

Teaching sustainability as a contested concept: capitalizing on variation in engineering educators' conceptions of environmental, social and economic sustainability

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Abstract

This study documents variation in engineering academics conceptions of sustainability. We investigated how a group of Australian engineering academics described environmental, social and economic sustainability, and identified a broad range of actions that participating academics associated with achieving sustainability. The study suggested marked variation in the actions that participating academics viewed as coherent with sustainable engineering practice, and therefore, potentially marked variations in the sustainability actions academics might advocate to their undergraduate students. Rather than framing this variation as problematic for teaching and learning sustainable engineering, we suggest that such variation in conception of sustainability, and explicit contestation of this variation in the engineering classroom, offers opportunities to enrich undergraduate sustainability learning and teaching. We develop this argument by using some generic environmental, economic, and social theoretical frameworks to characterize the differences according to the values and assumptions that may underpin the observed variation. Validated frameworks are useful to move beyond discussions based on 'opinion', because they provide a framework for critical reflection by engineering students and academics about the values and assumptions that inform engineering practice generally and sustainable engineering practice, particularly.

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1. Introduction

1.1. Impetus to infuse undergraduate education with sustainability

The past decade has witnessed international interest in incorporating the skills, attitudes and concepts of sustainability into undergraduate university courses across a range of

disciplines [1]. This interest in equipping graduates to enact sustainability is impacting on the engineering education context. The traditional role of the engineer in the design and application of technology for the resolution of problems has resulted in the profession coming under pressure from government, industry and society to practice engineering more sustainably. This is because the role of technology provider has placed engineering professionals in a pivotal position in structuring the way societies function. Harding [2] pointed out that while society drives the hunt for new technologies and applications by identifying and defining problems for engineers to solve, the range of technological solutions generated by engineers in response to those problems plays a fundamental role in structuring the urban environment, and to some extent delineates the different ways in which societies might use natural

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resources and waste sinks in the pursuit of economic gain and improved outcomes for humanity.

In the Australian context, pressure for more sustainable engineering has driven the body that accredits undergraduate engineering courses to specify sustainability competence as a condition of graduation. In 2000, Engineers, Australia implemented an accreditation process that mandated that academics must ensure that students understand sustainability by the time of graduation [3]. This effort at reorienting the education and induction of new engineers to incorporate sustainability competence has meant that many Australian engineering academics face the responsibility and challenge of assisting undergraduate students to an understanding of what sustainable engineering is and how it might be practiced. This would be a reasonably straightforward task if there were uniform agreement about what sustainability is and what its implementation in engineering professional practice entailed. Sustainability is, however, a contested concept.

1.2. Sustainability as a contested concept

Walter Filho, editor of the International Journal of Sustainability in Higher Education, has said “...what does sustainable development really mean? Depending on the way it is looked at, it may have many meanings” ([4] p. 9). The literature on sustainability is replete with anecdotal and empirical evidence of variation in the way that both sustainability experts and lay persons conceive of or understand the general concept [1,4–10]. Much of the debate in the literature takes the form of philosophical arguments in favour of a particular definition, understanding or application of sustainability: the presumed intention being to converge on one or two singular, generic or definitive conceptions of sustainability. We hold, however, that sustainability is a defensibly and necessarily variable concept.

The existence of different conceptions of sustainability is not surprising because the concept is comparatively young, complex and abstract and, as we and others have discussed [8,11], it rests on both factual and ethical components. As such, different underpinning value-based assumptions would naturally contribute to variation in the way that sustainability is understood and explained. Further, debates about sustainability are often centred on complex or poorly understood systems [12]. Being partly value-based and focused on complex systems means that the conceptual contest about sustainability is both inevitable and healthy, and offers a means to give voice to different stakeholder perspectives, to further evolve the concept, and supports the continuing flexible application of sustainability in contextualised consultative decision-making [1,5]. Crofton has also suggested that the conceptual debate about sustainability opens a range of starting points and ending points which sustainable decision processes may work from and towards [13,14]. As such, attempts to ‘normalise’, closely define, or freeze sustainability into a constant, inflexible, singular or generic concept may be somewhat counterproductive to the implementation of sustainability. In short, debate about the nature of sustainability provides a means of maintaining the concept’s flexibility to

adapt to unique problem contexts, and its capacity to represent a range of different stakeholder perspectives.

1.3. Variation in sustainability conception and teaching sustainable engineering

The contest in the broader sustainability literature over what sustainability might entail manifests in distinctive ways in the engineering education literature. In an earlier paper, we reviewed the engineering education literature and derived and discussed sustainability principles for the engineering education context [11]. We concluded that the general destination in terms of what a sustainable future (*outcome*) looked like was broadly agreed amongst the authors whose work we reviewed, but that the ways in which they believed we might achieve the specified outcomes (*actions*) were contested. This contest resulted in different prescriptions for sustainable engineering, for example, one author advocated pollution prevention as the path to more sustainable engineering outcomes [15] while another argued in favour of community engagement in decision processes [16]. The contest in the engineering education literature over what sustainability might entail suggested that while engineering academics were likely to agree at the level of principles, individual academics held varying conceptions of how sustainability might be achieved. So, while there may be broad agreement in the engineering academy about what sustainable outcomes look like, the literature suggests that engineering academics feel that sustainability requires differing actions.

Variation in the actions that individual academics associate with sustainable engineering has significance for both how and what engineering educators teach as sustainable engineering. Constructivist educational research suggests what a teacher already knows, thinks and feels about a topic will influence the way in which the teacher structures teaching and learning activities for students [17]. This theoretical position would suggest that what engineering academics already know, think and feel about sustainability will influence how and what they teach their undergraduate students about this concept. The foregoing argument held that engineering academics tended to diverge on the actions they believed that the implementation of sustainability warrants. This would suggest that what engineering academics already know, think and feel about sustainability would influence their approach to teach engineering students how to incorporate and enact sustainability in their work as professional engineers. This theoretical position is supported by evidence from the literature of substantial variation in the way that engineering academics construct and deliver engineering courses focused on sustainability. The proceedings of the 2002 Delft conference on Sustainability in Engineering contain over 70 papers describing approaches to teach sustainability in an engineering context, and the approaches described vary substantially. For example, Lemkowitz et al. [18] described a schema for developing students’ moral and intellectual criticality, whereas Wells’ [19] course was more focused on sustainable plant design. The theoretical relationship between approach to teaching and prior conceptions of topic, and this

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