Using a threshold concepts framework to develop a community of practice and effect curriculum change in undergraduate biology programs

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Threshold concepts are by definition transformative and integrative, providing a novel tool for effecting curriculum change (Entwistle 2005) by engaging teachers in discussions about their understanding of their discipline and how it is taught (Meyer and Land 2005). Previous studies have documented individual, program and institutional efforts to improve curriculum, usually with positive, if relatively small scale, outcomes (Zolan et al 2004, Tanner and Allen 2005, DiCarlo 2006). A current ALTC project on Threshold Concepts in Biology is developing a model of teaching and student learning which could stimulate curriculum change. We have designed our approach to explore Meyer and Land's (2005) ideas on troublesome knowledge and concepts, and liminal spaces, and to conduct quantitative and qualitative studies of student understanding of key biological concepts. These then inform discussions, and qualitative data collection, with biology teachers in ongoing national workshops (http://bugs.bio.usyd.edu.au/thresholds_in_biology/Index.html).

We acknowledge the importance of a strong theoretical and empirical base for discussions on curriculum and teaching approaches (Perkins 2007, McCune and Hounsell 2005) and focussed on the relevance of threshold concepts to biology teaching .(Martin and Leuckenhausen 2005). Our matrix of integrated concepts in biology (Ross et al 2010) and interviews with practising teachers (Taylor 2006) creates a basis for a dialogue with teachers, and development of a community who can effect change. Initial workshops with teachers used threshold concepts to 'break the ice', allowing further discussion of students' learning incorporating work on misconceptions, and our own experiences of teaching enquiry (Ross and Tronson 2004).

Using a cycle of discussion and empirical data collection, we designed teaching interventions and investigations of student conceptual understanding based on our thresholds matrix and teacher feedback. Results from these investigations were then used in further iterations of our biology community workshops to provide evidence of the success, or failure, of our model (Taylor and Meyer 2010; Lutze-Mann et al 2009). We also disseminated information and evidence of teaching successes through the development of a series of narratives and case studies provided by our workshop community.

The transformative nature of our thresholds model is evident at many levels:

- as individual teachers we engaged in improvements to our own practice and curriculum to test the thresholds matrix;
- as a project team we adapted protocols for measuring student learning (Lawson et al. 2000), designed teaching interventions to use in a broad range of courses, and used the resulting data to provide evidence for effecting curriculum change (Lutze-Mann et al. 2009);
- using our workshop series we have documented a wide diversity of curriculum activities, such as extending our original matrix to include new threshold concepts, applying teaching approaches to different areas of our very broad discipline, and developing teaching approaches with colleagues from other disciplines.

These initiatives will be sustained through online forums at the national and international level, thus extending applications of student learning and teaching approaches in biology.

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