Case study: engaging conceptual learning about threshold concepts with pots and pans

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Abstract

This case study discusses a recent session delivered to teachers on a Masters (MEd) programme which has a strong emphasis on enhancing professional practice at a university in the North West of England. The aim of the session was to develop an understanding of threshold concepts, a significant element in our teaching on curriculum design within the programme. In response to some initial difficulties we developed a novel and practical approach to engage the teachers who deliver Higher Education (HE) across a variety of vocational and subject areas in Further Education (FE) colleges. What was initially felt to be an unexpected and strange learning environment for the teachers (using a hands-on experiential approach with pots and pans) enabled a detailed focus on subject pedagogy (Cousin, 2010) and awareness of metalearning about threshold concepts (Ward and Meyer, 2010). The session supported the teachers, as learners, to move from viewing threshold concepts simply as 'troublesome knowledge' for themselves (Meyer and Land, 2005; Land et al., 2005) towards something that was transformative and that could usefully be integrated into their practice. The session, which presented threshold concepts as a threshold concept itself, challenged both our own and the teachers' assumptions about what were core or borrowed concepts in subject teaching, encouraging a greater questioning of how to embed threshold concepts within subject pedagogy and learning activities (Davies and Mangan, 2006).

Keywords: threshold concepts; developing teacher professional practice; general and subject curriculum; pedagogy.

The setting and the challenges

The Masters in Education (MEd) programme we teach has a strong emphasis on professional practice and development. As such, it is for many a unique space to critically reflect upon their practice delivering both FE and HE programmes within further education settings. The teachers on the programme cover subjects from Accounting to Early Years and represent a wide range of teaching experience, from novices to highly experienced practitioners. The programme provides a combination of pedagogical theories and perspectives, research methods and critical inquiry techniques enabling each teacher to critically reflect upon their practice as an FE/ HE teacher. Crossing many teaching areas and disciplinary boundaries it provides a rich mix for exploring both specific subject issues and general teaching insights within this context. Theory and practice is contextualised into each teacher's subject area; aligning both within the programme is an important but not always easy balance to achieve. For example, by including critical self reflection (Brookfield 1995), practitioner research (Cousin, 2009; Somekh, 2006) and educational/professional development perspectives (Eraut, 1994; Stewart, 2009) we create a space for holistic teacher professional development. This is something often neglected for those who work in HE who are frequently viewed only, or primarily, as subject specialists rather than teachers. On the other hand the programme has to recognise and address how the teachers apply their developing pedagogical insight within their individual specific subject areas; how, for example, Construction or Business Management teachers work within their particular teaching and learning contexts.

Some of the tensions of how to work effectively across both 'general' pedagogically informed perspectives and the 'particular' subject specific areas was illustrated for us in the module which looked at curriculum design. In this each teacher critically reviews their curriculum assessing if it is up-to-date and fit for purpose; if it supports or impedes learning; and if the assessment strategies are varied and relevant to the learning outcomes and the learners. Part of this process requires assessing how well the curriculum enables learners to understand the subject they are studying, whether this is Construction or Web-design. Whilst general principles of curriculum are helpful (Barnett, 2005; Kelly, 2009), including those relating to particular disciplines (Smith, 2002; Hussey and Smith, 2003; Ogborn, 2002; English et al., 2004) there are conceptual gaps in being able to question how far each curriculum specifically enables learners to achieve 'mastery'

in the subject. For us this is a real issue as we are potentially working across up to twenty different subject areas in any one group.

For the teachers this is an issue, as what is defined as levels of mastery is prescribed within the Framework for Higher Education Qualifications (QAA, 2008) outlining the knowledge, skills and understanding required from level 4 (Certificate of HE) to level 8 (doctoral study) qualifications. It is noticeable that concepts and principles are required for the Certificate in HE and the Foundation Degree (QAA, 2008, pp.15-17) but are not mentioned, thereafter. For the BA qualification the language is more general requiring understanding complex bodies of knowledge, some at the 'current boundaries of academic disciplines' (QAA, 2008, p.19). It does not refer specifically to subject concepts and principles, perhaps viewing these as more applied.

Threshold concepts, however, provide a useful conceptual tool for questioning whether the curriculum, and the teaching that supports this, enables learning leading to mastery of a subject or a discipline across the different HE qualification levels. Threshold concepts was developed by Erik Meyer and Ray Land (2003; 2005; 2008) to understand what they termed as the different 'conceptual gateways' or 'portals' which Economist undergraduates, the subjects of their study, needed to pass through to understand their discipline in a fundamental and irreversible way. In effect, students being able to master the core concepts and knowledge, becoming economists in their thinking and actions. Meyer and Land (2003) suggest five characteristics of a threshold concept, in brief: it is transformative as it requires a shift in thinking and in one's world view (ontology); it is irreversible, once learned it cannot be forgotten; it is integrative, allowing deeper insight and connections to be made; it is bounded, but may rely upon other disciplinary knowledge; finally, it often contains 'troublesome knowledge' which is often experienced as counter-intuitive by the learner. This work has been added to by others exploring wider applications (Land et al., 2005; Davies and Mangan, 2006), the implications of using this approach in teaching and learning (Cousin, 2006; 2009; 2010), in generic learning development work (Edwards, 2011) and in research education (Kiley and Wisker, 2009).

We felt that what Meyer and Land (2003) identified as key subject 'portals', or 'conceptual gateways' provided useful analytical tools for the teachers to question if and how their curricula enabled students to achieve subject mastery, as well as the designated level of qualification. We explored the idea that threshold concept was itself a threshold concept

within curriculum design, for us providing a process and evaluation for teaching it. If approached critically, in more than a simple instrumental or outcome focused way, understanding this concept had itself the possibility of becoming transformative, irreversible, integrative, bounded and troublesome in curriculum development. It provided a conceptual gateway or portal for the teachers to gain mastery of the concepts and knowledge of designing curriculum for learning within their own subject area.

We wanted the teachers to fully engage and explore threshold concepts in a critical way, at a general pedagogical conceptual level rather than only in a narrow subject focused approach concerned with applying insights to their specific area. Working at a metalearning capacity (Ward and Meyer, 2010) provides the possibility, as Glynis Cousin (2010) argues, for opening up discussion between subject specialists, students and educational researchers, creating transactional curriculum inquiry (Cousins, 2010, p.7) challenging what she earlier calls 'the stuffed curriculum' (Cousin, 2006). This fitted our own curriculum balancing act, our facilitative way of working and our range of teachers. Our challenge was therefore whether we could enable the teachers on our programme to gain 'mastery' of the concept at a metalearning level, apply it within their curriculum area, and change their practice irreversibly.

'Getting stuck' and using a practical approach for conceptual understanding

Our attempt at delivering threshold concepts for the first group did not work; the teachers were confused and did not see the relevance to their practice. After hasty mobile phone calls between ourselves we realised that we were in effect 'stuck' in our teaching, that what we were doing wasn't working. In response we designed a session which was both experimental and experiential; the teachers became learners and the subject area purposively was unfamiliar. It was experimental in design, as it developed new teaching strategies, and it was experiential, as the conceptual learning and metalevel awareness that we wanted the teachers to achieve was delivered using practical hands-on methods. In discussions, prior to the unsuccessful threshold concept session, teachers described when being worried most about teaching, or felt unable to teach well, they used a didactic approach. This enabled them to take control of the teaching by remaining in their disciplinary comfort zone and moving quickly on to safer areas of curriculum expertise;

things they described as 'knowing more about'. This provided some insight into why the teachers found threshold concepts difficult to engage with; we had not clearly articulated, or applied, what we meant by subject portals and conceptual gateways. Threshold concepts were therefore experienced by most as tricky, confusing and not clear, or in other words outside of their subject or pedagogical knowledge and to be avoided. We wanted to create a learning experience that would allow portals to emerge, providing a clear understanding of what threshold concepts were both conceptually and practically.

The session

Our starting point came from Meyer and Land (2003) who use the example of heat transfer, from Physics, to show how practical decisions about pots and pans is informed by this knowledge, once known it changes understanding specific to what goes on in the kitchen. They explain:

> So it could be said that, as a stand-alone example, heat transfer, or more precisely, controlling the rate of heat transfer, is a threshold concept in cookery because it alters the way you **think** about cooking. (Meyer and Land, 2003, p.2)

The teachers arrived for the experimental three hour session with no prior indication of the content or method of delivery. They were met with a table with several pots and pans, receiving no information on the aim of the session or expected learning outcomes. The aims and objectives for the session with a detailed session 'plan', based around the activities that had been created, were held safely in an envelop to be revealed at the end of the process. Without discussion the teachers were asked to look at and examine the pans on display and to record what they saw. They moved from simple description, such as small and round, to more analytically informed comments, represented in a chart, of characteristics and possible heat sources that would be suitable for the cooking with the pan.

Two pans were studied in detail questioning the shape, thickness and the most suitable heat source to use. Most identified that the relationship of metals and the transfer of heat was related to the discipline of Physics. To consolidate learning and indicate if transition to a more conceptualised level of understanding was occurring (Kiley and Wisker, 2009), the

teachers were asked to identify a suitable pan for a recipe, for example a stir fry, explaining the reasons for their choice. The two key concepts that came out of this discussion were that heat and time influenced the final product. We established that the knowledge of Physics (metals and heat transfer) and time were all threshold concepts that enabled a chef to develop mastery and create dishes to a required outcome and be consistently successful in the process.

From understanding gained at a metalearning level within the session, the teachers were asked to transfer this by identifying similar key concepts within their own vocational areas or subjects. They were able to identify within their subject areas concepts and theories borrowed from Sociology, Philosophy, Psychology, History, Biology and Chemistry. Many of the concepts or knowledge from other disciplines could be identified as the ones they felt uncomfortable, inadequate or underprepared in teaching; the ones to be avoided, or taught in a didactic way. Where knowledge or concepts were from other subjects or disciplines, most felt exposed and vulnerable – it undermined their own subject or discipline mastery. This discussion enabled many of the teachers to recognise the challenges threshold concepts present and where, particularly in vocational subjects, the focus is often on the skills which are taught and assessed at the expense of deep underpinning knowledge enabling subject mastery. Many of the teachers recognised that they themselves lacked the breadth of underpinning knowledge; a result often of their own skills-based graduate learning in FE and HE.

Using a visible practical approach enabled some teachers to immediately gain understanding of threshold concepts, itself as a threshold concept, and relate it to their practice. Some were able to reflect this back giving examples of making learning visible in their own classes. For example, one sports teacher explained how when he taught blood flow (now clearly recognised as a borrowed concept from Biology) he used rooms, corridors and doors to move learners around to show how clots formed. He explained that he now understood that this was a conceptual gateway or subject portal that his learners needed to pass through to master his subject, not a skill to be acquired. He also recognised that he needed to develop his understanding of Biology to teach his own subject well, conceptually and critically, rather than skills-based or relying on didactic methods. Another teacher working in Functional Skills discussed how numeracy was best taught when immersed in the students' own subjects, so she taught percentages by helping learners to deduct tax from their earnings. To do this she recognised that she drew

upon, or borrowed knowledge and concepts, from subject areas such as Economics and Mathematics to enable her students to learn.

Reviewing the session

We asked the teachers to review the session by answering some simple questions. From the twenty two responses we received, when asked how they felt at the beginning of the session most described being interested, if a little confused, excited, and curious to know what pots and pans had to do with curriculum design. A couple reported being amused but sceptical and unsure what the purpose was. When asked if this way of working helped in understanding threshold concepts most replied it had, although for many it took a while in the session for the connections to be made. For one this was a surprise and another said 'It was hard to identify with initially but it was a good way to learn'. One felt that it was too far removed from their subject to be helpful to them.

In response to being asked if they had a better understanding of threshold concepts all but one reported they had, with most adding the qualifier that they had become interested and had done additional reading to support this learning. This general understanding enabled nearly all to recognise threshold concepts in their own subject area, ranging along a spectrum of being very confident to not confident at all. The more confident teachers replied positively that they could recognise threshold concepts in their area, giving replies such as, 'Yes, I have been able to highlight several' and 'I am definitely more confident that I can, but we will soon find out!'. Middle confidence level teachers were more hesitant giving replies such as, 'mostly' and 'yes I think so'. Teachers who were less confident in recognising threshold concepts in their subject areas gave unsure replies such as 'yes with notes' and 'some'.

Most of the teachers felt that threshold concepts were helpful in recognising the significant knowledge, understanding and conceptual building blocks in their subject area that students needed to know that the curriculum should support. For some this formalised their existing teacher understanding, described by one teacher as 'something that you sort of know', whilst for others it prompted deeper understanding and reflection about the learners and about how curriculum shapes learning. Its usefulness to the teachers was expressed both generally, in terms of teaching and learning, and in terms of their own subject curriculum. General comments included: 'It helps establish a starting point in

mapping a curriculum' and for others it enabled a connection between teaching and the curriculum as in the comment, 'it will inform teaching style and course content'. Subject focussed comments included: 'It enables me to assess what's important to get across in my curriculum' to more specific curriculum areas such as 'I think it is fundamental to teaching Functional Skills maths'. One teacher didn't know if threshold concepts was useful to them and another wasn't sure but felt it was helpful in thinking about their teaching.

Did it work?

The feedback from the teachers showed that overall they enjoyed the session as the practical approach prompted curiosity and engagement. However, did using threshold concepts itself as a threshold concept, using a practical hands-on session, enable us to provide conceptual tools which could be applied by the teachers in their own subject areas? The two assignments for this module provide some insight into this question. The first assignment requires the teachers to work with a curriculum they use, have designed or developed, annotating the document critically with reference to curriculum theory, pedagogical perspectives, professional and sector requirements, as well as wider policy issues. The second assignment, a critical professional reflection, assesses strengths and weakness for teaching and learning within the curriculum documents, discussing recommendations for change or further development by the teacher.

It is within these two pieces of work that evidence of a shift in thinking about threshold concepts became evident. Drafts of the annotated subject specific curriculum documents viewed before the pots and pans session, whilst containing general comments about the curriculum, had almost nothing that was subject specific or addressed its effectiveness in delivering core knowledge or conceptual understanding for mastery in the subject. However, annotations after the session began to use threshold concepts as a critical lens for viewing curriculum effectiveness in enabling learning subject knowledge. The critical professional reflection, the second assessed piece of work, had many examples of teachers writing about the significance of understanding threshold concepts as a way of interrogating both the curriculum and their practice. This use of reflection shows levels of awareness and a narrative around transformation in teaching and learning (Ward and Meyer, 2010) developed from these insights. Many teachers suggested this would determine future curriculum development, either in validation or in designing new courses

and programmes. In this way it was transformative and did enable shifts in thinking about curriculum design and about the type of knowledge, concepts and understanding that learners needed for mastery of a subject. Many also commented that this concept was powerful and could be communicated to others including subject specialists, students and researchers creating what Cousin terms 'transactional curriculum inquiry' between them (Cousin, 2010). The writing of many of the teachers showed confidence in both understanding and application suggesting that had become irreversible. In both assignments the concept began to be applied to specific subject areas whilst drawing upon and connecting with other more general or holistic theories of teaching and learning. It could be argued, in terms of Meyer and Land's (2003) five characteristics of threshold concepts, this knowledge and these insights became integrative, leading to new practices.

It is the remaining two characteristics, that of subject knowledge being bounded and this new knowledge as troublesome, which suggest that teaching threshold concepts using pots and pans may have enabled the teachers to see the wider conceptual value, more than simply the application to their own subject area. We asked the teachers to engage with these ideas by using neutral disciplinary knowledge (heat transfer within cooking) where understanding came by applying knowledge outside of the subject (Physics) to show what needed to be known within it (cooking). In this way we asked the teachers to apply conceptual knowledge outside of their subject (threshold concepts itself) to understand how subject specific portals contain other disciplinary and conceptual knowledge. The pots and pans were a practical manifestation modelling this. Most of the teachers were able to make the connections, through their own learning experience, between core subject knowledge and that of contributing disciplinary knowledge which is needed for mastery. For many the session, although enjoyable, produced troublesome knowledge at the beginning; it didn't fit expectations, with some questioning why cooking had been chosen, suggesting it would be better if it was closer to the subjects the teachers actually taught. The written reflections showed that whilst many enjoyed the session, they also grappled with deeper understanding and the challenges of implementing this within their curriculum. This 'new' knowledge (about threshold concepts) was for some counter intuitive and challenged ways that they had taught their subject. For others it was like the 'penny dropping' or 'the light being turned on', as they saw and understood the meaning and the implications. This prompted thoughtful discussion about teacher autonomy within curriculum development as well as educational instrumentalism and student centred learning from experienced subject teachers.

The session was an attempt to find a way of teaching a general conceptual tool across a wide range of teachers, without relying on simple or overly reductionist concerns with specific subject issues – a 'how to' approach. As we developed and taught the session we felt that we were applying threshold concepts as a threshold concept itself which was, for us, a useful analytical device to construct the session and to assess it as a general learning perspective for subject specific teaching and learning, in this example through curriculum design. What emerged from the session, the following discussions and continued reflections was that many of the teachers understood where they 'got stuck' in their own subject teaching. This was often where core concepts or underpinning knowledge was borrowed from other disciplines, identified by them as information they were unsure of and which was therefore difficult to explain fully to students. Although Meyer and Land (2003) suggest that conceptual knowledge required for mastery is bounded, so that 'understanding' allows 'becoming' (for example an economist), the difficulties of borrowing from other disciplines or subjects to achieve this needs to be acknowledged and explored. For some of our teachers this awareness prompted critical pedagogical insights about their current practice, questioning what this responded to, as well as future development as subject teachers.

For others what emerged was the tension between the type and level of professional knowledge they felt was required for true mastery within their subject area and what was required to achieve an academic qualification. For example the appropriate professional knowledge and understanding so a construction worker was safe and competent, as well as what was required for external qualification validation. This was experienced as particularly difficult for those moving from HND to Foundation Degree validation systems. Whilst the Framework for Higher Education Qualifications (QAA, 2008) outlines the knowledge, skills, understanding and concepts for the Foundation Degree and Certificate in Higher Education these were questioned by some of the teachers as requiring academic competency rather than subject mastery. Threshold concepts allowed the teachers a more precise analytical tool to consider curriculum and validation documents, looking at the possibilities for integrating the knowledge, concepts and understanding to move through the subject portals and conceptual gateways for mastery of their subject. This examination allowed the teachers to consider not only where they got stuck in their teaching, particularly where borrowing from another discipline, but importantly where the curriculum itself produced tensions about what the content of learning should be and what constituted mastery of a subject. They questioned who, and how, the subject portals and conceptual

gateways were defined for the subjects they taught. Assessing why and how we were stuck, and our practical response to this, has supported some significant conceptual and critical thinking for us and the teachers, both for general teaching and learning and in applying these insights within teaching particular subject areas.

Acknowledgement

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