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A detailed anatomy of students' perception of engagement and their learning a threshold concept in core chemical engineering

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ABSTRACT

An attempt has been made to reveal a detailed anatomy of students' self-perceived engagement with material in a lecture and their learning of a key course threshold concept. A cohort of 80 students in a third year chemical engineering (64% response rate) course voluntarily recorded their engagement using a Likert-type scale at intervals of 5 min in a (nominally 50 min) lecture, together with written comments. Marks were awarded for a substantial, follow-up summative assignment to test their understanding of the threshold concept. It was found students were highly unaligned in their level of engagement with the lecture. A key reason was that individuals' engagement varied highly significantly during the lecture. Six engagement styles were identified. Some 33% exhibited Type 1 (engage strongly at the start and slowly disengage) and 23% exhibited Type 2 (remain at a more or less fixed engagement). Significantly, there was no correlation between students' engagement scores and marks awarded; in particular there was no correlation with specific lecture intervals in which material was identified as most important. Further, there was no correlation between the number of written comments made by an individual and their marks. It is concluded that student self-perceived engagement is not a good predictor of learning as assessed by marks awarded on a summative assignment. It is not known whether student engagement is predicated on particular lecture material and type of lecturer, or other contributing factors. The experimental design could be readily widely applied.

1. Introduction

> I cannot teach anybody anything. I can only make them think.
>
> Socrates 470–399 BC

There is a trend in higher education to use threshold concepts, that is, key concepts, mental hurdles or thought bottlenecks, to present and examine course material (Meyer and Land, 2003, 2005, 2006; Baillie et al., 2006; Korosteleva, 2010; Rourke, 2010; McDiarmid and Webster, 2010; Hassel et al., 2011; Meyer et al., 2010; Davey, 2012). Threshold concepts are said to be discipline specific (Meyer and Land, 2003; Reilly and Hunt, 2008; Park and Light, 2009; Perkins, 2006). However Rowbottom (2007), drawing on the work of Dummett (1993) and others (Brandom, 1994; Bonjour, 1998) has argued that it is better to describe these key concepts as 'threshold abilities' that can be tested in various ways such as exams. He contends that it is difficult to test whether a student has the necessary mental representation of an abstract entity, i.e. a concept.

The aim in using threshold concepts is to make acquiring knowledge potentially less 'troublesome' (*see* Perkins, 2006; Land et al., 2005) and, to illustrate the integration of ideas.

Recent findings in particular for two chemical engineering cohorts, are presented by Davey (2012) for undergraduate students. These findings support the widely accepted view that

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students highly value threshold concepts as a complementary learning experience. But at present the ways of students' thinking and engaging with particular material and learning a threshold concept are not clear.

Student engagement has received a great deal of research attention in higher education (Krause and Coates, 2008; Kuh, 1995, 2001; Fredericks et al., 2004[1]; Mann, 2001; Krause et al., 2005). (It should be mentioned here that the literature is not always clear about 'student', as what is often referred to are primary and secondary school experiences; the demise of the word 'pupil' has led to the need for this caution.)

The term in higher education is used to describe, and is almost always synonymous with, student 'involvement' or 'active participation' (*see* Russell and Slater, 2011) in University-wide activities. For example Scott (2008), in reporting consolidated findings on university engagement states, 'It is the total university experience that shapes productive learning, not just what happens in the traditional classroom.'

An extensive analysis of current engagement literature in higher education is presented by Krause (2005), Russell and Slater (2011), Zepke and Leach (2010) and Scott (2008). The underlying theme in this very wide ranging literature is that 'engaged' students are said to be more involved with their higher education study than their 'less engaged' peers (Krause, 2005), and; this engagement is likely to generate high quality learning (Scott, 2008; Russell and Slater, 2011; Palmer et al., 2005).

This literature is very important, not only pedagogically, because it is widely used to guide higher education research and practice, but also because this notion is used to purposefully shape institutions' policy and funding (Krause and Coates, 2008; Scott, 2008).

Student engagement is generally assessed by a grouping of all or most of the following: attendance at and active participation in classes; hours of personal study (alone or in a group) and degree and effectiveness of active study; engagement with the discipline the student is studying; collaborative and informal interaction with fellow students, or peer engagement; interaction with academic staff, particularly interactions which focus on an individual's learning and development; interaction with other support staff, such as student affairs staff; participation in extra-curricular activities, engagement with and through a range of available learning resources, including online media; sense of belonging to a learning community (study group, a tutorial group, a faculty), and; sense of belonging to the university as an institution.

Generally, however, the literature fails to acknowledge the pivotal role of lecturers and course structure. Almost unremarkably, Russell and Slater (2011) conclude that, 'Friendly, interesting lecturers who are reasonably available, who challenge and who themselves engage in a teaching-learning dialogue with their students, foster the engagement of those learners in their university study'.

The term 'student engagement' as used therefore appears to offer little real explanatory power for academic learning in the classroom. Actually the term is publicly viewed by some as the latest buzzword in higher education (Gibson, 2014).

A more resonate definition for the present author is provided by Hu and Kuh (2002) (see also Astin, 1985 and Chickering and Gamson, 1987) who define engagement as, '... the quality of effort students themselves devote to educationally purposeful activities that contribute directly to desired outcomes'. That is, the term should mean more directly the students' engagement with their studies, not with their social group or their institution, together with a focus clearly on pedagogic practices of learning and teaching.

This is the meaning in which it will be used here in this study.

1.1. *This study*

A study was undertaken to try to establish a measure of student engagement with particular lecture material in which a course threshold concept (Davey, 2012) was carefully identified and developed, and to determine if there was any correlation with student grades from a follow-up and extensive summative assignment.

Students were tasked to self-score their perceived engagement at intervals of elapsed time (5 min) in a nominally 50 min lecture and to comment on particular issues, or items that resonated or engaged them. Student learning of the material and particular threshold concept was then examined in a summative assignment that was graded by an experienced course tutor using the idealized solutions and general shell-form marking scheme of the lecturer.

A justification for the work is that an improved understanding of the anatomy of student engagement and consequent learning in a class of particular troublesome (Perkins, 2006) material could be used to enhance learning in higher education.

2. Aims

The aims of the study were to:

(1) Identify the level, and possibly type, of student self-perceived engagement during a nominally 50 min lecture in which a particular course core threshold concept (Davey, 2012) was developed and illustrated using a worked example.
(2) Examine students' learning of the particular threshold concept with a summative assignment.
(3) Correlate student marks awarded on the assignment with the particular level, and possible type, of student self-perceived engagement with the material during the lecture.

3. Materials and methods

3.1. *Course and cohort*

The course was a three-unit level III core course (nominally 45 h of contact, plus 100 h of study time) titled *Separation Processes* (*Applications C*) in which students are introduced to the principles and applications of separations involving gas–liquid, liquid–liquid and solid–liquid systems in equilibrium-stage and continuous contact operations (e.g. Foust et al., 1980; Geankoplis, 2003; Wankat, 2007). This was delivered in one-semester in a School of Chemical Engineering in a research intensive university. The course is presented in the third-year of the globally accredited four-year bachelor of chemical engineering degree programme (Anon, 1989). Key concepts and methods are introduced for use by practicing graduates in a wide range of chemical engineering industries.

[1] This paper is sometimes incorrectly cited as 'Student engagement...', e.g. Krause and Coates (2008).