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Making the development of critical thinking visible in undergraduate research experiences

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What is Higher Education for in the 21st century? What do we hope that students will learn through their university experiences, and how do we make their learning visible (and hence assessable)? These questions are at the heart of current debates about the role of universities and university education, and attempts to answer them form the rationale for the continued existence of the higher education sector in its current form. While different stakeholders – academics, employers, government and students themselves – may put forward a range of answers, perhaps most agree that the acquisition of specialist content knowledge or disciplinary expertise that dominated conceptions of university education over the past half century is no longer sufficient to justify its special status. Particularly in the sciences, an exponential expansion of the knowledge base has meant that no degree program can be expected to provide students with a complete, detailed picture of their discipline. At the same time, the development of the world wide web has led to a "democratization" of facts, with a multitude of sites offering open access to information, opinion and opportunities to debate that would once have been the domain of the specialist few.

In response to this situation, universities are increasingly positioning themselves as providing students with opportunities to develop the generic skills and attributes that will help them cope with a future of flux and change, both in their disciplines and in their own careers. Employers and governments alike emphasise the need for graduates who can think critically, solve unfamiliar problems, innovate and adapt. The increasingly messy, interdisciplinary nature of the challenges faced by humanity, encapsulated in Barnett's concept of supercomplexity (Barnett 2000), provides a further rationale for a shift in emphasis from the acquisition of disciplinary knowledge and skills to the development of mechanisms for coping with and constructively responding to the new. Thus universities develop statements of graduate attributes outlining generic skills and attitudes that each graduate is expected to develop during the course of their studies, regardless of discipline (Barnett 2006; Barrie 2007). These statements frequently include attitudinal skills such as professionalism and social responsibility, relational skills such as intercultural capability and communication, and analytical skills such as critical thinking and problem solving.

The potential value of such statements depends strongly, however, on how the generic skills they contain are understood by both students and the discipline-based academics who are expected to engage in facilitating their development. It is an open question as to whether the common language adopted reflects common meaning or shared understanding across institutions or disciplines. In addition, although these skills are expected to be developed within disciplinary curricula, questions of exactly how this will happen, how they will be made visible and how they will be addressed often remain unaddressed. With the increasing use of standards frameworks by quality assurance bodies such as TEQSA in Australia and the QAA in the UK, universities' claims that such skills are guaranteed

in all graduates means that evidence of their development is essential. Such evidence requires clear identification and articulation both of different degrees of sophistication in the generic skills, and of ways of making those different degrees visible. Without this, generic graduate attributes run the risk of becoming a "top-down" imposition that merely adds to the normal disciplinary requirements for graduation. For example, academics may interpret the requirement that all students develop oral communication skills as meaning that students should at some point give conference-style presentations. Such an interpretation misses the opportunity to consider how the different elements, aspects and purposes of communication might be understood and unpacked within the discipline, and how this understanding can be made more flexibly applicable (and hence more genuinely generic).

In this paper, we focus on one particular generic skill – critical thinking – and explore ways in which it can be both developed and made visible through undergraduate research experiences and related forms of research-led education. Immersive undergraduate research experiences, in which students engage in substantial, extended research projects under the supervision of an active research academic, are often presented as places in which students may develop critical thinking, problem solving and communication skills (Hunter, Laursen and Seymour 2006; Laursen et al. 2010). In science, such projects have also been suggested to address some of the neglected strands of science education identified by the US National Academies (Alberts 2009; Duschl, Schweingruber and Shouse 2007) such as students' understanding of the nature and practice of science. However, there is little evidence to support claims that students develop higher order thinking skills in these contexts, and without such evidence it is difficult to see how they can be assessed as part of a generic skills agenda. We have therefore initiated a project aimed at making the development of critical thinking through research-focused experiences visible to both students and academics.

Our project was prompted by the results of our earlier studies of the intentions and learning outcomes identified by staff and students engaged in an elite, research-immersive degree at an Australian university (Howitt et al. 2010; Wilson et al. 2012; Wilson et al. 2012b). This degree provides a unique opportunity in which to examine the experiences and attitudes of a cohort of students undertaking multiple, sequential research projects that form substantial, assessed components of an undergraduate degree program. As an elite cohort, these students might have been expected to both achieve and recognize high level learning more easily than the average undergraduate. However, we found that even in this research-rich context, students showed only limited recognition of higher level learning outcomes. Supervising staff exhibited a similarly limited range of intended learning outcomes. Perhaps most disappointingly, neither academics nor students explicitly referenced critical thinking or transferability of learning outcomes to other contexts.

In an attempt to both further understand this somewhat worrying situation and to simultaneously embed processes for making the development of critical thinking visible, our project asks students to regularly reflect on their learning in undergraduate research experiences in response to a series of common prompt questions. These reflections, together with interviews of staff and students involved in the project, will be analysed for qualitative differences in experience and expression of critical thinking development, in an approach informed by the methods of phenomenography (Åkerlind 2005). We will look for evidence of whether critical thinking is developed both through the discipline-specific context of the project itself and at a meta-level, through the act of reflecting on

that learning. In parallel, we examine the reflections of students engaged in research-focused learning in more traditional, structured, coursework contexts.

References

Alberts, B. (2009). Redefining Science Education. *Science* 323, 437.

Åkerlind, G.S. (2005). Variation and commonality in phenomenographic research methods. *Higher Education Research and Development* 24, 321.

Barnett, R. (2000). *Realizing the University in an Age of Supercomplexity*. Buckingham: OUP

Barnett, R. (2006). Graduate Attributes in an Age of Uncertainty, in *Graduate Attributes, Learning and Employability*, ed. Paul Hager and Susan Holland. Springer

Barrie, S.C. (2007). A conceptual framework for the teaching and learning of generic graduate attributes. *Studies in Higher Education* 432, 239.

Duschl, R.A., H.A. Schweingruber and A.W. Shouse (2007). *Taking science to school : learning and teaching science in grades K-8.* Washington: National Academies Press.

Howitt, S. M., A.N. Wilson, K.F. Wilson and P. Roberts. (2010). 'Please understand we are not all brilliant:' undergraduates' experiences of an elite, research-intensive degree at a research-intensive university, *Higher Education Research and Development* 29, no. 4: 405-420.

Hunter, A.-B., S.L. Laursen, S. L. and E. Seymour. (2006). Becoming a scientist: The role of undergraduate research in students' cognitive, personal and professional development. *Science Education* 91, no. 1: 36-74.

Laursen, S.L., A-B. Hunter, E. Seymour., H. Thiry and G. Melton. (2010). *Undergraduate research in the sciences: Doing real science*. San Francisco: Jossey-Bass.

Wilson, A., S. Howitt, K. Wilson and P. Roberts. (2012a). Academics' perceptions of the purpose of undergraduate research experiences in a research-intensive degree, *Studies in Higher Education,* available via iFirst 27/05/2011

Wilson, A., S. Howitt, P. Roberts, G. Åkerlind and K. Wilson. (2012b). Connecting expectations and experiences of students in a research-immersive degree, *Studies in Higher Education,* available via iFirst 31/01/2012