frameworks, methodologies and educational research is the next hurdle. To some extent getting the commitment to this research area is somewhat harder to attain. Many of the group pursue educational research as a secondary research area next to their 'technical' area. To tackle this problem we are forming links with the Faculty of Education (FoE) and forming small special interest groups. It is anticipated that the FoE can provide guidance and expertise on frameworks, methodologies and qualitative issues to grow the knowledge of the engineering members.

Future Engineering Education Directions (FEED) - CQUni

Future Engineering Education Directions (FEED) is a Special Interest Group (SIG) of the Learning and Teaching Education Research Centre (LTERC), a university-wide research centre. FEED started in September 2008 to formalise a group of staff that were focusing their research in the area of engineering education. In late 2009 it became a formalised SIG of LTERC. FEED aims to address the triple challenge (access-quality-cost) and to develop a more effective and professional learning culture by engaging the power of scholarship to improve learning and teaching practices. Participation of non-engineers is strongly supported, as the current push in engineering education is the consideration of sustainability and interdisciplinary practice.

As mentioned above, FEED faces the 'triple challenge' (Ehrmann, 1996); to increase participation and access, to improve quality, and reduce cost per student - as well as shifting to more active teaching strategies. In addition to these challenges, learning environments at CQUni are complex as they involve multi-campus and multi-mode operations, a strong emphasis on technology-based learning environments as well as a diverse student body with mature, remote and international students. The CQUni Engineering program and its staff have demonstrated a capacity and a propensity for practical innovation in education. To make CQUni a preferred provider of engineering education, we must build on our experience with systematic, focused scholarship.

The group has a permanent leader, who represents the SIG on the LTERC Board of Management. The leader is not allocated any time release or workload allocation for the role. Currently FEED has 20 members. While the group was developed initially with the support of the Faculty, the main support for the group now comes from the Research Centre. Members are entitled to apply for funding support from the centre, and the centre provides administrative support and a web presence for the group.

Regular activities include a monthly meeting, which is run as a discussion group rather than as a formal meeting. Each month the leader nominates a topic for discussion (based on feedback from the group), and organises a person or team of people to lead the discussion topic that was nominated and advertised. These discussion groups have been used to help members prepare abstracts for conferences and University Learning and Teaching grant applications. Other sessions have been to workshop papers and grant applications, or presentations by visiting scholars. Often the sessions are to have discussions around the different types of research methodologies that may be applied to educational research, and help members in their transition to a new research paradigm. The milestones have included the transition into the university research centre, which was important for the recognition of its producing members as active researchers within the university.

The major challenges have been to work without any recognition of the work, and funding. Time is not allocated to the members for attendance at meetings and the leader has no workload recognition. Along with this, there has been no funding allocated to the group. All funding is sourced externally to the faculty. The research centre membership has been important in this area for recognition of research outcomes in the form of RIS funding, and access to research centre support, such as conference travel funding and visiting scholar funding.

Key Aspects of Engineering Education Research Groups

The similarities and differences between the three cases are presented in Table 1.

Table 1: Similarities and Differences Between Three Cases

| | ESER | EERG | FEED |
|--------------------------------|--|--|--|
| Aim | Strengthen student learning Enable staff to do SoTL | Enhance teaching and learning practices | Develop a professional learning culture Use SoTL to improve student learning |
| Structure | Leader - Assoc Dean (L&T) & 2 Coordinators Community of practice with active and potential members | Director Informal group of active members | Leader Formal SIG of a larger research group with active members |
| Support – Leader / Coordinator | Leader & coordinators with workload alloc. | Director with small workload alloc. | Leader with no workload alloc. |
| Support – Formal Recognition | Formal support from Dean & senior management | Formally reports to Associate Dean (L&T) | SIG of a university wide research centre |
| Support – Funding | Significant funding for activities, research grants and visiting scholars Assoc Dean (L&T) also supports attendance at AAEE conference | Funding for activities and registration at AAEE conference | Funding available through central centre (through application) |
| Activities | Weekly activities - Conversations (active workshops), Journal Club, Writing Group, Invited Speakers, Research Discussions. Full-day workshops | Monthly meetings – professional development Larger events (engineering education symposium) | Monthly Meetings – discussions around issues |
| Major Challenges | Organisational memory Perception that education research ‘not real research’ Push to publish in good journals from the start | Shifting ‘show and tell’ paper to rigorous research | No workload allocation for Leader No funding controlled by the group Recognition within university |

Discussion

While the three groups discussed in this paper differ in structure, size and support, they all have essentially the same aim, to increase student learning by helping staff undertake research and scholarship on their practices. They all have regular activities that bring a community of academics together to learn about and share their experiences of undertaking education research and scholarship.

The advice offered for others thinking of starting an engineering education research group is that there is greater strength in numbers, and even if not supported financially by the faculty, the support and

encouragement of others working in a non-traditional field is critical. The collaborative learning opportunities are enormous in such an environment. It is a big leap for many scientifically trained engineers to make the transition to educational research. It is a new discipline for the members, and should be recognised as such. The help and support of those who have the discipline knowledge is needed, and it should not be expected that the educational research skills that are needed will simply be developed because academics are problem solvers.

Other advice includes:

- You can do more when you have funding and the coordinator has workload allocation
- Members gain a lot when you can build in a cross-disciplinary approach
- Create an atmosphere of open dialogue - Listen to members and meet their current needs
- Remember that to be accountable for funding, reportables will also be important
- Don't try and re-invent the wheel. There is a lot of literature on good practice and useful theoretical frameworks that can help you.
- Build a research approach (such as action research) into your work developing the group. This allows you to be systematic in the way you begin and develop any group.

Conclusions

This paper presents the cases of three engineering education research groups in Australia and identifies commonalities and differences. It is argued that all engineering faculties/schools should have an engineering education research group to support individuals to research and strengthen their own teaching and learning practices. The transdisciplinary professionals that emerge are new academics who see the world differently, and will never be able to return to their pure engineering form.

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