What to do with a Threshold Concept: A case study

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Stemming from a strategically funded project 'Enabling visible and effective learning in engineering' at The University of Queensland, this is an account of how 'critical flow' was identified as a threshold concept in a third-year civil engineering course on 'open channel hydraulics', and how a consideration of responses to associated variation in student learning and metalearning led to the development of new forms of sustainable pedagogy. The methodology employed is transferable to other contexts, while the pedagogy targeting 'structural complexity' in student understanding is adaptable as appropriate to other threshold concepts.

A starting position acknowledged the status of a threshold concept being of limited use in the absence of responsive pedagogy, and that such pedagogy in relation to that concept must proceed from knowledge of how students vary in their learning of it (Meyer, 2010). Thus emphasised, 'variation in student learning' is important for three reasons: First, conceptually discrete patterns of learning within such variation establish a basis for pedagogical responses including mechanisms for increasing students' metalearning capacity in relation to that concept (Meyer, et al 2009). Second, these patterns partially explain why a particular threshold concept will be apprehended and experienced by students in varying degrees attributable to individual differences. And in doing so a basic premise is reinforced: the epistemological, epistemic, discursive, and ontological shifts associated with threshold concepts constitute dimensions of inter-individual variation, not conformity. Third, when exhibited in a professional development context (informally and collegially so in the present case) such variation is catalytic; it serves as a threshold concept in its own right in reconceptualising teaching practice (Meyer, 2012).

The threshold status of 'critical flow' emerged from a triangulation of three sources of evidence: (a) expert conceptual analysis, (b) students' experiences and, (c) statistical analyses of students' answers to past examination questions (Knight, et al 2013a). Also empirically determined, in accordance with theoretical expectations, was clear evidence of variation in students' learning of, and capacity for metalearning engagement with, this concept (Meyer et al, 2012). In particular, patterns of variation exhibited in factor structures clearly contrasted deep-level integrative, versus pathological, forms of contextualised learning – the former and latter being respectively theoretically associated with high and low quality learning outcomes. 'Quality' in students' understanding (in answers to examination questions involving 'critical flow') was interpreted here as variation in 'structural complexity' after the work of Biggs and Collis (1982). With a precursor of metalearning activity focussed on 'critical flow', associated follow up pedagogy of the concept centred on activity to directly alter students' learning behaviour by altering assessment practices and students' perceptions of task demands. 'Metacognitive assessment activities' based on 'critical flow' have accordingly been developed and trialled (Meyer, et al under review) with outcomes consistent with theoretical expectations as evidenced in demonstrably improved student engagement, satisfaction, and performance (Knight et al, 2013b). Work in progress (for Conference reporting) refines and extends these pedagogic activities.

References

Biggs, J.B. and Collis, K.F. (1982). Evaluating the quality of learning: The SOLO taxonomy. New York: Academic press

Knight, D.B., Callaghan, D.C., Baldock, T. & Meyer, J.H.F. (2013a). Identifying threshold concepts: Case study of an open catchment hydraulics course. *European Journal of Engineering Education*. http://dx.doi.org/10.1080/03043797.2013.833175

Knight, D.B., Meyer, J.H.F., Baldock, T.E., Callaghan, D.P. & McCreddon, J. (2013b). Embedding metacognitive exercises in the curriculum to boost students' conceptual understanding. AAEE Conference proc., Gold Coast, Australia, Dec 8–11. (URL for online access is forthcoming.)

Meyer, J.H.F. (2010). Helping our students: Learning, metalearning, and threshold concepts. In Christensen Hughes, J. & Mighty, J. (Eds.). *Taking Stock: Research on Teaching and Learning in Higher Education*. Montreal and Kingston: McGill-Queen's University Press, 191–213.

Meyer, J.H.F. (2012). 'Variation in student learning' as a threshold concept. *The Journal of Faculty Development*, 26(3) 8–13.

Meyer, J., Knight, D., Baldock, T., Kizil, M., O'Moore, L. & Callaghan, D. (2012). Scoping metalearning opportunity in the first three years of engineering. AAEE Conference proc., Melbourne, Australia. http://www.aaee.com.au/conferences/2012/documents/abstracts/aaee2012-submission-17.pdf

Meyer, J.H.F., Knight, D.B., Callaghan, D.P., and Baldock, T.B. (Under review). An empirical exploration of metacognitive assessment activities in engineering. *European Journal of Engineering Education.*

Meyer, J.H.F., Ward, S.C. & Latreille, P. (2009). Threshold concepts and metalearning capacity. *International Review of Economics Education*, 8 (1) 132–154. http://www.economicsnetwork.ac.uk/iree/v8n1/meyer.pdf