REFERENCE No. RES-139-25-0361

# ACTIVITIES AND ACHIEVEMENTS QUESTIONNAIRE

## 1. Non-Technical Summary

A 1000 word (maximum) summary of the main research results, in non-technical language, should be provided below. The summary might be used by ESRC to publicise the research. It should cover the aims and objectives of the project, main research results and significant academic achievements, dissemination activities and potential or actual impacts on policy and practice.

'Threshold Concepts' is one of the key ideas which had been found to be useful in analysing 'what works' in undergraduate teaching and learning environments. They are described as being transformative, probably irreversible, integrative, 'bounded' or domain specific, and sometimes problematic; they 'open up' areas of domain knowledge and link areas of disciplines. From the learners' perspective they help them make sense and 'constructively align' prior knowledge, curriculum content, course elements and assessment activities. Given the concern about the validity of claims that constructivist/situated learning models could be supported by technology, threshold concepts (with their associated demand for conceptual change and revisiting of prior understanding) appear to present a challenge for technology enhanced learning.

The main aims of the project were the establishment of an interdisciplinary network (including representatives from education, computer science, psychology and a range of subject domains) to explore perspectives on the teaching and learning of threshold concepts across a number of disciplines; and the exploration of opportunities offered by a range of technologies (including, but not limited to, the adaptive intelligent tutoring systems being researched and developed at the University of Cambridge Computer Laboratory) to support the teaching and learning of threshold concepts across a range of disciplines.

The project conducted a literature review of areas related and relevant to threshold concepts; given the emergent nature of the research area and the resulting small literature set, this extended into more general studies of conceptual development and teaching and learning environments and practices, and its scope also extended beyond higher education into school, workplace and professional learning and informal learning.

Two seminar series were organised: one focusing on the identification of threshold concepts across a range of disciplines and the other introducing interdisciplinary perspectives on 'the concept of threshold concepts'. A further seminar explored postgraduate perspectives on the ideas of threshold concepts and troublesome knowledge. Participants in the first seminar series developed case studies of potential threshold concepts; these involved staff and student interviews, documentary analysis, focus groups and practical activities. Participants conceptualised their involvement in different ways; while for some it provided a means of initiating changes in practice at faculty, department or course level, others couched their involvement in terms of their own professional development or intellectual curiosity. The most important outcome of this process was a recognition that research approaches and methods emerge as part of the conceptualisation of the problem and through discourse around these points of focus -in this case, the specific threshold concepts and the idea of threshold concepts in general.

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While the project was not primarily concerned with developing new technologies (but rather with scoping existing technological frameworks and developing specifications), the close links between the University of Cambridge Computer Laboratory and CARET allowed the development of a pilot project based on the existing IVC adaptive tutoring system originally used to support the learning of the Verilog language. A series of interfaces were built to allow students to engage with a specially constructed knowledge-base representing an area of Plant Science which was regarded as complex and potential 'troublesome' to many learners and this was evaluated by a group of undergraduate science students.

The project's use of a Virtual Research Environment has not only supported the project itself, but has served as a useful model for other projects within the University and more widely. The tools developed by the project, including the research toolkits and the literature review have been disseminated and shared with other projects who have begun to implement them as part of their own practice.

The project has also produced a number of substantive outputs including conference papers presented at the TLRP and BERA conferences, the literature review and a chapter in a book on innovation in higher education. Strategic collaborations established during the course of the project led to the submission of a proposal for funding of a large project to the second round of the ESRC/EPSRC Technology Enhanced Learning Programme.

The project has highlighted the importance of discursive practices amongst both teachers and learners both in understanding the nature and role of threshold concepts and troublesome knowledge in their disciplines and in interdisciplinary activities. This points to the importance of technology enhanced learning tools and environments that engage teachers and learners in enquiry and reflection as an essential element of practice – both disciplinary and pedagogical.