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Building Bridges for Future Sustainability? Breaching the research-teaching nexus in Engineering Education.

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Abstract:

The relationship between research and learning and teaching represents what has been described as 'amongst the most intellectually tangled, managerially complex and politically contentious issues in mass higher education' (Scott, 2005, p 53). Despite this, arguments that in order to achieve high quality scholarly outcomes, university teachers need to adopt an approach to teaching similar to that of research (founded upon academic rigour and evidence), has long been discussed in the literature. However, the practicalities of promoting an empirical and evidence-based approach to teaching in engineering education make dealing with the research / teaching nexus a somewhat challenging proposition. Using a phenomenographic approach, bringing together and applying the findings of a mixed methodological study, the workshop will adopt an activity based, interactive approach to encourage staff to consider the challenges and benefits of adopting an evidence-based approach to learning and teaching through the utilisation of research to inform their own practice.

Based upon the premise that the promotion of research-led teaching will act to bring teaching and research together, and in doing so enhance engineering students' learning experiences, the workshop will provide the forum for colleagues to critically consider the practical and conceptual challenges of using educational research to engage and excite current and future students. It will conclude by discussing how learning and teaching research in engineering education may influence organisational culture and in doing so prompt positive change by enhancing the wider student experience and positively impacting institutional academic outcomes.

Introduction: Background to Workshop

The quality of teaching within the UK Higher Education Sector has received much public attention in recent years - most notably in the context of the National Student Survey (HEFCE, 2009) which puts the UK Higher Education Sector under the spotlight on an annual basis. Such attention reflects academic debates concerning the quality of university teaching over the past two decades (Barnett, 2005; Biggs, 1996; Prosser & Trigwell, 1999; Ramsden, 1992). Much of this debate is grounded in the concept of Scholarship proposed by Boyer (1990), who argued that there are four separate, but overlapping areas of Scholarship namely: Discovery, Integration, Application and Teaching; each of which is integral to academic work.

The first of these areas, the Scholarship of Discovery comes closest to concept of research and is often perceived to be at the 'heart' of academic life. The Scholarship of Discovery contributes to the sum of human knowledge, incorporating disciplined investigation through the *pursuit of knowledge* (p 18). It focuses not just on outcomes, but also on process. From an engineering education perspective, the use of project based learning whereby students are encouraged to undertake individual or group

investigations in an applied learning setting in many ways captures the ethos of the Scholarship of Discovery. Linked to the Scholarship of Discovery is the Scholarship of Integration; however, the difference is that the Scholarship of Discovery asks what is it we want to find out whereas Scholarship of Integration looks at what the findings mean. By *making connections across disciplines, placing specialities in larger context* (Boyer, 1990, p18), the Scholarship of Integration moves beyond traditional boundaries to involve a variety of scholarly trends includes those that are, *interdisciplinary, interpretive, integrative* (p 21). In doing this, problem-based learning approaches utilised in engineering education encapsulate the Scholarship of Integration by synthesizing and interpreting academic work to bring new insights to original research.

The third area of Scholarship identified by Boyer is that of Application. Tied to disciplinary knowledge, and encapsulating the concept of work-based learning, it may be argued that the Scholarship of Application is relevant across all areas of engineering education. Boyer argues that the Scholarship of Application is far more dynamic than the simple acquisition and Application of knowledge in that it necessitates the acquisition and Application of skills and insight.

The final area identified by Boyer, the Scholarship of teaching, involves a dynamic process linking teachers' understanding and students' learning. As in all Higher Education, the Scholarship of Teaching in engineering education means that students are scholars as well as learners. Teaching in engineering not only involves transmitting knowledge but also involves transforming and extending it. In discussing the importance of teacher knowledge Boyer argues ... *As a scholarly enterprise, teaching begins with that the teacher knows. Those who teach must, above all, be well informed and steeped in the knowledge of their fields* (1990, p 23).

Whilst from Boyer's perspective, the relationship between the different areas of Scholarship may be defined as conceptually and pedagogically interdependent, one significant weakness with his approach is that whilst he argues that what is needed *is a more inclusive view of what it means to be a scholar - a recognition that knowledge is acquired through research, through synthesis, through practice and through teaching* (1990, p 24) the basis upon which this assertion is made does not itself appear to be grounded in research, but rather offers a purely theoretical approach. Much previous literature also critiques the notion of a linkage between teaching and research (see for example, Jenkins et al, 1998; Robertson & Bond, 2001; Jenkins, 2004) focusing on the concept of discipline-specific research and how it may be applied within a teaching setting. Such research suggests that whilst discipline-specific research may be linked to teaching, such a linkage is at best tenuous, and at worst non-existent (Zaman, 2004).

Described as '*amongst the most intellectually tangled, managerially complex and politically contentious issues in mass higher education*' (Scott, 2005, p 53) the debate regarding the relationship between research and teaching continues. Developing this debate one stage further, arguments that in order to achieve high quality scholarly outcomes, university teachers need to adopt an approach to teaching similar to that of research, founded upon academic rigour and evidence (Healey, 2000; Trigwell et al, 2000; Elton, 2005) continue. Indeed, from the authors' perspectives, it would appear that for some the concept of evidence-based practice in higher education teaching is at best deemed to be 'wishful thinking' and at worst continues to be much maligned.

Workshop Approach

Starting with the research question 'What is the relationship between learning and teaching research and teaching practice in engineering education?', this workshop will provide the opportunity for engineering educators to reflect upon the cultural, pedagogical, and organisational issues encountered during teaching and learning in a manner that promotes evidence-based practice in engineering education. Focusing specifically on staff perceptions of the role of learning and teaching research, the workshop is being offered by two researchers from very different academic disciplines; namely an engineer and a social scientist. What these two individuals have in common is an interest in improving

all aspects of the student learning experience through empirically grounded research. Thus, in addition to focusing on learning and teaching, the workshop will address the cultural and attitudinal challenges of change management within Higher Education (Kotter, 1996; 2008). In doing it will begin to collect empirical evidence about practice in Engineering Education.

Utilising grounded theory analytical techniques (Strauss & Corbin, 1998), the workshop facilitators will offer participants the opportunity to reflect upon their perceptions of the relationship between research and teaching in their own practice and in their particular department or research group. Participants will be asked to 'depict' their answers in diagrammatic format to the following two questions:

1. Describe the relationship between learning and teaching research and teaching practice in your School/ Research Group
2. How do you view the relationship between learning and teaching research and your teaching practice?

The use of diagrams will afford the opportunity for the participants to work with the workshop facilitators to consider in some depth their own practice. In previous workshops the use of visual representations has provided a creative and inclusive way of promoting discussion. During the workshop, the images created by the participants will be used to identify the participants' concerns and issues, and to discuss, in some depth, approaches to evidence-based practice in engineering education. Participants will benefit from the opportunity to raise issues of concern with colleagues as well as from the opportunity to consider which pedagogical research methods might be suitable for their use.

Following the workshop, an in-depth analysis of the visual data collected will be undertaken and analysed using an approach based upon the principles of grounded theory (Strauss & Corbin, 1998). This analytical approach is particularly appropriate in this setting as it will afford the opportunity for the researchers to identify and critically analyse the issues of importance to the workshop participants. The approach adopted during the workshop will involve a social scientist undertaking a cursory analysis of the diagrams and grouping together the main concepts which will be used as a basis for discussion. Following the workshop, a much more in-depth and academically grounded analysis will be undertaken in which the diagrams will be analysed in a critical and comparative manner through the use of theoretical sampling supported by a process of open coding. In effect this will entail the two researchers working individually, and then together, to reflect upon the conceptual and practical meaning of the diagrams. This will involve identifying key concepts and sub-concepts. Contemporaneous notes will be made of the emergent theoretically grounded concepts. Using a process of axial coding a micro-analysis of the key emergent concepts will be undertaken by both researchers working in tandem. Earlier fieldwork has enabled the researchers to contrast key comparative themes within the data before agreeing upon how the data should be represented within the identified categories. It is anticipated that the workshop data will be analysed in a similar manner. Having reached a mutual agreement in respect of the key emergent themes and concepts, selective coding will be used to re-analyse all of the diagrams with the researchers working in collaboration. In-depth notes will be made in respect of the researchers' interpretations of the conceptual meanings of each of the diagrams (the reaching of collaborative agreement) and of the thematic groupings of diagrams. The final stage of the analysis process will involve an interpretation of the relationships and linkages between the concepts and sub-concepts in which key conceptual themes emerged from the data. Detailed notes will be taken explaining and exploring the theoretical underpinnings of the emergent themes. By undertaking a constant comparative analysis of the data, the process will afford the opportunity for the researchers to develop theory, grounded in data, and to identify and critique new theoretical ideas and concepts relevant to engineering education.

Workshop Learning Outcomes

The learning outcomes for this workshop are:

1. To give participants a deeper understanding of the relationship between educational research and learning and teaching.
2. To enable participants to reflect upon their own teaching practice in a supportive and critical environment
3. To provide the opportunity for participants to consider suitable pedagogical methodologies for use in researching their own teaching practice.

Workshop participants will be asked in advance whether they consent to their individual 'images' being used in this manner. Those who consent, and who provide contact details, will be provided with a short synopsis of the findings at a later date. This will comprise a summary of the issues raised during the workshop.

Concluding Remarks

The complexities of academic life mean that many academics are inevitably struggling with the requirement to balance expectations of quality in learning and teaching with increased teaching loads and continuously high research demands. This means that they are very often unwilling to discuss learning and teaching in an open and in-depth manner making other methodological approaches, including interviews and surveys, somewhat difficult. The value of using diagrams as a methodological tool is that they afford the researchers the opportunity to work directly with visual concepts whilst allowing the participants to express themselves in a creative and imaginative manner. Previous attempts within the researchers own institution to persuade staff to participate in in-depth interviews on this subject have proved almost impossible as staff have been reluctant to discuss their attitudes towards evidence-based practice in interview.

Within contemporary UK Higher Education, the notion of the forthcoming REF is the subject of much debate – undoubtedly influencing academic practice meaning that research continues to be a priority for many. Concurrently, the annual National Student Survey has identified several areas where students feel unhappy with current practice – assessment being a particularly notable area in the 2009 survey (HEFCE, 2009).

From a pedagogical perspective the concept of Scholarship, linking research, teaching and learning is an important factor impacting academic practice across all disciplines (Boyer, 1990). However, the notion of evidence-based practice encapsulating a research-teaching nexus appears to remain somewhat illusive both in engineering education and in other disciplines. It is hoped that any reluctance by colleagues to discuss the concept of evidence-based teaching practice may be overcome during the workshop by the use of diagrams as a research tool.

In conclusion it is anticipated that the workshop will provide the opportunity for participants to make a conceptual connection between teaching and research a reality by reflecting upon their own, and their institutions, approach. In doing so, one of the outcomes of the workshop will be a move towards an ethos of Scholarship within engineering education (Boyer, 1990) whereby the interdependence between research and teaching is not only acknowledged by the workshop participants, but is celebrated.

Time Plan for workshop:

Introduction: 10 Minutes

Activity: 30 minutes

Discussion: 40 minutes

Informed Consent

Full informed / written consent is an important part of the ethical procedure being adopted by the workshop facilitators. It will be made clear to the participants from the onset that participation in the workshop, and further participation in the study, is entirely voluntary and that they may withdraw their consent at any time. Participants who do not wish their diagrams to form part of any further research may be assured that such data will be destroyed immediately following the workshop.

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