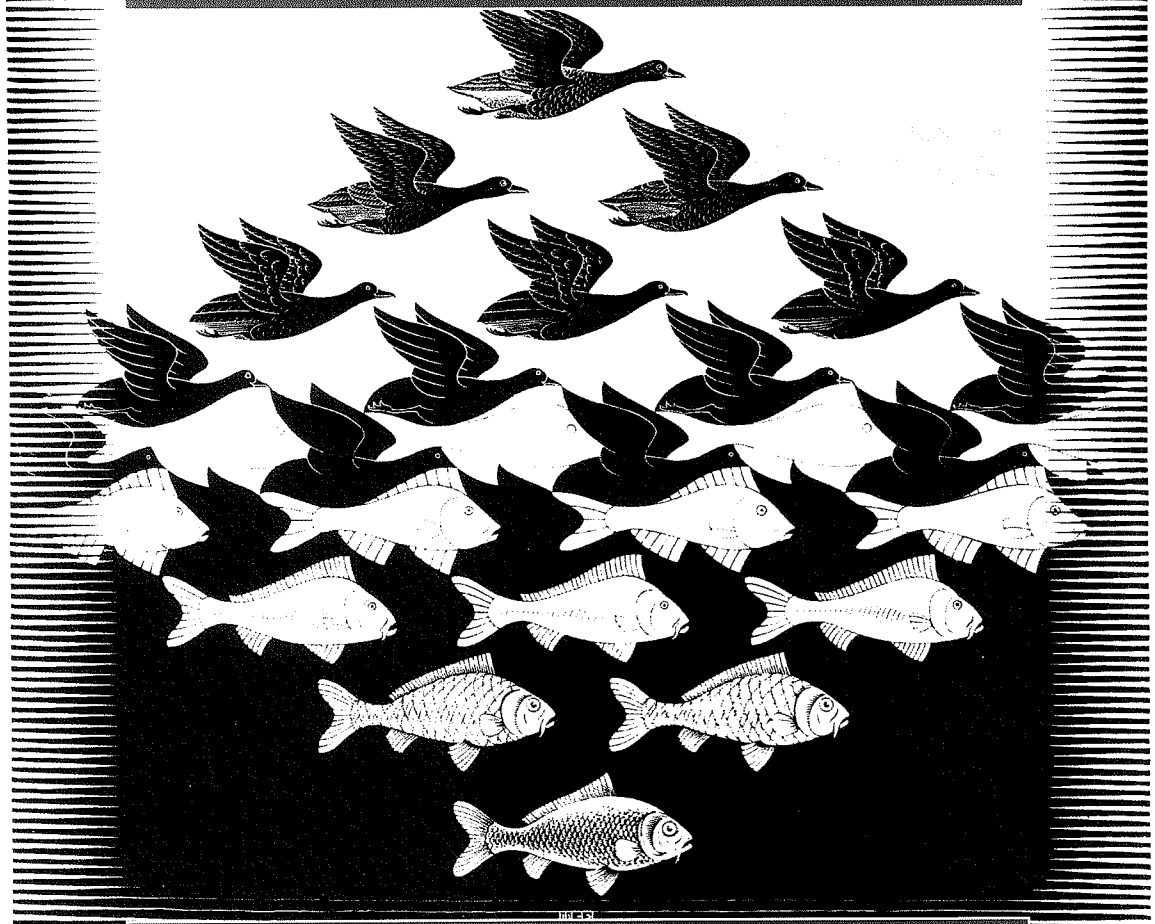
EDUCATIONAL FUTURES: RETHINKING THEORY AND PRACTICE

Threshold Concepts and Transformational Learning

Jan H.F. Meyer, Ray Land and
Caroline Baillie (Eds.)



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Threshold Concepts and Transformational Learning

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ABSTRACT

This chapter has as its main focus the research we have carried out with supervisors regarding their identification of candidates' "learning leaps" or conceptual threshold crossing, with reference to the threshold concepts that have been identified as part of the process of learning to be a researcher. Experienced supervisors across a range of discipline areas and a number of different countries were surveyed or interviewed with the aim of identifying supervisors' views on: conceptual challenges that candidates encountered when learning to be a researcher, how supervisors recognised that a candidate had successfully met those challenges, and how they might have assisted the candidate in that process.

As an outcome of the study we suggest that with the development of research supervisors' ability to appreciate the concepts involved, to identify moments of research learning, and to have access to a range of strategies, they might be more able to assist candidates when they struggle in their engagement with these concepts and threshold crossing.

INTRODUCTION

Most research focusing on threshold concepts has considered the learning of undergraduate students and definitions of subject-related threshold concepts with examples of strategies and practices, which aim to encourage students to make the crossing through a liminal space to the position of understanding and using the concepts in their work (Cook-Sather, 2006; Deegan & Hill, 1991; J. Meyer & Land, 2006; Turner, 1979; Wisker, Robinson, & Kiley, 2008). This crossing of the threshold, a process which in this paper we call *crossing conceptual thresholds*, can alter the learner's approaches to, and perceptions of learning in the subject and often of learning itself. This change, it can be argued, means that the learner has not only revealed a more complex landscape of knowledge, but can understand, manipulate, and create knowledge, a type of learning defined by Flavell (1979) as meta-learning. Such a developmental change can be troublesome, causing disruption in the learning practices of the doctoral student and so affect both ontology, their identity, and epistemology, their construction of and contribution to knowledge.

J. H. F. Meyer, R. Land and C. Baillie (eds.), Threshold Concepts and Transformational Learning, 399–414.

The theory and use of threshold concepts in student learning has developed dramatically over the past few years, for example, with conferences in Scotland, 2006 and Canada 2008; books, Land, Meyer & Smith, 2008; Meyer & Land, 2006; funding for research projects such as the UK National Teaching Fellowships Scheme Project on Doctoral Learning Journeys (2007–2010) based at the Universities of Brighton and Anglia Ruskin, the Australian Learning and Teaching Council project at the Australian National University, and numerous conference and journal papers. We have paralleled this work with research into threshold concepts in research education, and with research into the crossing of conceptual thresholds, those learning moments at which doctoral students begin to view the construction of knowledge and to work at a more complex, conceptual, critical and creative level.

Our research into threshold concepts in research education began with the Reflections on Learning Inventory (ROLI) (Meyer & Boulton-Lewis, 1997) which aimed to identify student learning approaches, motivation, and their meta-cognition, that is when they knew they were learning and what they thought learning was for them (Flavell, 1979; Wisker, Robinson, Trafford, Lilly, & Warnes, 2004). The ROLI was used in a study in the UK with a large international, cohort-based PhD programme spanning 1998–2008. It was administered at the start and end of the candidate's doctoral learning journey. Used in conjunction with interviews, focus groups, supervisory dialogues and set group dialogue events. The action research accompanied a five stage research development programme. It focused on postgraduate student learning and moved through the identification of various moments when students can be seen, or not, to develop their approaches to, and perceptions of, the learning necessary at doctoral level. Initially, much of this research focused on the identification of questions or problems at doctoral level for example, methodology and the development of the literature review. Dialogues between candidate and supervisor have identified where students find their own voice and are able to explain and argue their contribution. Recently, the research has focused on candidates working at conceptual levels in their research, for example conceptual levels of enquiry, research, design, data management, interpretation of findings and conclusions. These findings related to candidates' conceptual level of learning that has been referred to as 'doctorateness' (Trafford, 2003).

A further related stage in the emerging work on research learning was the development of the Students' Conceptions of Research inventory (SCoRi) which aimed to identify what it was that students understood 'research' to be, leading further to conceptions of research held by academics, particularly research supervisors Kiley & Mullins, 2001, 2002, 2003, 2005, Meyer, Shanahan & Laugksch, 2001).

Additionally, research on the examination of the doctoral dissertation and viva/oral suggested not only that work that was deemed to have achieved the level of the doctorate had made a contribution to knowledge, but also that candidates were able to present their work conceptually and to theorise and abstract their findings in ways which allowed them to have broader application (Bourke, Hattie, & Anderson, 2004; Hartley & Wisker, 2004; Holbrook, Bourke,

Farley, & Carmichael, 2001; Isaac, Quinlan, & Walker, 1992; Johnston, 1997; Kiley & Mullins, 2004, 2006; Mullins & Kiley, 2002; Tinkler & Jackson, 2004; Winter, Griffiths, & Green, 2000).

The combination of these aspects of our work with the theory of threshold concepts became a turning point in our own research. Student meta-cognition, conceptual level thinking and developing facility and ability to articulate their research learning were seen as crucial in the development of postgraduates' doctoral learning journeys through to the crossing of conceptual thresholds and the achievement of their doctorate. We argue that conceptual thresholds are the stages or critical points in students' research journey where they move into work at a conceptual, critical and creative level. Such moments include, for example, the identification of a research question from a topic, and engagement in dialogue with the literature, placing their own work and findings in their own voice in this dialogue. This work led to the first paper on research candidates' threshold concepts at the Quality in Postgraduate Research conference in 2006 (Wisker, Kiley, & Aiston, 2006) and further papers on conceptual thresholds in literature and art, and in education (Wisker, Robinson, & Kiley, 2008) and on supervisory recognition of this conceptual threshold crossing (Kiley & Wisker, 2008).

The research has advanced with four main aims:

1. The identification of concepts in research learning that might be argued to be threshold concepts
2. The identification by research supervisors of the moments of development or crossing of the conceptual threshold associated with having understood one of these concepts, often referred to in this paper as the "learning leap"
3. The ways in which research supervisors might be able to assist candidates in understanding these concepts and cross conceptual thresholds or making the learning leap, and
4. The identification by research candidates of the moments of understanding or learning leap that is their own meta-cognitive understanding of learning.

This chapter has as its main focus the second and third of the above aims. However, we begin with an overview of the Threshold Concepts that have been already identified in research education (Kiley, in press, Kiley & Wisker, submitted for publication). Following this we present the study that identified how supervisors recognised the crossing of these thresholds.

In our earlier work, we suggested that there were six initial threshold concepts emerging from the data. The first was the concept of *argument* or thesis, a concept which the research on doctoral examination frequently cites either because of its presence, or lack of it, in the dissertation (Bourke, Hattie, & Anderson, 2004; Kiley & Mullins, 2004, 2006; Lovitts, 2007; Mullins & Kiley, 2002). The second threshold concept identified was the concept of *theory* either underpinning research or being an outcome of research. A research students' understanding of the role and use of theory was a critical issue raised in the earlier work. A third concept identified in the research was that of *framework* as a means of locating or bounding the research.

The other three possible threshold concepts suggested by the earlier research include the concepts of knowledge creation, of analysis, and of research paradigm. The concept of originality and *knowledge creation* was one reported to challenge students. The idea that in undertaking original research one is contributing something new to our knowledge and understanding is a substantial leap for many. In the earlier research it was not uncommon for supervisors to report that some candidates had difficulty appreciating the concept of *analysis.* Again the research on examination (Kiley, 2004; Kiley & Mullins, 2004; Lovitts, 2007; Mullins & Kiley 2002, and (Lovitts, 2007; Winter, Griffiths, & Green, 2000) suggests that examiners frequently comment negatively on lack of analysis or analysis that might be termed "haphazard" or "undisciplined". The sixth threshold concept to be identified to date is the concept of *paradigm* that is the epistemological framing of one's approach to research.

Having outlined our previous work on identifying threshold concepts we now move to the more recent study which examined how supervisors recognised when students had grasped one of those concepts and crossed the threshold.

AIMS OF STUDY

Work being discussed and reported in this chapter comes from an early investigation into the awareness and articulation by research supervisors, who are engaged in encouraging students to cross conceptual thresholds and gain threshold concepts at doctoral level. This specific contribution focuses on ways in which they intervene in working with their postgraduate students' learning that is how they "nudge" students across conceptual thresholds.

Hence, the specific aims of this particular part of the study were to identify:

1. How research supervisors recognise the acquisition of the threshold concepts
2. Where and how they recognise evidence they are crossing, and
3. How they "nudge" candidates in the crossing of this threshold.

For us as supervisors in an educational development context we might ask what it is we do or could do to help students engage at this conceptual level to gain the threshold concepts and get through the conceptual thresholds.

METHOD

We have used face-to-face interviewing of individuals and small groups (n = 40) (see Table 1) and written surveys (n = 26) (see Table 2) with experienced supervisors across a range of disciplines to identify if they are aware of such conceptual threshold crossing and the gaining of threshold concepts. We were seeking to find how this "crossing" might appear and take shape in terms of "articulation" i.e. in the written and spoken work of their students. In addition we wanted to know what they felt was their contribution to "nudging" students through the various thresholds. Early work has suggested that supervisors identify key issues in what can be termed doctoral work that is: conceptual, critical and creative (enough) to be accepted as doctoral work.

Responses were coded by discipline e.g. SS for Social Science, and each respondent identified numerically e.g. SS10. Where terms exist in the transcripts that might identify the respondent they have been removed and replaced with … which has also been used when parts of the quotes are not specifically relevant. False starts and "words" such as um and err have been removed to aid in reading.

Table 1. Interviewees by discipline cluster and country

Discipline cluster	*Australia*	*UK*	*Jamaica*	*Trinidad*	*Canada*	*Total*
Engineering & IT	2			1		3
Humanities	4	2		2		8
Science & Health Science	9	2		1		12
Social Science	11	2	3		1	17
Total	**26**	**6**	**3**	**4**	**1**	**40**

Twenty-six experienced doctoral supervisors across eleven universities, in five countries were invited to complete a short survey. As Table 2 demonstrates the supervisors represented the same four main areas as in the interviews. In the survey, respondents were asked to identify the main learning challenges that they considered their research candidates experienced and the strategies that they as supervisors had adopted to assist learners overcome these challenges.

Table 2. Survey respondents by discipline cluster and country

Discipline cluster	*Australia*	*UK*	*New Zealand*	*Malaysia*	*Israel*	*Total*
Engineering & IT			1			1
Humanities		1	3	1		5
Science and Health Science			6	1		7
Social Science	3	1	6	2	1	13
Total	**3**	**2**	**16**	**4**	**1**	**26**

Hence, we have a total of 66 sources of data to assist us in answering our questions.

FINDINGS

The analysis of the transcripts suggested that there are a number of moments when candidates demonstrate that they have made a "learning leap" and are operating at a conceptual, critical and creative enough level for a doctorate. These moments are presented below followed in each case with examples of how supervisors in the study report that they have been able to nudge candidates to work at the appropriate level.

However, it is important to note that several supervisors indicated that some of their students have clearly reached the level of conceptual threshold crossing prior to their commencement of the doctorate. This is particularly true of some Masters

students, or in the Australian context, First Class Honours graduates. Also, in the North American system, where course work and examinations, and often a *viva*, precede the development of the dissertation. In these cases it is anticipated that many candidates would have reached these levels of conceptual thinking in their pre-dissertation learning experiences, for example:

> Some students seem to be like that [thinking conceptually] from the beginning almost even in their proposals. I have a couple of really good Masters students, none of them are moving along very well but what they are capable of, and in terms of what they write, I am very impressed. So often these are people who are adults, they have problems, they have families, a couple of them have had crises.
>
> Interviewer: And that stops them from working at anything other than university level?
>
> It stops them from working at all, once they have finished their coursework, and they have gone off to deal with their family issues. (SS25)

Some students, conversely, never reach this conceptual, critical and creative level of threshold crossing in their work and some cannot even glimpse the portal let alone get through it. Supervisors have indicated that at this point they feel it is wise to ask whether such students could develop to achieve this level and whether they could or should receive a PhD. Many universities are now introducing probationary enrolments and assessed proposal seminars in the first year of candidature as a means of identifying those candidates for whom a research degree might not be the most appropriate award.

Having addressed the issue for whether the candidate should/could continue, it might be here that the question of the 'good enough PhD' is raised. This is particularly the case with good 'journeyman' work where the PhD is solid but not earth shatteringly new or conceptualised. Many examiners of doctoral dissertations report that a substantial number of dissertations they receive could be classified as 'passable' in that they are 'good enough' without being exciting, ground breaking, and 'short, simple, elegant, surprising, beautiful, and out of the ordinary' (Lovitts, 2007, p. 203).

Hence, we are at pains to make it clear that we are aware that we are not dealing here with a cohort of learners who are starting from the same learning point and moving through a staged development. Rather we are considering learners who come with diverse experiences, capabilities and motivations, all within an overlay of disciplinary and inter-disciplinary variation.

"Nudging," i.e. the constructive intervention of the supervisor to aid the student's conceptualised work, takes place through staged interventions during the development of the supervisory relationship. The interventions are aimed at working with candidates in terms of their own development of the research and the writing and preparation of the dissertation. These interventions occur at many stages of candidature, with some of the more specific and critical being:

> The development of research questions.

> The movement from other-directed reading to self-directed and 'owned' reading of the literature leading to the development of a sound literary review.
>
> Working with data at different conceptual levels, analysing, interpreting and defining findings which make a contribution to understanding as well as factual knowledge.
>
> Developing an argument or thesis which can be sustained and supported.
>
> Producing the abstract and the conceptual conclusions.

All of the above are seen as key moments for making "learning leaps" and articulating at a conceptual level and we address each one in more detail below. However, as one very experienced supervisor suggested, these breakthroughs might not always be evident in the outcome:

> In terms of conceptual breakthroughs, the students I've supervised I think would have made conceptual breakthroughs that wouldn't be evident necessarily to an independent examiner. But as a supervisor you see it all the time. They're making a series of conceptual breakthroughs themselves as a learner. Whether they're a contribution to the field in the end or whether other people are able to see what's been accomplished hopefully yes, but not always. Sometimes I think people in the end produce a more modest piece of work. (SS18)

The Development of Research Questions

A commonly reported 'identification' of having crossed a threshold was when a candidate was able to define a research question from a broad topic, and then ask questions of the field, their data and themselves.

Supervisors comment on the quality and cognitive level of the students' discussion with them as providing evidence of not just ownership of, and contribution to the field but a deep level of understanding and engagement with the discipline and the doctoral level of work:

> One of the things that you get an idea that the students have actually crossed that threshold is when they start to ask you higher level questions. And all of a sudden they are not asking any more if this is red or if this is blue but all of a sudden their level of questioning is on a whole different plane and its very exciting. (Hum02)

A Social Sciences supervisor talked about the mature-age candidates with whom she mainly works. She suggested that they have had many years of professional practice and generally find it difficult to ask questions of the literature and work at a theoretical or conceptual level as they are keen to find an answer to a specific practice question, which they come with when starting the research process. She then

went on to talk about one student who had just started and who was different from the other mature-age, practice-oriented candidates she had supervised:

> One extreme example then in terms of conceptual breakthroughs, this is in just the last week. I had another student who even though he's a very experienced educator and worked for many years in three different school sectors and now working in policy, but he's a theory junky. I'm never going to stop this guy he's never going to get down to the project. The other co-supervisor was away so I put a bit of pressure to see what happened if we push it a little bit to try and get to the proposal. Here we have a colloquium process that they need to do within the first twelve months. (SS18)

The supervisor decided to use the proposal colloquium as an opportunity for the candidate to engage with 'a few very well read people who were also of a theoretical bent to really push him a little bit' (SS18).

Similarly, in Engineering.

> I can't say...that there is a specific time when it happens, I believe in my case it happens gradually over a period. Of course there are those students who quickly grasp what is required of them and get on with their thesis. There are some however, I have one who is taking time to bring it together and it is a gradual thing over time, one thing will happen, the methodology that they will use as an engagement, a discussion.
>
> Interviewer: A dialogue
>
> Very much of that and I would ask engaging questions to try to remove from them, establish, determine in my own mind whether they know what is taking place.
>
> As a supervisor I would see, what I would do I make suggestions to them often I would give them an example of a system that would do something similar, for them to start them off, rather than them searching the literature, I would give them a sample of something and encourage them to come back and let us discuss these techniques and eventually I expect them to come up with what I call a conceptual solution to the problem which is just what you have to do to get the data across...So I don't think it happens in a discrete manner, it's more gradual, at least in my experience. (Eng04)

The Movement from Other-Directed Reading to Self-Directed and "Owned" Reading

Supervisors report that they are aware of research candidates working in a different way when the candidate sees her/himself as part of the research environment:

> Undergraduate students talk about 'they' as the researchers but a research candidate identifies a relationship between their own work and the ideas of others and how these ideas advance theory. They are looking to be specific about the authoring of the literature and then advancing the development of research. (Sci10)

Similarly in the Humanities:

> Some of them really struggle to understand how to make choices in the literature review. How to produce a literature review which isn't almost a general history of the discipline but is actually focussed down to their particular part of the research. I think that for some students they really struggle with that and they can never figure out why that particular piece of literature is relevant and why it is important and how to summarise it so that people can understand why it links to what they're doing. (Hum07)

Another supervisor (Sci12) is aware of the student's ownership of and contribution to the field when they:

> Have finally understood where their work fits into the context of the entire field so that they know where they sit and they know...They know what forces can reinforce, or shift, or move their thesis basically so when they can identify other people's work.
>
> They know what they are looking for and they know what is relevant. Before that you have to keep saying you should look at this piece, have a look at this, have a look at this, see if you find anything on that. There comes a time when they are coming to you and telling you this is really important.

A Humanities supervisor reported that to help candidates to "own" the literature and place themselves with it 'I've tried a range of strategies: brainstorming with the student around a particular issue to get ideas going and build confidence, focussing particularly on what the student knows rather than what critics have said.' (Hum05)

Working with Data at Different Conceptual Levels: Interpreting Findings and Presenting Arguments

This stage is where students are analysing, interpreting and defining findings which make a contribution to understanding as well as to factual knowledge. They then can contribute to understanding and conceptual levels of debate in their presentation of the dissertation or a *viva*.

The following extract is taken from an online supervisory discussion about recognising conceptual threshold crossing and considering ways of enabling candidates in their crossing.

> Message no. 65: [Branch from no. 40] posted by (hedgehog2) [candidate] on Wed Feb 19, 2003 09: 57
>
> "Framework'", "architecture", "underpinning", "scaffolding"—the discussion has focused on building metaphors which seem OK for hard scientific/ engineering models of research but are hardly appropriate for softer approaches. I'd want to encourage students to look at different and more flexible ways of characterizing their research. For example, a stance or perspective I favour may be termed pragmatic or pragmatist which admits that the concepts or

> principles we use are far from exact and indeed may be termed fuzzy. Concepts like freedom, democracy, equality, growth, variety—all key terms in the pragmatist's lexicon—are fuzzy and essentially contested but should we run a mile from them if they are relevant to what we are studying? The scientist's answer is of course to define them so narrowly that they can be chopped up and measured thereby turning them into some sort of impoverished version of the messy original. I think we inhabit a fuzzy old world and we do it and ourselves a disservice by pretending otherwise. I don't think we are in the building trade.
>
> Response: Message no. 66: posted by Supervisor Team on Fri Feb 20, 2003 14: 45
>
> Yes indeed—many of us prefer more organic metaphors and language. X talks of completing the thesis like threading beads, and I use metaphors of weaving indicating the setting up of theories and theories/theorists and how these threads interweave throughout the whole until they are apparent in the finished thesis and can be seen to underpin it and can be discussed in the viva.

This supervisor encourages novice researchers to work with the meaning of those words, not just adopting popular technical terms, but instead using them as terms which are questioned, understood and put to work in the research and the dissertation.

Some of the early work of nudging takes place in the problematising of terms and the development of meaning, so that candidates can take ownership of the discourse and ideas which they then articulate in their research.

> I think conceptual insights also come through sitting down and having free serious discussions with them…So what do you think about it?...What do you mean by this?
>
> I'll give you one example…what I do is I take them etymologically through their title as a conceptual entity. I always say it's going to change, at the change…and you are getting closer and closer to what you are dealing with, the title of your thesis. (SS22)

Another supervisor comments on a constructive dialogue involving the appropriate use of the subject and doctoral level discourse:

> Usually their first drafts are hardly ever very good. They just don't know where to start. But you can help them a lot by a couple of helpful things like what does this concept mean? And they will often write to the wrong audience…If they start using very technical terms, like "hybridity", they will lose people that read it, so you have to help them with that. (SS25)
>
> In terms of "helping students through conceptual thresholds". In my experience the student has identified a blockage, the nature of the blockage has been discovered through supervisory dialogue and the conceptual threshold has been

> crossed when a deeper and usually more conceptual understanding has been reached. These have been moments of "insight" and connected to being able to identify the particular threshold concept that has enabled the making of new connections from what was previously a "collection" thus removing the "blockage". (Hum09)

And another supervisor…

> In discussion with students about their theses there's moments which I can visualise a kind of matrix of interlocking ideas and images which represent the unique contribution of their work and the step up they're making. This emerges out of a grey, blank, left space – and then if I can articulate it, they have to work to understand those nudges through questioning e.g. Can you see it? What does it mean? How do these things connect to you?
>
> When you realise it, you can steer the discussion to enable the student to clarify, arrange, challenge, destruct and reconstruct and create a way to move forward as mini thresholds. (Hum10)

These supervisors suggest that is it necessary to recognise blockages in their own learning, as well as that of the student in order to 'nudge' candidates into more conceptual work in ways which are acceptable to, and can be owned and actioned by, the student.

Writing is an important step – and the learning of both supervisor and student need to be matched, as one of the authors has suggested is necessary in a good supervisory dialogue (Wisker, 2005). Hence:

> When they are writing that's when I work really hard with the students. They send me each chapter sometimes several chapters. It's me that goes through the threshold…I also run a study group which is very important for my students, about once a month, call it a thesis support group, they turns up if they can, sometimes one person is under spot light and talks about what stage they are up to, sometimes it is an open session where everyone talks, or sometimes I'll focus on a particular thing, like how to publish, when someone comes up to their oral exam, we do a practice. (SS25)

Developing a Sustained and Supported Argument or Thesis

The concept of argument is one which many supervisors mentioned was difficult for some of their research candidates to understand and develop. Some are stuck in the journeyman, busy work of data collection and even analysis, rather than the interpretation. For example:

> It doesn't matter how much fieldwork you do, it will never be a PhD. It's the next stage, taking that information and utilizing it to produce a coherent, sustained argument which makes it a PhD and that I think is where there is a problem. (Hum07)

A supervisor from Engineering agrees that candidates often find it difficult to mount an argument supported by evidence:

> With the students who seem to struggle to get 'it', often the 'it' is the notion of what a thesis is, that is, a claim and defence. It is more than just a body of work. In the experimental sciences and engineering it's a whole kind of building evidence to find out if a hypothesis will be proven or not. (Eng02)

An experienced supervisor in the Social Sciences appreciates when candidates have made the breakthrough and can tell that it happened. This is an indication of meta-learning:

> When they begin to surprise me with their discussions and their ideas. When they are discussing something and they see something that I don't expect them to have [and] during the discussion. They managed to surprise me in the arguments they are making or the direction that they are taking. Also when they begin to be the ones who retrieve relevant articles and present them to me.
>
> They know what they are looking for and they know what is relevant. Before that you had to keep saying 'You should look at this piece, have a look at this, have a look at this, see if you find anything on that'. There comes a time when they are coming to you and telling you 'This is really important'. (SS23)

Assisting candidates to develop a position and argument has clearly been an issue for many supervisors, including those who are now successfully at the professorial level: 'My supervisor said to me, and I say to my students, "The day that you come into my office and sustain an argument with me about your research is the day I know you are close to submitting"' (Pers. Com. Professor T. Smith, The Australian National University, July 2008). This comment was made to a group of new doctoral candidates by a supervisor in Finance who has supervised, to completion, over 40 doctoral candidates.

Challenging candidates to be able to argue their position might not actually assist the candidate in being able to understand the concept of argument and the skill of being able to develop and sustain one. One supervisor suggested that she has found it helpful:

> Playing 'Devil's Advocate'. It's delicate because picking holes in their work can hurt confidence, so instead I take the perspective that we need to think of opposing arguments for the purpose of handling them (as opposed to suggesting that their arguments might mean that the student's thesis is not supportable, although conceivably it could come to that)' (Hum03)
>
> I think the skill of helping somebody through this thought process in terms of research came from my own PhD. I mean, it has to, because I think that I had such a struggle and because I had such a struggle, I knew where I was coming up against brick walls and where I could have done with understanding the process better as I went along. And so I think that it was out of my own sort

> of conflicts that, that I recognised those in other people's. It is being able to see that problem and then just sort of say, 'Well, what do you think?' You know, 'which way do you think that you are going to go? (SS26)

These comments indicate a sense that the blockage and the gradual development in learning are perceived as troublesome in the first instance. For several supervisors in the study to date, students have been seen to indicate their threshold crossing achievement in writing the conclusions only when students stand back, view the whole, define what they have understood and contributed to meaning, and then return to their writing and make it explicit, articulate it:

> It is always very nice when it happens...when I think it happens a lot is when there is a bit of a break in conclusion, when a conclusion is written, a conclusion is a summary of factors that occurred and you conclude...without understanding that your conclusion actually draws out and creates that pivotal point around which your thesis really contributes scholarship and knowledge. If you can get them to put down the thesis for a month, literally put it down, don't even look at it and then go back, and start as if they were somebody reading it afresh, as they go through read every chapter, think about the insides...and start listing, making the links. (SS22)

Here the supervisor is nudging the student to look for the insights rather than merely to rewrite. She is inviting the candidate to step back from the text itself to see what it means, what the overall structure and emerging meanings are, and how the ideas work at a conceptual level throughout.

SUMMARY

Research conducted so far with experienced supervisors across a range of subject areas and from different countries throughout the world suggests that they are aware both of the kind and quality of student work when they have crossed conceptual thresholds and achieved conceptualized levels of learning and articulation at a doctorate level. Such work appears when these novice researchers:

> Develop a research question from a topic ensuring a feasible and conceptual-level question.
>
> Develop an appropriate design and research processes for their work.
>
> Focus on conceptual framework, methodology and methods
>
> Enter the dialogue with experts in terms of their selection and engagement with their reading in the literature review/theoretical perspectives chapter and then throughout the thesis.
>
> Put forward an argument supported by evidence.
>
> Produce an abstract and a conclusions chapter which deal with concepts, not merely facts.

The responses also indicate that supervisors are equally aware of ways in which specific elements in their supervision practices with students can lead to developments in the level of the students' work which we define as conceptual threshold crossing. Supervisors comment on moments of what can be called "nudging" of students' work towards the achievement of a high conceptual level including the following activities:

Encouraging engagement with the research question.

Offering and prompting opportunities for engagement with the literature in relation to themes, issues and then in a dialogue with the candidate's own work.

Oral prompting of conceptual work in groups, supervisory meetings, and individually.

Encouraging conceptual and critical work with prompt feedback.

Pointing out contradictions and tensions.

Encouraging careful data analysis, developing themes, engaging with theories.

Encouraging early writing and much editing-sharing and reflection.

Using the language of 'doctorateness' e.g. conceptual framework, and the ideas, the research and theories of learning e.g. meta-cognition.

Offering opportunities to articulate ideas and achievements in mock vivas and other oral presentations.

DISCUSSION AND CONCLUSION

Theories of threshold concepts and conceptual threshold crossing indicate that students who have crossed conceptual thresholds can be seen to have developed in the ways in which they see themselves (ontology) and the world, and the ways they perceive, construct and express knowledge and meaning (epistemology). This early research with supervisors from a range of discipline areas and a number of different countries indicates both that they are aware of such changes in the conceptual levels of operation of research students and that they are equally aware of some of the ways in which their interventions with students can nudge, support and contribute to the candidate working at more conceptualised, critical and creative levels. Students are perceived to be changing their ways of working, their contribution to meaning, and also changing in terms of behaviour, particularly their ways of going about their learning. Identity is then an important factor noted by supervisors in terms of the changing ways students engage with, conduct and articulate their research.

We argue that when a candidate's behaviour changes it suggests that they have crossed a particular conceptual threshold and that this indicates a shift, a change, in the learner's appreciation and understanding of her/himself as well as what has been learned. These shifts or learning leaps might well be perceived by the student and or supervisor as troublesome, challenging, certainly in the first instance, but generally leading to new insights and levels of work.

Two of the four aims of our current research have produced compelling results which is hoped to encourage support for the work of research supervisors in their supportive engagement with student work at conceptual, critical and creative levels, such as are appropriate for a doctorate.

REFERENCES

Bourke, S., Hattie, J., & Anderson, L. (2004). Predicting examiner recommendations on PhD theses. *International Journal of Educational Research, 27*(4), 178–194.

Cook-Sather, A. (2006). Newly betwixt and between: Revising liminality in the context of a teacher preparation program. *Anthropology and Education Quarterly, 37*(2), 110–127.

Deegan, M. J., & Hill, M. (1991). Doctoral dissertations as liminal journeys of the self: Betwixt and between in graduate sociology programs. *Teaching Sociology, 19*, 322–332.

Flavell, J. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34*(10), 906–911.

Hartley, P., & Wisker, G. (2004, December 14–16). *Using the Interviewer software to simulate the postgraduate viva.* Paper presented at the 'Whose Higher Education? Public and Private Values and the Knowledge Economy' University of Bristol.

Holbrook, A., Bourke, S., Farley, P., & Carmichael, K. (2001, February). *Analysing PhD examination reports and the links between PhD candidate history and examination outcomes: Methodology.* Paper presented at the HERDSA Conference, Newcastle.

Isaac, P., Quinlan, S., & Walker, M. (1992). Faculty perceptions of the doctoral dissertation. *Journal of Higher Education, 63*(3), 241–268.

Johnston, S. (1997). Examining the examiners: An analysis of examiners' reports on doctoral theses. *Studies in Higher Education, 22*(3), 333–346.

Kiley, M., & Mullins, G. (2001). *Supervisors' and students' conceptions of research: A comparison.* Paper presented at the Paper presented at 'Bridging instruction to learning' 9th European conference of the European Association for Research on Learning and Instruction, Fribourg, Switzerland.

Kiley, M., & Mullins, G. (2002). Supervisors' and students' conceptions of research. In M. Kiley & G. Mullins (Eds.), *Quality in postgraduate research: Integrating perspectives* (p. 178). Adelaide, Australia: CELTS, University of Canberra.

Kiley, M., & Mullins, G. (2003, August 26–30). *Why conceptions of research might be significant in postgraduate education.* Paper presented at the Paper presented at the 10th European Association of Research in Learning and Instruction, 'Improving learning: Fostering the will to learn', Padova, Italy.

Kiley, M., & Mullins, G. (2004). Examining the examiners: How inexperienced examiners approach the assessment of research theses. *International Journal of Educational Research, 41*(2), 121–135.

Kiley, M., & Mullins, G. (2005). Supervisors' conceptions of research: What are they? *Scandinavian Journal of Educational Research, 49*(3), 245–262.

Kiley, M., & Mullins, G. (2006). Opening the black box: How examiners assess your thesis. In C. Denholm & T. Evans (Eds.), *Doctorates downunder: Keys to successful doctoral study in Australia and New Zealand* (pp. 200–207). Melbourne: ACER.

Kiley, M., & Wisker, G. (2008, June). *"Now you see it, now you don't": Identifying and supporting the achievement of doctoral work which embraces threshold concepts and crosses conceptual thresholds.* Paper presented at the Threshold concepts: From theory to practice, Queen's University, Kingston Ontario Canada.

Lovitts, B. (2007). *Making the implicit explicit: Creating performance expectations for the dissertation.* Sterling, VA: Stylus.

Meyer, J., & Boulton-Lewis, G. (1997). Variation in students' conceptions of learning: An exploration of cultural and discipline effects. *Research and Development in Higher Education, 20*, 481–487.

Meyer, J., & Land, R. (Eds.). (2006). *Overcoming barriers to student understanding: Threshold concepts and troublesome knowledge.* Abingdon: Routledge.

Meyer, J., Shanahan, M., & Laugksch, R. (2001, Aug 28–Sept 1). *A quantitative analysis of students' conceptions of 'research'*. Paper presented at the Paper presented at 'Bridging instruction to learning' 9th conference of the European Association for Research on Learning and Instruction, Fribourg, Switzerland.

Mullins, G., & Kiley, M. (2002). 'It's a PhD, not a Nobel Prize': How experienced examiners assess research theses. *Studies in Higher Education, 27*(4), 369–386.

Tinkler, P., & Jackson, C. (2004). *The Doctoral Examination Process: A handbook for students, examiners and supervisors*. Buckingham: SRHE and Open University Press.

Trafford, V. (2003). Questions in doctoral vivas: Views from the inside. *Quality Assurance in Education, 11*(2), 114–122.

Turner, V. (1979). Betwixt and between: The liminal period in rites de passage. In W. Less & E. Vogt (Eds.), *Reader in comparative religion*. New York: Harper and Row.

Winter, R., Griffiths, M., & Green, K. (2000). The 'academic' qualities of practice: What are the criteria for a practice-based PhD? *Studies in Higher Education, 25*(1), 25–37.

Wisker, G. (2005). *The good supervisor: Supervising postgraduate and undergraduate research for doctoral theses and dissertations*. Basingstoke: Palgrave Macmillan.

Wisker, G., Kiley, M., & Aiston, S. (2006). Making the learning leap: Research students crossing conceptual thresholds. In M. Kiley & G. Mullins (Eds.), *Quality in postgraduate research: Knowledge creation in testing times* (pp. 195–201). Canberra, ACT: CEDAM, The Australian National University.

Wisker, G., Robinson, G., & Kiley, M. (2008). Crossing liminal spaces: Encouraging postgraduate students to cross conceptual thresholds and achieve threshold concepts in their research. In M. Kiley & G. Mullins (Eds.), *Quality in postgraduate research: Research education in the new global environment – Part 2: Conference Proceedings*. Canberra, ACT: CEDAM, ANU.

Wisker, G., Robinson, G., Trafford, V., Lilly, J., & Warnes, M. (2004). *Achieving a Doctorate: Meta-learning and research development programmes supporting success for international distance students*. Paper presented at the Quality in Postgraduate Research: Re-imaging research education, Adelaide, Australia.

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