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Research Paper

Engineering the Future! Innovation in Learning & Teaching; An Empirical Approach(0145)

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Abstract

Learning and teaching approaches to engineering are generally perceived to be difficult and academically challenging. Such challenges are reflected in high levels of student attrition and failure. In addressing this issue, a unique approach to engineering education has been developed by one of the paper authors. This approach, which is suitable for undergraduate and postgraduate levels, brings together pedagogic and engineering epistemologies in an empirically grounded framework. It is underpinned by three distinctive concepts: Relationships, Variety & Alignment. Based upon research, the R + V + A approach to engineering education provides a learning and teaching strategy which in enhancing the student experience increases retention and positively impacts student success. In discussing the emergent findings of a study into the pedagogical value of the approach the paper makes a significant contribution to academic theory and practice in this area.

Background: The Importance of Engineering & Engineering Education

The importance of engineering in addressing some of societies most pressing problems has recently come to the fore with issues such as the BP Oil Spillage, the Icelandic Volcano and Global Warming consistently in the headlines (see for example BBC, 2010)http://www.bbc.co.uk/science/. Moreover, the need for the engineering profession to provide innovative and practical solutions to some of societies most pressing modern-day problems, including those related to sustainability, poverty and pollution, is reflected in the academic and policy related literature (IMechE, 2009; RAE, 2008; Spinks et al, 2006a). Whilst other contemporary engineering innovations including the Large Hadron Collider (LHC, 2010),Virgin Galactic spaceflight (Virgin Galactic, 2010) and the Apple i-pad (Apple, 2010) have acted to spark the public's engineering imaginations bringing science to life in an applied yet exciting manner. Given the complexity of such problems and innovations, the demand that universities provide a ready supply of suitably qualified engineering graduates,

equipped with high level employability skills, able to make innovative decisions and think 'outside of the box' is at unprecedented levels (Lucena et al, 2008; RAE, 2007). Yet whilst innovation is often perceived to be one of the most exciting and crucial aspects of engineering as a discipline, public misconceptions regarding exactly what the discipline constitutes represents a significant barrier to the profession. Such a lack of understanding is evident when considering young people's perceptions of engineering, resulting in many undergraduate engineering programmes experiencing difficulties attracting young people onto engineering programmes (DIUS, 2008; RAE, 2009; NSF, 2009).

The situation is worsened by problems high levels of attrition with retention being a major issue in engineering education (DIUS, 2008; RAE 2008; NSF, 2009). One of the main outcomes of this is that there is a shortage of young people entering the profession at graduate level. Furthermore, whilst the current situation is undoubtedly troubling, unless urgent action is taken to remedy the situation, matters will deteriorate markedly over the next two decades – resulting in unprecedented shortages in the number of engineers. Indeed, there is a likelihood that predicted shortfalls in the numbers of students expected to enrol on undergraduate engineering programmes over the next 10 to 20 years, will seriously test future governments' ability to retain and sustain local, national and global infrastructures and communities (RAE, 2008).

From an educational perspective, whilst many undergraduate engineering programmes have been transformed and updated in order to meet the changing needs of engineering students (see for example, Miller et al, 2005; Machika, 2007), learning and teaching approaches to engineering remain a significant issue with the subject generally perceived to be difficult and academically challenging. In addressing this issue, a unique approach to engineering education has been developed by one of the paper authors. This approach, which is suitable for undergraduate and postgraduate levels, brings together pedagogic and engineering epistemologies in an empirically grounded framework. It is underpinned by three distinctive concepts: Relationships, Variety & Alignment. Based upon research, the R + V + A approach to engineering education provides a learning and teaching strategy which in enhancing the student experience increases retention and positively impacts student success.

The presentation will outline the conceptual framework upon which the approach is built; in doing so will critically discuss the emergent study findings of research conducted into the academic and pedagogic value of the approach from students' and lecturers' perspectives.

The R+V+A Study: Methodology

In order to empirically test the R+V+A=S proposition, an empirical research design was developed the first stage of which, an exploratory study, forms the basis for this paper. Comprising a mixed methodological approach, the exploratory study involved a critical analysis of four different sets of data, namely: A survey of students administered 'mid-module': Non participant observations conducted during the field trip: A short survey aimed at capturing students' perspectives of the field trip: An evaluation of assignment and module marks for the cohort.

Findings

The study findings support the contention that the first component of the approach, Relationships (R) are crucial to students' learning experiences and as such need to be valued and nurtured (Cowan, 2006). In developing a learning environment founded upon strong internal and external relationships, university teachers can provide an enhanced learning opportunity in which individual students feel valued as individuals whilst at the same time feeling part of an active learning community. This in itself positively impacts learning which in turn promotes student success.

The Variety (V) element of the approach was identified in the study as being critical to innovation in teaching (Prosser & Trigwell, 1999) . By adopting a variety of approaches to engineering education, students are offered relevant and applicable learning experiences which not only build upon previous knowledge but also provide a broad education upon which future learning may occur.

The final part of the approach, alignment (A) necessitates the aligning of learning and teaching strategies with desired learning outcomes and assessment (Biggs, 1999). In the context of the study, it was found that by going beyond Biggs' definition to include previous educational and work opportunities as well as future employability students were able to identify and overcome threshold concepts in a manner that is contextually and conceptually relevant.

Conclusion

In conclusion, initial work to explore the R+V+A model suggests that by focusing on these components of the learning experience, the impact on the student journey is a positive one. The challenge is to move from this empirical starting point towards obtaining evidence that demonstrates the value to both students and staff in considering such a focus. The evidence will then suggest what aspects may be absent and how the approach may be adapted for use in other disciplines.

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