Threshold concepts and troublesome knowledge (3)*: implications for course design and evaluation

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1.0 Introduction

It has long been a matter of concern to teachers in higher education why certain students 'get stuck' at particular points in the curriculum whilst others grasp concepts with comparative ease. What might account for this variation in student performance and, more importantly, what might teachers do in relation to the design and teaching of their courses that might help students overcome such barriers to their learning? As students from a much wider range of educational backgrounds now enter higher education these issues are becoming of increasing importance across all disciplines. A further and related concern is why certain concepts within disciplinary fields appear particularly 'troublesome' to students. What makes particular areas of knowledge more troublesome than others, and how might we make such areas less so?

This paper discusses these concerns from the new perspective of 'threshold concepts'. Within all subject areas there seem to be particular concepts that can be considered as akin to a portal, opening up a new and previously inaccessible way of thinking about something. A threshold concept represents a transformed way of understanding, or interpreting, or viewing something without which the learner cannot progress. As a consequence of comprehending a threshold concept there may thus be a transformed internal view of subject matter, subject landscape, or even world view, and the student can move on. In attempting to characterise such conceptual gateways it was suggested in a paper presented at an earlier ISL conference that they are *transformative* (occasioning a significant shift in the perception of a subject), *irreversible* (unlikely to be forgotten, or unlearned only through considerable effort), and *integrative* (exposing the previously hidden interrelatedness of something). They also entail a shift in learner subjectivity and an extended use of discourse.

* Please note that this chapter constitutes the third in a series on this topic. The two earlier pieces are listed in the references below under Meyer JHF and Land R (2003 and 2005).

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2.0 Threshold concepts

In order to make clear our aims in this paper we begin with an explanation of the meaning and derivation of the term 'threshold concept'. The idea of a threshold concept has been developed by Meyer and Land (2003) in the context of the ETL project. Threshold concepts are defined as concepts that bind a subject together, being fundamental to ways of thinking and practising in that discipline. They have attracted particular interest from economics communities in the UK (Davies, 2003) and Australia (Shanahan and Meyer, 2003). Once a student has internalised a threshold concept they are more able to integrate different aspects of a subject in their analysis of problems. Students who have not yet internalised a threshold concept have little option but to attempt to learn new ideas in a more fragmented fashion. On acquiring a threshold concept a student is able to transform their use of the ideas of a subject because they are now able to integrate them in their thinking.

The integrative aspect of a threshold concept presents distinctive problems for learners who are studying a subject (such as economics) as part of their degree. Students who do not think of themselves as 'learners of economics' are likely to face particular difficulties in grasping concepts that bind together aspects of a subject that may seem quite disparate to a novice. This problem arises because the acquisition of such concepts (eg opportunity cost, price and value, equilibrium) is intrinsic to grasping the ways in which economists 'think' and practice.

3.0 Troublesome knowledge

Such integration and subsequent transformation, though necessary for progress within the subject, may prove *troublesome* to certain learners for a variety of reasons, not the least of which is that such transformation entails a letting go of earlier, comfortable positions and encountering less familiar and sometimes disconcerting new territory. Threshold concepts are inherently problematic for learners because they demand an integration of ideas and this requires the student to accept a transformation of their own understanding.

An accountancy lecturer discusses the problematic nature of the concept of depreciation both for her students, and for her own attempts to get them to engage with the concept:

> *And why I think depreciation is a threshold concept, is that because what it draws in to an understanding of depreciation is a particular way of viewing business events or transactions which demand students to see these within a very particular framework. ie an accounting framework rather than what might be termed a commonsense or intuitive framework… it isn't a particularly natural process and actually the more you look at it the more contrived it gets, because it isn't just a straightforward alternative framework. Actually, within the framework, there are lots of compromises. And it is based, in part, on the intuitive framework. In fact the more I think about it now, I am changing my mind about the students misunderstanding it.*

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The transformation mentioned earlier can also entail a shift in the learner's identity. The result may be that students remain stuck in an 'in-between' state in which they oscillate between earlier, less sophisticated understandings, and the fuller appreciation of a concept that their tutors require from them. This in-between state we have termed a state of 'liminality', from the Latin meaning 'within the threshold'. One outcome is that students present a partial, limited or superficial understanding of the concept to be learned which we have characterised as a form of 'mimicry'. A more serious outcome is that students become frustrated, lose confidence and give up that particular course. It is the hope of the authors of this paper that within our various subject areas we can devise ways of helping students to overcome such 'epistemological obstacles' (Brousseau 1983). We would seek to create supportive liminal environments to help students through such difficulty – what might be characterised as a kind of conceptual peristalsis – that they might move on and succeed.

Sometimes the troublesome nature of knowledge stems from its being tacit – that which remains mainly personal and implicit (Polanyi, 1958) at a level of 'practical consciousness' (Giddens, 1984) though its emergent but unexamined understandings are often shared within a specific community of practice (Wenger, 1998). In other instances the troublesomeness is linked to language. Specific discourses have developed within disciplines to represent (and simultaneously privilege) particular understandings and ways of seeing and thinking. Such discourses distinguish individual communities of practice and are necessarily less familiar to new entrants to such discursive communities or participants who are peripheral to them.

> *Now if you think about the word 'cost', really all it means is, it is a value, an acquisition value. So instead of using the word 'cost' you could say this acquisition value, and it would mean the same thing wouldn't it? But the words 'value' and 'cost' are quite troublesome, literally, in accounting (and in economics), because 'cost' can mean very different things depending on who the user is, and for what purpose you are calculating the 'cost'. So, you know, in accounting you might have three or four very different understandings of what 'cost' means.*

4.0 Threshold *conceptions*

To complicate matters further, in some instances students may grasp concepts but the barrier to their learning appears to lie at a deeper level of understanding, where the student finds difficulty in appreciating what Perkins (2005) has termed 'the underlying game', or a threshold *conception*. Like the characters in Buñuel's (1962) film, *The Exterminating Angel*, who cannot leave the house in which they have attended a dinner, but are unable to account for their immobility, the students similarly are unaccountably unable to move on. An example would be where students of electrical engineering can cope with the required concepts from physics but do not have a working understanding of the highly unpredictable and surprising ways in which complex circuits might behave. In computer programming, similarly, students may grasp the concepts of class, objects, tables, arrays, and recursion, but they may not appreciate the threshold conception, the

underlying game, of the interaction of all these elements in a process of ever-increasing complexity. Such instances present teachers with particularly difficult challenges in class to assist their students in coming to understand the underlying conceptions of such phenomena.

Savin-Baden's work (2005) on the notion of 'disjunction' in problem-based learning (PBL) would seem to point to something similar to this notion of a threshold conception.

> *'Disjunction' refers to the idea of becoming 'stuck' in learning and I have suggested elsewhere (Savin-Baden, 2000) that disjunction can be both enabling and disabling in terms of its impact on learning. Disjunction, then, can be seen as the kind of place that students might reach after they have encountered a threshold concept that they have not managed to breach. Many staff and students have described disjunction as being a little like hitting a brick wall in learning and they have used various strategies to try to deal with it. These include retreating from the difficulty and opting out of any further learning, using strategies to avoid it, temporising and waiting for an event or stimulus that will help them to move on or engaging with it directly in an attempt to relieve their discomfort (Savin-Baden 2005: in press)*

If the portal appears 'bricked up' then clearly the threshold of new transformative understanding is not visible to the student. Savin-Baden argues that, although disjunction occurs in many forms and in diverse ways in different disciplines, it seems to be particularly evident in curricula where problem-based learning has been implemented. She suggests that this may be because PBL programmes prompt students to critique and contest knowledge early on in the curriculum and thus they encounter knowledge as being troublesome earlier than students in more traditional programmes. However, she goes on:

> *it might also be that problem-based learning encourages students to shift away from linear and fact finding problem-solving. Instead they move towards forms of problem management that demand the use of procedural and personal knowledge as students are asked to engage with strategy or moral dilemma problems. Thus it might be that disjunction is not only a form of troublesome knowledge but also a 'space' or 'position' reached through the realisation that the knowledge is troublesome. Disjunction might therefore be seen as a 'troublesome learning space' that emerges when forms of active learning (such as problem-based learning) are used that prompt students to engage with procedural and personal knowledge*

5.0 Considerations for course design and evaluation

The idea of a threshold concept presents important challenges for curriculum design and for learning and teaching. At a general level we would argue that programmes should be designed and systematically reviewed according to:

a) the sequence of content;

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b) the processes through which learners are made ready for, approach, recognise, and internalise threshold concepts. We would argue that this process of the student's learning, their encounter with threshold concepts in a given subject, might be considered as akin to a journey or excursion. Such an *excursive* account of the learning experience would see these processes as a framework of engagements, designed to assist students to cope with threshold concepts. (This notion of excursive learning will be discussed further in 5.6 below).

c) the ways in which learners and teachers recognise when threshold concepts have been internalised – in effect what would constitute appropriate assessment for the attainment of threshold concepts.

More specifically we would draw attention to nine considerations that we feel are important in the design and subsequent evaluation of curricula in higher education.

5.1 Jewels in the curriculum

Threshold concepts can be used to define potentially powerful transformative points in the student's learning experience. In this sense they may be viewed as the 'jewels in the curriculum' inasmuch as they can serve to identify crucial points in the framework of engagement that teachers may wish to construct in order to provide opportunities for students to gain important conceptual understandings and hence gain richer and more complex insights into aspects of the subjects they are studying. They may also serve a helpful diagnostic purpose in alerting tutors to areas of the curriculum where students are likely to encounter troublesome knowledge and experience conceptual difficulty – the 'stuck places' to which Ellsworth refers (1997:71).

5.2 The importance of engagement

There is already a considerable existing literature in relation to how tutors might help students to develop genuine understanding of a troublesome concept. Many of these studies point to the need for active student engagement with, and manipulation of, the conceptual material. For example it is recommended that tutors ask students to explain it, to represent it in new ways, to apply it in new situations and to connect it to their lives. The emphasis is equally strong that they should not simply recall the concept in the form in which it was presented (Colby et al, 2003: 263). We would wish to appropriate these emphases and, with Wenger, think about constructing a *framework of engagement* within the course that might enable students to experience and gain understandings of the ways of thinking and practising (WTP) that are expected of practitioners within a given community of practice, be this the recognition of the importance of contestability amongst historians, or the appreciation of the fluidity of double curvature surfacing in automotive design. We will wish our students not only to understand 'how historians think', but to begin to 'think like a historian'. But within this framework, as a course design question, what will be the specific *forms of engagement* which will be most appropriate to bring about these particular *transformative* understandings at various points in the curriculum and which will assist students to acquire the threshold concepts

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that are necessary to ensure satisfactory progression through the course? Lather has spoken of the kinds of engagement or praxis 'where the effort is to… provoke something else into happening – something other than the return of the same' (1998: 492). As course designers what 'provocations' might we be seeking through these forms of engagement to bring about the transformations in understanding that we would wish?

5.3 Listening for understanding

However, teaching for understanding of threshold concepts needs to be preceded by listening for understanding. In terms of what we will refer to below as 'pre-liminal variation' in the ways in which students approach, or come to terms with, a threshold concept, we can't second guess where students are coming from or what their uncertainties are. It is difficult for teachers, experienced and expert within the discipline, who long since travelled similar ground in their own disciplinary excursions, to gaze backwards across thresholds and understand the conceptual difficulty or obstacles that a student is currently experiencing. This requires 'cultivating a third ear that listens not for what a student knows (discrete packages of knowledge) but for the terms that shape a student's knowledge, her not knowing, her forgetting, her circles of stuck places and resistances' (Ellsworth1997:71).

5.4 Reconstitution of self

Grasping a threshold concept is never just a cognitive shift; it might also involve a repositioning of self in relation to the subject. This means, from the viewpoint of curriculum design, that some attention has to be paid on the part of course designers to the discomforts of troublesome knowledge. Knowledge may be troublesome because it has become ritualised, or inert, because it is conceptually difficult or alien, because it is tacit and perhaps requires awareness of an 'underlying game' imperceptible to the student (see below), or because of the discourse that has to be acquired for the concept to become meaningful (Meyer and Land 2003; Perkins 1999).

> *as students acquire threshold concepts, and extend their use of language in relation to these concepts, there occurs also a shift in the learner's subjectivity, a repositioning of the self... What is being emphasised here is the inter-relatedness of the learner's identity with thinking and language. Threshold concepts lead not only to transformed thought but to a transfiguration of identity and adoption of an extended discourse (Meyer and Land 2005: in press).*

This transfiguration and extension of the subjectivity of the learner might be exhilarating but might incur a sense of disquietude or even loss on the part of the learner as they let go the security of a previously held conceptual stance to enter less certain terrain. Again we return to the notion of the appropriate forms of engagement within which such transformations might take place and the need for the teacher to provide what Winnicott (1971) used to term a 'holding environment' or nurturing space. We prefer to call this a supportive liminal environment, feeling that Winnicott's term suggests a somewhat static, even inhibitive space, rather than the peristaltic process discussed earlier. Given, too, that

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the process of acquiring new knowledge tends to involve what Bonamy et al (2001) would call 'provisional stabilities', this means that over the course of an entire programme such periods of letting-go and reconstitution will be repeated and call for metacognitive skills on the part of the learner to cope with such transformation and to tolerate uncertainty.

5.5 Tolerating uncertainty

Learners tend to discover that what is not clear initially often becomes clear over time. One of our respondents, a first year student in media studies, came close to abandoning her course and dropping out halfway through the first year because she found the programme too conceptually difficult. She commented, however, that had she known, at the time of her encountering this troublesomeness in her understanding, that eventually she would come to cope with the programme (and the threshold concepts it involved), the transition would have been easier. The next time she faced such troublesome knowledge, she asserted, she would 'hang in there' with greater confidence because now she knew she would eventually find a way of coming to understand. So, in such a situation, there is a metacognitive issue for the student of self-regulation within what we have called the 'liminal state'. Efklides (2005) has emphasised the indispensable role of metacognition in the learning process 'both directly by activating control processes and indirectly by influencing the self-regulation process that determines whether the student will get engaged in threshold concepts or not.'

> *What distinguishes metacognitive feelings is their cognitive and affective nature. Metacognitive feelings take the form of feeling of knowing, of familiarity, of difficulty, of confidence, and of satisfaction, whereas metacognitive judgments or estimates can take the form of judgment of learning, of where, when, and how we acquire a piece of information, of time and effort spent on a task. Metacognitive experiences serve the* monitoring *and* control *of the learning process and at the same time provide an intrinsic context within which learning processes take place. This intrinsic context is to a large extent affective and determined by self processes, individual difference factors as well as task factors, including task difficulty, task instructions, and feedback used. The intrinsic context influences students' strategies in problem solving, but also their emotions, causal attributions, and self-concept. In this way, metacognitive experiences affect both online task processing and future motivation towards learning. (Efklides 2005:in press)*

5.6 Recursiveness and excursiveness

Given the often troublesome nature of threshold concepts it is likely that many learners will need to adopt a recursive approach to what has to be learned, attempting different 'takes' on the conceptual material until the necessary integration and connection discussed earlier begins to take place. The need for the learner to grasp threshold concepts in recursive movements means that they cannot be tackled in a simplistic 'learning outcomes' model where sentences like 'by the end of the course the learner will

be able to…' undermine, and perhaps do not even explicitly recognise the complexities of the transformation a learner undergoes. It is likely that any course requiring student engagement with threshold concepts and troublesome knowledge will entail considerable variation in the conceptual stances and outcomes that are reached by members of the cohort – what we might term *post*-liminal variation. Consideration of threshold concepts to some extent 'rattles the cage' of a linear approach to curriculum design that assumes standard and homogenised outcomes. Lather (1998:492) offers a counter-narrative rejecting 'the rhetorical position of "the one who knows"' in favour of 'a praxis of not being so sure'. A 'praxis of stuck places' might tolerate 'discrepancies, repetitions, hesitations, and uncertainties, always beginning again' (491). What it refuses is 'the privileging of containment over excess, thought over affect, structure over speed, linear causality over complexity, and intention over aggregate capacities' (497). We would argue, similarly, for the notion of learning as *excursive*, as a journey or excursion which will have intended direction and outcome but will also acknowledge (and indeed desire) that there will be deviation and unexpected outcome within the excursion; there will be digression and revisiting (recursion) and possible further points of departure and revised direction. The eventual destination may be reached, or it may be revised. It may be a surprise. It will certainly be the point of embarkation for further excursion.

5.7 Pre-liminal variation

An abiding question for educators, and for course designers in particular, is why some students productively negotiate the liminal space of understanding we have discussed earlier and others find difficulty in doing so. Does such variation explain how the threshold will be, or can be, or can only be approached (or turned away from) as it 'comes into view'? And how does it 'come into view' for individual students? We need to know more about the pre-liminal variation in the constitution of student cohort, given the obvious implications this would seem to have for subsequent student retention and progression (Meyer and Shanahan 2003). To this end a three-year funded study on threshold concepts within a given discipline is currently getting under way (see section 6.0 below) to investigate systematically, amongst other phenomena, the issue of pre-liminal variation and its implications for the sequencing, structure and forms of engagement that a course will contain.

5.8 Unintended consequences of generic 'good pedagogy'

There is emerging indicative evidence from research into threshold concepts (eg Meyer and Shanahan 2003; Lucas 2000) that what has traditionally been considered 'good pedagogy' may, on occasion, break down or prove dysfunctional in relation to the acquisition of threshold concepts. For example, the conventional practical wisdom of simplifying concepts in order to render them more accessible seemed to prove dysfunctional in the case of teaching the threshold concept of opportunity cost in economics in a South Australian context.

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> *one implication of the argument presented thus far is that 'first impressions matter'. Efforts to make threshold concepts 'easier' by simplifying their initial expression and application may, in fact, set students onto a path of 'ritualised' knowledge that actually creates a barrier that results in some students being prevented from crossing the 'threshold' of a concept (Meyer and Shanahan, 2003, p15)*

The simplified interpretation of the concept, intended to some extent as a proxy for the fuller, more sophisticated understanding which it was intended to lead on to, was found to operate more frequently as a false proxy, leading students to settle for the naïve version, and entering into a form of ritualised learning or mimicry. Such findings may prove useful as future keys to understanding the pre-liminal variation in student approach discussed earlier.

In a similar fashion the often-advocated form of engagement of relating concepts to everyday phenomena, or to the personal experience of students, was found to be ineffective in a first year introductory accounting course which sought to help students grasp the threshold concept of 'depreciation'. In this case it was the absence of any significant budgetary or financial experience in the students' experience which rendered the approach ineffective. It would seem salutary, therefore, periodically to cast a cold reviewer's eye over tried and tested 'good pedagogy'.

5.9 The underlying game

Finally, in the light of our earlier discussion of threshold *conceptions*, it would seem advisable for course designers to query whether, in addition to the forms of engagement they may have designed to assist students to cope with identified threshold concepts in a programme, there might remain what Perkins calls 'an underlying game' or threshold conception, which, if not recognised and understood by students, might still render their learning troublesome and lead to further frustration or confusion in their studies. Lucas (2000), for example, provides an example of such an underlying conception that Accountancy students are not always aware of. She distinguishes between 'authorised' and 'alternative' understandings of threshold concepts. 'Authorised' understandings are those endorsed and maintained by the disciplinary community and within textbooks. 'Alternative' understandings of events and transactions are independent of authorised versions, and arise from intuitive or everyday (common sense) understandings of a concept such as 'depreciation' or 'profit'. 'Alternative' understandings might on occasion be substituted for, or provide an alternative to, the authorised versions. Often, where students hold these alternative understandings, they do not recognise that these conceptions are in *opposition* to the authorised (and perhaps counter-intuitive or troublesome) versions promulgated within the course. Thus a particularly important (or higher level of) *threshold conception* may be required to recognise the difference between authorised and alternative understandings of threshold concepts.

6.0 Case study – developing first year undergraduates' acquisition of threshold concepts in economics

As a way of testing and implementing these considerations, and furthering our understanding of the issues of student variation in their acquisition of threshold concepts, we are now embarking upon an empirical study of the experience of first year students in a given disciplinary context. A three year national project, funded by the HEFCE FDTL5 programme, is currently getting under way as a collaborative venture led by Staffordshire University and involving the Universities of Coventry, Durham, and the West of England. By focusing curriculum development on threshold concepts in first year economics in the four universities this project provides an opportunity to re-evaluate the key binding ideas of the subject that should be introduced in level one, and what it means for students to understand these ideas in a deep-level transformative way. We aim to develop methods of assessing variation in the acquisition of threshold concepts. These methods will help students as well as lecturers to recognise levels of understanding. Students' acquisition of threshold concepts will depend on their prior experience and learning, and the way they are therefore likely to initially approach their studies. The project will aim to develop ways in which teaching can respond to the variation in which students engage and acquire these concepts. We anticipate that careful evaluation of the process and outcomes of the project will be useful for other colleagues wanting to pursue these issues in economics and in other subjects. The emphasis on teaching strategies that can respond to variation in ways in which students engage with and acquire threshold concepts provides the rationale for self- and teacher assessment that seeks to identify whether students have understood these concepts and this in turn will provide information that will identify 'at risk' students. Shanahan and Meyer (2003) have shown how recognition of failure to acquire threshold concepts can form part of the process of identifying 'at risk' students and that remedial measures can improve retention. We hope similarly to be able to support students through developing responses best suited to the needs of students on different named awards. Based on previous work on threshold concepts in economics (Davies, 2003; Shanahan and Meyer, 2003; Reimann and Jackson, 2003) the initial focus will be upon students' understanding of opportunity cost, price and value, equilibrium and gains from trade. These concepts feature frequently in standard first-year courses. On the basis of dialogue between colleagues in partner institutions and the economics Subject Centre in the UK we anticipate further threshold concepts in economics. The concepts of cumulative causation, externalities and rent-seeking behaviour have been suggested.

7.0 Conclusion

The task for course developers and designers here is to identify, through constructive (and constructivist) feedback, the source of these epistemological barriers, and subsequently to free up the blocked spaces by, for example, redesigning activities and

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sequences, through scaffolding, through provision of support materials and technologies or new conceptual tools, through mentoring or peer collaboration, to provide the necessary shift in perspective that might permit further personal development. The way in which chess players talk of 'developing' a piece involves the removal of other pieces (obstacles) so as to free up various (multiple) ways in which the piece might now be empowered to move. The significance of the framework provided by threshold concepts lies, we feel, in its explanatory potential to locate troublesome aspects of disciplinary knowledge within transitions across conceptual thresholds and hence to assist teachers in identifying appropriate ways of modifying or redesigning curricula to enable their students to negotiate such transitions more successfully.

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