Linking practice and theory using Engaged Scholarship

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Linking practice and theory using Engaged Scholarship

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ABSTRACT
This paper reports on a study aiming to develop theory and improve practice within an Engineering Education context. The focus is on the development of students’ graduate-level work skills during Higher Education programmes and a specific practice example provided an ideal study opportunity. Engaged Scholarship, a research approach from Management Science, was selected as it provided a way to study practice that can generate both theoretical and practical knowledge. This paper summarises the philosophical underpinnings of the approach and sets out the strengths and challenges in applying it. The research design is then evaluated, concluding that the design is internally consistent and suitable for this study. The authors then reflect on implementation, provide examples of findings and discuss some of the practical challenges encountered. Practice improvements implemented to date include improvements to reflection activities and skills definition, and a theory of developing work skills in HE programmes is emerging.

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KEYWORDS
Engaged Scholarship; skill development; graduate work skills; theory and practice

1. Introduction
The problem to be investigated was, how to develop skills that graduate engineers require in the workplace as part of Higher Education (HE) Programmes. The particular focus was the skills required to solve real-world practical problems, which have been characterised (Hedlund and Sternberg 2000) as being poorly defined, lacking in information and having multiple correct answers.

The development of skills that graduates require in the workplace is important. There is increasing pressure on Higher Education Institutions (HEIs) to improve their ability to prepare students for work and there is a requirement of engineering programmes to prepare students for practice. ‘The fundamental purpose of Engineering Education is to build a knowledge base and attributes … that will develop the competencies required for independent practice’ (International Engineering Alliance 2013).

Some HEIs are able to provide graduates that are considered more ‘industry ready’. At the Cambridge University Institute for Manufacturing (IfM), there is an MPhil programme that claims to be able to prepare graduates for work in Industry (Ridgman and Wiggins 2003). This programme includes four different Short Industrial Placements (SIPs) of 2 weeks duration where students address real and significant practice problems for participating companies. These students undertake their first SIP after a four-week Induction Module. One strand of this module is dedicated to developing the skills they need to solve practical problems in industry. This skills development activity, followed immediately by problem-solving work based in a company, provided an opportunity to study the over-arching problem in relation to practice that was considered to be effective.
A five-year research timeframe coupled with an annually run programme provided an opportunity for a longitudinal study or multi-stage research strategy. Given the authors’ limited understanding of the problem, a multi-stage strategy was adopted where the first stage would be an exploratory study.

This study aims to investigate practice as a way of informing theory. This ‘object’ driven approach is considered appropriate to identify a theoretical basis (Flick 2014), as long as it is sufficiently open to the complexity of the study (Flick 2014). This involves adopting a strategy of emerging methods (Creswell 2009) – i.e. selecting methods as the study progresses that address the aspects being investigated at that time.

The combination of requiring an open approach over multiple stages leads to the adoption of a ‘mixed-methods’ approach.

Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g. use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration. (Johnson, Onwuegbuzie, and Turner 2007, 112-133).

Mixed-methods studies are often multi-stage and enable combinations of quantitative or qualitative methods to be employed as appropriate to the response to the emerging needs of the enquiry (Creswell and Tashakkori 2007; Creswell 2009; Teddlie and Tashakkori 2010).

The primary philosophy associated with mixed-method research is pragmatism (Johnson, Onwuegbuzie, and Turner 2007). This aligns well with the author’s pragmatic worldview (Creswell 2009) and is strongly associated with a bottom-up or practice view of mixed-methods research (Creswell and Tashakkori 2007).

Specific multi-stage, mixed method research strategies were identified as Engaged Scholarship (Van de Ven and Johnson 2006) and Action Research (Stringer 2007; Koshy 2010). An alternative was to view the research as a two-stage sequential process with an exploratory study leading to an investigation of a particular aspect – Creswell (Creswell 2009) identifies three such strategies – explanatory, exploratory, and transformative.

These strategies were evaluated on the following criteria:

- Suitable for social science research in an educational context
- Suitable for understanding/describing a specific example of complex practice
- Be capable of supporting theory generation
- Be flexible in terms of method
- Be less weighted towards the initial research stage rather than subsequent stages – as initial stage in this research is shorter

Out of the range of approaches in Table 1, Engaged Scholarship was judged the best fit for this study as all the evaluation criteria were met. Confidence in this approach increased on the publication of a successful study (Garner 2015) that used Engaged Scholarship as a mixed-method, sequential multi-phase research strategy that enabled emergent research questions to be addressed.

Engaged Scholarship developed initially out of concerns about the declining engagement of academia with practice were raised earlier by Boyer (Boyer 1996). He used the term ‘scholarship of engagement’ to articulate the view of the engagement movement in U.S. HE (Kenworthy-U’Ren 2005), that academia should focus more on solving real-world problems. This type of scholarship was seen as being able to bridge gaps between theory and practice in Management Science (Van de Ven and Johnson 2006). This resulted in the Engaged Scholarship methodology being developed for research on complex problems and to create knowledge that advances theory and practice (Van de Ven 2007).

Informing both theory and practice is a recognised challenge for those undertaking research in profession-related disciplines such as engineering, business and education (Van de Ven 2007). For academics their challenges are undertaking research relevant to practice and disseminating it such
<table>
<thead>
<tr>
<th>Research strategy</th>
<th>Description</th>
<th>Suitable for an education context</th>
<th>Suitable to investigate an example of complex practice</th>
<th>Capable of supporting theory generation</th>
<th>Flexibility in terms of method</th>
<th>Weighting by stage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Action Research</strong></td>
<td>A systematic and participatory approach that enables evidence-based improvements to practice – considered to be grounded in the qualitative research paradigm</td>
<td>Yes – widely applied in education and teaching</td>
<td>Yes – good for developing understanding</td>
<td>Limited</td>
<td>Yes</td>
<td>No pre-determined predominant stage</td>
</tr>
<tr>
<td><strong>Engaged Scholarship</strong></td>
<td>A systematic and participatory approach that works across the theory-practice boundary to advance improvements in both</td>
<td>Yes – applied in professional practice</td>
<td>Yes – good for understanding complex practice</td>
<td>Yes</td>
<td>Yes</td>
<td>No pre-determined predominant stage</td>
</tr>
<tr>
<td><strong>Sequential Explanatory</strong></td>
<td>Typically quantitative followed by qualitative research used to explain and interpret quantitative data – particularly useful for explaining unexpected results</td>
<td>Limited</td>
<td>No</td>
<td>Yes</td>
<td>Some</td>
<td>The first stage is more heavily weighted</td>
</tr>
<tr>
<td><strong>Sequential Exploratory</strong></td>
<td>Typically qualitative followed by quantitative research to assist in the interpretation of qualitative findings to explore a phenomenon and/or develop an instrument</td>
<td>May be – dependent on study</td>
<td>Yes – but potential problems with small sample sizes</td>
<td>Yes</td>
<td>Some</td>
<td>The first stage is more heavily weighted</td>
</tr>
<tr>
<td><strong>Sequential Transformative</strong></td>
<td>Used for a two-stage study with a theoretical lens, e.g. gender, race applied over both stages – can be any combination of quantitative and qualitative methods</td>
<td>Yes</td>
<td>May be – unlikely to be the main purpose of such research</td>
<td>Yes</td>
<td>Yes</td>
<td>Weighting adjustable</td>
</tr>
</tbody>
</table>
that it has an impact, and for practitioners their challenges are being aware of relevant research and then using this knowledge in their practice.

This paper sets out to evaluate if a research strategy using Engaged Scholarship was appropriate for this study and to answer the question – what strengths and challenges were identified when undertaking Engaged Scholarship research in an Engineering Education context? In addition examples of both practice and theoretical findings are provided to demonstrate the impact applying the Engaged Scholarship approach has had so far.

2. Engaged Scholarship

Engaged Scholarship is defined as a ‘participative form of research for obtaining the different perspectives of key stakeholders in studying complex problems’ (Van de Ven 2007, 9). This approach is designed to work across the theory–practice boundary and, through a pluralistic methodology, to advance knowledge by leveraging multiple perspectives.

Engaged Scholarship is considered to be a research strategy that consists of four fundamental activities, Problem Formulation, Theory Building, Research Design and Problem-Solving. A summary of these activities and their relationship is shown in Figure 1.

2.1. Strengths and challenges

According to Van der Ven (Van de Ven 2007, 2010) and Van der Ven and Johnson (Van de Ven and Johnson 2006) the main strengths and challenges of Engaged Scholarship can be summarised as follows. They are not presented in a rank order.

Strengths:

- an increased chance that the research will be applied in practice
- an increase in the likelihood that the research will advance knowledge for theory and practice
it facilitates understanding of real-world complex problems
it is suitable for interdisciplinary research.

Challenges:

- creating and managing an effective engagement between researchers and stakeholders
- spending sufficient time interacting in the study
- applying the Engaged Scholarship method to leverage its strengths
- being reflexive and objective as a researcher.

The strengths of Engaged Scholarship appeared to align with the aims and context of the research study, however, both the strengths and challenges require an explanation of how they are realised in practice to fully evaluate their potential impact. This is presented in Tables 2 and 3 and draws on the literature referenced earlier in the section. Each table, one for strengths and the other for challenges, contains an evaluation of how they might relate to this research study.

An evaluation of how the strengths are achieved suggested a potential problem in terms of ‘multiple investigators’ because this study involved two researchers. This was considered to be manageable by inviting multiple perspectives at each stage of the research through discussions, and presentations of the study at a range of conferences and special interest groups. The challenges are now considered.

Each of the four challenges will be reviewed in turn.

Challenge E (Effective engagement with stakeholders): The first researcher, although a novice researcher, has significant experience of working in a large industrial company, multiple academic environments and has worked in and managed collaborative teams. As such the researcher is well equipped to tackle such a challenge. The second researcher is also a key practice stakeholder as he is the academic who facilitates the skill development activities. This academic role did have the potential to cause issues, but were considered manageable.

Challenge F (Time interacting in the study): Both researchers are based at the IfM providing plenty of opportunities to interact both formally and informally with most stakeholders. A study over five years studying an annual programme meant repeated trials were possible.

Challenge G (Applying Engaged Scholarship): Applying Engaged Scholarship without prior experience and as a novice researcher would require careful reference to the literature regarding the methodology and some discussions and checks with other researchers who have applied this in practice.

Challenge H (Being a reflexive and objective researcher): The range of experience of both researchers in industrial and in lecturer/trainer roles, the experience of the first researcher undertaking SIPs as

<table>
<thead>
<tr>
<th>Table 2. Engaged Scholarship strengths.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strength</strong></td>
</tr>
<tr>
<td>A. Increased chance that the research will be applied in practice</td>
</tr>
<tr>
<td>A2. By framing a given problem as an instance of a more general case</td>
</tr>
<tr>
<td>B. Increases the likelihood that the research will advance knowledge for theory and practice</td>
</tr>
<tr>
<td>B2. Arbitrage – a process of engaging with practitioners and working with different views</td>
</tr>
<tr>
<td>B3. A research process of four interrelated activities – problem formulation, theory building, research design and problem-solving</td>
</tr>
<tr>
<td>B4. Through research collaborations between multiple scholars and practitioners and addressing dual hurdles of quality and relevance</td>
</tr>
<tr>
<td>B5. Triangulation of methods and models increases reliability and validity</td>
</tr>
<tr>
<td>C. Facilitates understanding of real-world complex problems</td>
</tr>
<tr>
<td>C2. Multiple investigators and perspectives</td>
</tr>
<tr>
<td>C3. Multiple frames of reference</td>
</tr>
<tr>
<td>D. Suitable for interdisciplinary research</td>
</tr>
</tbody>
</table>
a graduate student, coupled with an awareness of potential issues should enable this challenge to be managed.

Of the challenges discussed above the most significant identified was Challenge G – applying the Engaged Scholarship methodology as this was something that neither researcher had experience of doing. Challenges E and H were considered manageable and Challenge F was considered to be fully addressed.

McKelvey, a strong critic of Engaged Scholarship from a Management Science perspective, (McKelvey 2006) notes similarities with Action Research, a methodology used extensively in Education Research (Koshy 2010) to improve practice. He questions whether the addition of multiple aspects such as research collaborations, arbitrage, big questions and extended time periods will be achievable in real life, fast changing, company contexts and thus enable contributions to theory. Engineering Education contexts, however, are likely to offer a more stable context and there is a greater probability that all stakeholders will be aligned with the goals of the work.

Having discussed the practical aspects of applying an Engaged Scholarship approach the underlying philosophical perspectives will now be considered.

2.2. Philosophical aspects of Engaged Scholarship

The philosophical underpinnings of Engaged Scholarship are more complex than those of most other methodologies (Bechara and Van der Ven 2007) and there is only space for a short summary in this paper. Engaged scholarship adopts a philosophy that includes, and integrates, aspects of what might traditionally be considered alternative philosophies, incorporating key ideas from positivism, relativism, pragmatism and realism. Ontologically, Engaged Scholarship adopts the critical realist position of Bhaskar, with its mid positioning between positivism and relativism, and the realistic pragmatism position of Rescher. Epistemologically it adopts Campbells’ relativist evolutionary position (Bechara and Van der Ven 2007).

Table 3. Engaged Scholarship challenges.

<table>
<thead>
<tr>
<th>Challenge</th>
<th>The importance of addressing the challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. Creating and managing an effective engagement between researchers and stakeholders</td>
<td>E1. To increase the likelihood that the research will be applied</td>
</tr>
<tr>
<td></td>
<td>E2. To ensure all research stakeholders have clear expectations and are clear about their roles, responsibilities and use of study findings</td>
</tr>
<tr>
<td></td>
<td>E3. To ensure the research team is balanced in terms of skills and background and all research collaborators are motivated and able to work on the project</td>
</tr>
<tr>
<td></td>
<td>E4. To ensure there is regular communication between collaborators, they get to know each other and reflect on how the collaboration is performing</td>
</tr>
<tr>
<td></td>
<td>E5. To deal with conflicting views and interpersonal tensions arising through use of arbitrage</td>
</tr>
<tr>
<td>F. Time interacting in the study</td>
<td>F1. To increase likelihood of making significant advances in knowledge</td>
</tr>
<tr>
<td></td>
<td>F2. To build relationships and trust</td>
</tr>
<tr>
<td></td>
<td>F3. To be able to observe directly</td>
</tr>
<tr>
<td></td>
<td>F4. Longer study durations can enable deeper learning via repeated trials</td>
</tr>
<tr>
<td>G. Applying the Engaged Scholarship method to leverage its strengths</td>
<td>G1. Problem Formulation – to ground the research question/problem in observable phenomena and to make sure that the size and scope of the study is achievable</td>
</tr>
<tr>
<td></td>
<td>G2. Theory Building – to develop plausible concepts and models that provide a base for new theories to address the research question</td>
</tr>
<tr>
<td></td>
<td>G3. Research Design – to design the research and obtain empirical evidence</td>
</tr>
<tr>
<td></td>
<td>G4. Problem-Solving – to apply and disseminate the findings from the perspective of different academic and practitioner users</td>
</tr>
<tr>
<td>H. Being reflexive and objective as a researcher</td>
<td>H1. To achieve internal and external validity</td>
</tr>
<tr>
<td></td>
<td>H2. To ensure research goals are not compromised</td>
</tr>
<tr>
<td></td>
<td>H3. To view the study from both a researcher and practitioner perspective</td>
</tr>
<tr>
<td></td>
<td>H4. To undertake problem-driven research</td>
</tr>
</tbody>
</table>

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The Engaged Scholarship position is summarised (Van de Ven 2010) as:

- There is a real world out there, but our understanding of it is limited
- All facts, observations, and data are theory laden
- Social science has no absolute, universal, error-free truths, or laws
- No form of inquiry can be value free and impartial
- Knowing a complex reality demands use of multiple perspectives
- Robust knowledge is invariant across multiple models
- Models that better fit the problems that they are intended to solve are selected, producing an evolutionary growth of knowledge.

The above statements align with the positions of the researchers and appear to be internally consistent. However, the authors acknowledge that their expertise in this area is limited.

3. Research strategy evaluation

The review in the above sections has identified Engaged Scholarship as an appropriate research strategy for this study and the quality of this study at a general level should now be evaluated (Bernhard and Baillie 2016).

Six criteria were proposed at the level of study following a review of quality criteria (Bernhard and Baillie 2016). These are presented in Table 4 as criteria 1–6. These criteria appear to have been developed from a reviewer perspective. Researchers in the process of setting out a research design also have to consider whether it will enable the research question to be answered and a significant contribution to be generated. These criteria form part of the list by (Tracy 2010) and are added to Table 4 as criteria 7 and 8.

Against each of the eight criteria in Table 4, an explanation is provided on how each one could be addressed in this study using an Engaged Scholarship approach.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Explanation</th>
<th>How this could be addressed for this research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research question</td>
<td>Worthy topic: relevant, timely, significant, interesting</td>
<td>Development of skills in HE is a nationally and internationally recognised issue and is of particular concern for those providing initial professional education in applied disciplines such as engineering</td>
</tr>
<tr>
<td>Internal consistency of a study</td>
<td>Consistency between research question, methodology, epistemology and ontology</td>
<td>There is a clear fit between the research question and methodology. The methodology is understood in terms of its epistemology and ontology positions and is judged to be internally consistent</td>
</tr>
<tr>
<td>Perspective awareness</td>
<td>Awareness of how the researcher views their subject</td>
<td>The perspectives of the researchers are understood and articulated. This awareness will enable associated limitations to be considered throughout the research</td>
</tr>
<tr>
<td>Informed by theory and literature</td>
<td>Significant research cannot be performed without being informed by literature</td>
<td>The Engaged Scholarship methodology requires input from literature at multiple times</td>
</tr>
<tr>
<td>Upholding ethical values</td>
<td>With regard to all stakeholders related to the research</td>
<td>The interests of all stakeholders are to be considered at each stage. No major ethical dilemmas are expected as the research should benefit all stakeholders</td>
</tr>
<tr>
<td>Acknowledging different traditions and cultures</td>
<td>Respect and awareness of the perspective of other researchers</td>
<td>The research will be carried out whilst being sensitive that many in Engineering are unfamiliar with social science research. Explanations on method and perspectives on knowledge will be required</td>
</tr>
<tr>
<td>Fit for purpose</td>
<td>Design likely to enable the research question to be answered</td>
<td>An Engaged Scholarship methodology is likely to be effective in informing both theory and practice which is the purpose of this study</td>
</tr>
<tr>
<td>Significant contribution</td>
<td>The research design has the potential to generate a significant contribution</td>
<td>An Engaged Scholarship methodology was selected as it was judged to be most likely to generate the most significant contribution</td>
</tr>
</tbody>
</table>
It was concluded that all the criteria in Table 4 had been met and an Engaged Scholarship research strategy was a coherent and appropriate approach that is aligned with the context and aims of the study.

With this study approaching completion, it is now possible to reflect on the experience of implementing this research strategy and present some practice and theoretical findings to date.

4. Research strategy implementation

Although it is possible to start with any of the four activities in the Engaged Scholarship process, this research started with problem formulation as depicted in Figure 1 and three sequential rounds of the Engaged Scholarship methodology were carried out in this study. The research undertaken is summarised in Tables 5–8, one table per research activity, which can be found in the following reviews of each of the four Engaged Scholarship research activities. Each review reflects on the implementation of one research activity over all three research rounds and examples are given of findings and implementation challenges.

4.1. Problem formulation

The first issue was selecting an aspect of the overall problem, of suitable size and scope, for the first round of research. The early recognition that the teaching of practical problem skills in the Induction Module could be seen as an instance of the general problem was a major factor. This coupled with the timing of the Induction module and a focus on specific set of teaching sessions provided an ideal study opportunity.

As part of the Engaged Scholarship practice, a detailed and systematic grounding and diagnosis of the problem in terms of the practice and the literature is recommended as an important step (Van de Ven 2007). This was found to be the case. The analysis of the practice considerably narrowed the

<table>
<thead>
<tr>
<th>Research round</th>
<th>Research round summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 1</td>
<td>An understanding of the skill development practice was developed through interviews and course data analysis to identify a specific research focus. Literature was reviewed to identify models and theories that were relevant to skill development to enable a diagnosis of the practice. A number of research questions were identified of which one was selected that was considered the most relevant and practical for an initial study – What happens during the ‘practice’ to support the development of skills?</td>
</tr>
<tr>
<td>Round 2</td>
<td>The poor definition of skills was considered to be the most significant practice and research problem. Different ways of defining skills were analysed and an activity approach was selected. The research question identified was – What activities are undertaken by students during a SIP?</td>
</tr>
<tr>
<td>Round 3</td>
<td>A re-formulation, focussed on the process management activities, determined that the five ‘managing the process’ or ‘through SIP’ activity groups required capturing individually and at a holistic level. The same research question from Round 2 was used – What activities are undertaken by students during a SIP? However, this time it was applied to the five ‘through SIP’ activity groups</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Research round</th>
<th>Research round summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 1</td>
<td>A plausible skills development theory was constructed and evaluated along with a conceptual model by drawing on the findings of the problem formulation activities. From this a Conceptual Skills Development Framework (CSDF) was generated to provide an analysable format suitable for theory testing.</td>
</tr>
<tr>
<td>Round 2</td>
<td>A plausible SIP activity framework was developed by combining multiple perspectives from literature. This could then be compared with what students experienced in practice.</td>
</tr>
<tr>
<td>Round 3</td>
<td>Conceptual ‘through SIP’ activity group frameworks were constructed from literature for all five activity groups. These provided a basis for a comparison with practice.</td>
</tr>
</tbody>
</table>
focus onto the most relevant aspects and informed the decision of which fields of literature were most important to review. The analysis of the literature enabled a much deeper appreciation of the complexity of the problem area and identified models that provided explanations of why some aspects were more effective in practice than others. An example of this is the theory of constructive alignment (Biggs 2003). Applying this demonstrated that the summative assessment of SIP skills (not undertaken in the Induction Module) whilst well positioned in terms of timing for supporting the development of skills was problematic in practice due to lack of alignment with clear and relevant assessment criteria. When applying constructive alignment to the formative assessment of SIP skills undertaken in the Induction Module, it was found that the teaching and assessment activities were fully aligned. However, the lack of detailed description of the skills restricted both the breadth and depth of the feedback given to the students.

There are four activities recommended in the process of problem formulation, being situating, grounding, diagnosing, and resolving the problem (Van de Ven 2007). Each was valuable and definitely warranted the time spent in terms of the insights it enabled for the first round of the research. These activities were much less extensive in the subsequent rounds of research having benefitted from a really detailed analysis from the first round. Of equal value were the insights generated for practice. Two more appropriate summative assessment methods were identified being reflective journals and portfolios (Biggs and Tang 2007).

In the subsequent rounds, a challenge was finding appropriate academic terms that connected with practice. One example, the practice of ‘working with information’ was found to map onto the academic field of ‘personal knowledge management’, which was not considered obvious. Systematic literature reviews and talking to researchers from other disciplines were found to be effective methods of making some of these connections.

4.2. Theory building

This comprises three activities in the Engaged Scholarship methodology: creating, constructing and justifying a theory. This could not have been successfully undertaken without a rigorous problem formulation process and the detailed guidance available in Van de Ven’s book (Van de Ven 2007).

<table>
<thead>
<tr>
<th>Table 7. Research design and execution.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research round</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Round 1</td>
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<tr>
<td>Round 2</td>
</tr>
<tr>
<td>Round 3</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Table 8. Problem-solving.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research round</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Round 1</td>
</tr>
<tr>
<td>Round 2</td>
</tr>
<tr>
<td>Round 3</td>
</tr>
</tbody>
</table>
In the first two rounds of the research, the theory construction activity involved combining multiple different models and perspectives. In round one, for example, theories of constructive alignment (Biggs 2003), experiential learning (Kolb 1984; Moon 2004) and self-efficacy (Bandura 1995) were combined to produce a skills development model. In round two, perspectives of how experienced consultants approach practical problem-solving (Rasiel and Friga 2001; Cope 2010) were combined with known weaknesses of novice engineers (Jonassen, Strobel, and Lee 2006) and a model of generic graduate skills (Bennett, Dunne, and Carré 1999) to produce a theoretical model of what students do during a SIP.

An approach that really helped in all three theory construction processes was the use of visual representations. As engineers, visual representations appeal as they are a familiar way of communicating and they challenge thinking on boundaries and relationships between different elements – two crucial elements of a theory (Van de Ven 2007).

4.3. Research design

In each round of research, the design took into account that all stakeholders were busy, so methods were chosen that were deemed effective in terms of time and effort. Two useful questions in this process were: What data are really needed? In what ways might the data be collected to involve multiple stakeholders with the minimum investment of their time? The first of these questions is essential to critically evaluate the theoretical perspective under test. In research rounds 2 and 3, where there were multiple cycles of data collection and analysis, this resulted in individual questions initially and, as the research outcomes developed, group activities were found to be more effective in increasing the level of critical challenge.

It was anticipated that the students would engage with this research as SIPs were a significant reason for taking the programme and account for 50% of the overall mark. To make it convenient for the students to contribute the majority of research activities were conducted within course hours. This design consistently achieved response rates of over 90% and, on multiple occasions, 100%. Some research activities did involve students outside of teaching time, e.g. when moving a survey from in-class on paper, to out of class online, and the response rate fell to 74%. However, the most time-consuming data recording was undertaken during one SIP and a response rate of 78% was achieved. This was attributed to making this data collection as painless as practical and the quality of the relationship developed with this cohort. Students were kept informed about the research and were provided with any findings they might find helpful.

The Engaged Scholarship approach provided useful direction on selecting between a variance and process model research design (Van de Ven 2007). In all three rounds, a variance research design model was used where the practice was compared to the theoretical models constructed in the previous theory building activity of each round. However, the detailed steps in designing and executing the research were best informed by research method resources dedicated to the methods selected, e.g. in Research Round 1 resources on mixed methods were used such as (Teddlie and Tashakkori 2009) and in Research Round 2 resources related to action research were used such as (Stringer 2007).

4.4. Problem-solving

This involved a critical evaluation of the data and results, firstly by the researchers, and then with the students where there were concerns or conflicting perspectives. Some of the key questions used at this stage were: What results are unexpected or conflicting? What are these data telling and not telling me? What perspectives have been missed? At all stages both the researchers independently reviewed the raw data. The first author then analysed the data and proposed results which were then discussed together and agreed findings negotiated.

The particular value of the Engaged Scholarship approach at this stage was the dissemination and negotiation of the findings. The academic dissemination process of preparing papers and
presentations proved valuable to reflect on the theory and practice contributions and to engage in a broader peer review process. Multiple presentations have been made to an IfM/University of Cambridge audience, aspects of this research have also been presented to eight different U.K. and international audiences including: SRHE 2012, SEFI 2013 (Shawcross and Ridgman 2013), SEFI 2014 (Shawcross and Ridgman 2014a), REES 2015 (Shawcross and Ridgman 2015), and two journal papers are published to date (Shawcross and Ridgman 2012, 2014b). The internal negotiation of findings was helpful in challenging and aligning viewpoints as well as agreeing on how final findings related to practice could be implemented to make improvements.

Each round of the Engaged Scholarship methodology generated multiple findings and presented further questions. The choice of question for the next round was made on the basis of its potential to make the most significant contribution. At the end of Round 1 the choice was to focus on defining skills for SIPs where there was a larger gap in knowledge rather than on improving student reflection where there is an extensive literature already. The improvement of student reflection activities was taken on board and major improvements were implemented in the following academic year.

5. Discussion

5.1. Strengths of Engaged Scholarship

The Engaged Scholarship approach was chosen as its strengths, as described in the literature, aligned with the aims of the study. Care was taken to employ the strategies identified in Table 2 to enable the strengths to be realised. Of these strategies C2 the ‘multiple investigators’ aspect is the one potentially compromised as this research was primarily undertaken by two researchers. To counter this, multiple perspectives were sought throughout the study from others with interests and experience in teaching practical problem-solving skills.

In this instance Engaged Scholarship has only been applied to a small complex practice problem so claims that this method (Van de Ven 2007) can be applied to large complex problems (strength C in Table 1) cannot be discussed. However, the authors are confident that the results so far have helped to understand a complex practice problem and with some aspects already implemented in practice, strength A (increased chance of application in practice) has been realised at a local level.

In terms of strengths B (Advancing knowledge in theory and practice) & D (suitability for interdisciplinary research), these will be formally judged when the findings are published. The authors agree that knowledge has been advanced at the local level and are confident that the emerging theoretical knowledge will be informative for the HE teaching community involved in teaching professional skills. The strategy B1(Choice of research methods based on context) giving the freedom to select from, and apply, a range of different social science research methods appropriate to the problem being addressed provided valuable opportunities to develop as researchers.

5.2. Challenges of Engaged Scholarship

The most significant issue found for Challenge E (Effective engagement with stakeholders) was dealing with conflicting perspectives which happened on multiple occasions. As an example, differences emerged whilst adapting a project management practice-based framework to the SIP context in research round 3. In this case, the research design for testing this framework with the students probed specifically into this issue and enabled appropriate evidence to be collected to resolve the conflict. Evidence was a useful tool on other occasions to counter what appeared to be strong SIP Tutor opinions. Other conflicts of perspective were more difficult to resolve an example being the use of the same terms but meaning different things. These differences were often down to background and experience as different communities describe skills in a range of ways.

Having established relationships at the beginning of the study with many of the academic stakeholders was a major advantage. However, new relationships had to be developed each year with the
students and some in each cohort did not really engage in any skill development activities that were not directly linked to assessment. Different mechanisms were tried to promote deeper levels of engagement with post SIP facilitated discussions and focus groups being found to be the most insightful.

Challenge F (Spending time in the study) was overcome largely by contextual factors. The co-location of the researchers and the programme being investigated provided easy access to the stakeholders and the five year time horizon enabled multiple rounds of research.

Challenge G (Applying Engaged Scholarship) a new method is always challenging – like making a new recipe – it takes longer than you anticipate and sometimes the instructions only become clear during the process. This was definitely the most challenging of the challenges. Applying the methodology was greatly assisted by the detailed guidance written by Van de Ven (Van de Ven 2007) even though some sections took many reads to make sense! Of the four main research activities, it was the theory building and research design that were least familiar to the researchers and where the most effort was required to make sure a quality study was undertaken.

The theory building stage was considered to be the most intellectually challenging and where working as part of a larger collaborative team, more typical of an Engaged Scholarship process, would probably have been helpful.

Challenge H (Being a reflexive and objective researcher) is essential. For the first researcher, the balance between developing theory and improving practice was more challenging than dealing with conflicting data or perspectives due to the researcher being a more experienced practitioner and teacher than a researcher. The questions posed by the co-researcher and the detailed methodology explanations (Van de Ven 2007) were both helpful in counteracting this.

One feature of this methodology is that it limits how far one can plan ahead, as a full round of activities needs to be completed to inform the following round. The long duration of the work makes it important to be able to step out of the operational level and reflect on whether the research is still heading in the right direction and aligned with the overall aims.

The annual academic programme with its fixed schedule of teaching and SIPs drove the research forward as it provided hard deadlines. Whilst helpful in maintaining momentum this also meant that sometimes plans had to be redrawn to accommodate issues that arose and different aspects had to be prioritised. For example, the work on ‘through SIP’ activities took much longer than anticipated which meant that further work planned on assessment aspects that would have enabled testing of an improved skills development model were not able to take place.

5.3. Opportunities for applying Engaged Scholarship

The fact that this research was undertaken on a part-time basis suggests that researchers, even with significant commitments, could contribute to projects of this nature providing they have the appropriate skills, e.g. working with conflicting views and experience.

Applying Engaged Scholarship has been a valuable learning experience, requiring the researchers to appreciate a broad range of methods and apply several. It has also enabled a greater appreciation of how theory and practice can work together to the benefit of both.

6. Conclusions

The Design of this engaged scholarship research was able to address the criteria presented in Table 4 for assessing the quality of a study. This methodology does pose challenges though, particularly related to perspective awareness, dealing with conflicting views, finding the relevant academic literature and the thinking involved in developing a theory.

Three rounds of engaged scholarship have been carried out and each round succeeded in its objectives of building further understanding and contributing to IfM practice.
Of the four strengths claimed for Engaged Scholarship B (advancing knowledge) and C (facilitating understanding) were clearly demonstrated. A (increased chance of application) was true in the local area of the study but remains untested at a broader level. D (suitable for interdisciplinary research) was only tested to a limited extent as the disciplines drawn on in this research were already closely related.

In terms of the challenges, those posed related to E (effective engagement) and F (time) were able to be managed. G (applying the method) was found to be the biggest challenge because developing an understanding of the methodology while simultaneously applying it adds additional complexity. H (objectivity) was also a challenge because the greater intimacy with the subject and engagement with the practice make it harder to recognise hidden bias.

Engineering Education Research is often constrained by being carried out by practitioner/researchers and being subject to the annual academic time cycle. A further challenge is convincing colleagues, whose research background is primarily engineering science, that the work has similar rigour. The Engaged Scholarship method provides an opportunity to harness the benefits of the unique context while demonstrating rigour, and addressing complex theory–practice boundary spanning issues.

7. Recommendations and further work

Engaged Scholarship should be an appropriate approach for other studies in Engineering Education with similar aims. Collaborations with those familiar with this methodology and social science research might be an effective way of undertaking such research in practice and overcoming traditional research boundaries.

The authors plan to continue their work to implement the findings in practice and undertake research to address the unanswered questions parked on the journey so far.

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