

## Final submission

### **Learning about what research is and how researchers do it: supporting pursuit of and transition to postgraduate studies**

Dr Cosette Crisan and Dr Eirini Geraniou UCL Institute of Education

Adam Townsend, Department of Mathematics, UCL

Sebastian Seriani, Dept of Civil, Environmental & Geomatic Engineering, UCL

Pedro De Oliveira Filho, Department of Chemical Engineering, UCL

This article is written jointly by Cosette Crisan and Eirini Geraniou - both lecturers in mathematics education with an interest in teaching and learning at all levels of education, including higher education level and transition to postgraduate research, Adam Townsend - PhD student in Mathematics and Sebastian Seriani and Pedro De Oliveira Filho - PhD students in Engineering at UCL. This article is the result of conversations between the authors of this chapter about what ways in which to raise awareness amongst undergraduates about what research entails and what support could be put in place to facilitate the development of those skills needed by researchers in mathematics and maths related field. A brief review of research concerned with postgraduate transition that is not subject specific has been carried out in this chapter. We then suggest some strategies for engaging undergraduates, postgraduates and academics in a partnership intended to develop their subject based research and enquiry skills, grounding their understanding about what research is and what researchers do from early on in their studies.

**Abstract:** The transition from undergraduate to postgraduate study has been recognised as not a smooth process. Most undergraduates do not necessarily know or understand what is expected of them on a postgraduate course. The difference between the nature of a taught degree, and a research degree, requires significant changes on behalf of the students: independent study skills, inquiry minds, new understanding of the nature of the subject, to mention just a few.

In this chapter, the views of a number of current UCL postgraduate students who shared their experiences transitioning to research and their views of what and how their undergraduate studies have and could have supported them best in this transition are presented. These views are supported by a brief review of research concerned with postgraduate transition.

Research has suggested that postgraduate transition deserves the same attention as undergraduate transition. In a project which involved focus groups with thirty members of staff and forty-one postgraduate students and five in-depth individual interviews with postgraduate students (one PGCE, one MA, one MBA and two PhDs) at Greenwich University, Alsford and Smith (2013) found that postgraduate students want recognition that postgraduate study is different and that their transitional needs are as valid as those of undergraduates. Indeed, there is a growing body of research into master and doctoral students' experiences and their transition journey which acknowledges the needs of these students in transition. Preparedness for postgraduate life and study, communication and socialisation skills, staff and student training have recently started being acknowledged by research and the recommendations about policy and practice have started being addressed by some institutions (Alsford & Smith, 2013).

Researchers have suggested that a lack of focus on the transition needs of the postgraduate students reflected an assumption that students are somehow already prepared for postgraduate study since 'postgraduate-level study is simply "more of the same", "taken to the next level" (O'Donnell et al, 2009, p. 27) or that they are already experts in the realm of higher education and learning, hence not even acknowledging the moving on to the next level of studying as being a transition issue (Tobell et al, 2010). Indeed, it was only when working on his master project that Adam, one of the PhD students contributing to this chapter, formed a clearer idea about what his PhD research was going to be like. Many students who decide not to complete a master degree, would graduate with no insight or experience about the

research process, thus unprepared for the workplace which requires them to confidently tackle and solve problems.

Through interviews and focus groups, Symons (2001) found that students had a desire for more information about the course they were going to be studying and wanted to know what would be expected of them in terms of academic requirement (Symons, 2011). The difference between the nature of a taught undergraduate degree, and a research degree, requires significant changes on behalf of the students in terms of how they deal with the subject. At undergraduate level, one accumulates a solid foundation of discrete knowledge mainly through understanding and reproduction of lecture notes. Adam recalls his undergraduate years when he was given a problem to work on, which most of the time was already broken down in 'bits and pieces' for him. Understanding the statement of a theorem, being able to reproduce its proof and applying it were skills and knowledge Adam developed through regularly assigned homework which tended to focus on the techniques and applications of maths results introduced in the lectures. These skills were invaluable for Adam in carrying out his PhD research. However, Adam came to realise that he was missing the big picture, of how the different maths topics he studied related to each other and fitted together in the maths landscape that he is now aware of, through much of his own, individual and lengthy pursuit. In his view, undergraduates would benefit from gaining an insight into, seeing maths as a unified field of interconnected pieces of knowledge rather than as a field made up of a disjoint areas of maths.

Both Sebastian and Pedro, PhD students in Engineering reflect on their undergraduate experience and how it contributed to and supported their Engineers by formation. Pedro works with optimisation under uncertainty, which has applications in many fields, for example, modelling and design of processes. He believes that the knowledge and skills he developed through studying pure mathematics for his first two years of his engineering degree developed his enquiry mind, paying attention to details and asking lots of 'what if' questions. These skills and knowledge empowered him not only to understand the 'theory behind the models out there' but also 'to go inside' those models and adapt them for the problem at hand. In his view, the current engineering undergraduates would benefit from being made aware that understanding the principles behind how models work enables them to modify, adapt and customise the models 'to work for them'.

Sebastian thinks that undergraduates learning could be made more exciting. In his opinion, undergraduate engineers find it difficult to engage with the mathematics. They find it 'dry' and as a result they are not really motivated to know more than the final equation that is needed for the application of a model. For this reason, Sebastian suggests that undergraduates could be shown what research entails: engaging creatively with the 'dry maths' to create and improve the models.

In this chapter we propose that engaging students in research and inquiry could and should be supported from early on in the undergraduate studies. In the HEA report, Healy and Jenkins (2009) argue that all undergraduates students in all higher education institutions should come as close as possible to the experience of academic staff carrying out their disciplinary research. Indeed, Connected Curriculum promoted at UCL aims to ensure that all students are able to learn through participating in research and enquiry at all levels of their programme of study. Moreover, Hathaway et al (2002) found that those undergraduates involved in research were more likely to pursue graduate education and postgraduate research activity than students who did not participate in undergraduate research.

Through exposure to disciplinary research all students will benefit from asking the right questions in the right way, conducting experiments, collating and evaluating information. In the UK, most undergraduate students experience research as part of their final year dissertation. For their dissertation, students choose a topic of interest to them, and such interest is mainly shared with the supervisor and the second marker, with no further dissemination of the outcomes of their work. Adam recounted his almost struggle at the beginning of his postgraduate degree with reading maths papers. These papers tend to be quite technical and difficult to understand. But once understanding was achieved, Adam found that he needed to develop a habit of sitting back trying to see the bigger picture, raising above the maths propositions, lemmas, theorems, etc and understanding where the idea fits in the maths landscape. Adam's view is that this skill should and could be learned early on, at undergraduate level, through collaboration with peers and researchers.

Although academic mathematicians are well aware of the role of intuition in mathematics (Burton, 2004), they may not address it explicitly in their teaching beyond linking it with problem solving. Just as Burton (1999) pleaded with anyone who has responsibility for the learning of mathematics, to model their own intuitive processes, to create the conditions in which learners are encouraged to value and explore their own and colleagues' intuitions, Adam too thinks that, "this intuition needs to be explicitly taught" and he tries developing this intuition in the tutorials he teaches to undergraduates as this intuitions could then be used and developed further in acquiring new knowledge.

We thus propose a collaboration between staff and students at undergraduate and postgraduate level aimed at raising awareness amongst undergraduates about what research is and what researchers do. The undergraduates could be brought into the world of research by enabling them to learn in ways that parallel and reflect the ways academic staff and postgraduates themselves research and learn their discipline.

## References

Alsford, S. and Smith, K. 2013. 'Transition into Postgraduate Study. Case Study 23 in Learning from International Practice – Taught Postgraduate Student Experience.' SHEEC Enhancement Themes. <http://www.enhancementthemes.ac.uk/sheec/learning-from-international-practice/taught-postgraduate-student-experience>.

Burton, L. 1999. Why is intuition so important to mathematicians but missing from mathematics education?. *For the Learning of mathematics*, 19(3): 27-32.

Burton, L.L., 2004. *Mathematicians as enquirers: Learning about learning mathematics* (Vol. 34). Springer Science & Business Media.

Hathaway, R. S., Nagda, B. and Gregerman, S. 2002. 'The relationship of undergraduate research participation to graduate and professional education pursuit: an empirical study.' *Journal of College Student Development* 43:614–31.

Healey, M. and Jenkins, A. 2009. 'Developing undergraduate research and inquiry'. Higher Education Academy. <https://www.heacademy.ac.uk/resource/developing-undergraduate-research-and-inquiry>

O'Donnell, V.L., Tobboll, J., Lawthom, R. and Zammit, M. 2009. 'Transition to postgraduate study: practice, participation, and the wider participation agenda.' *Active Learning in Higher Education* 10:26–40.

Tobbell, J., O'Donnell, V. and Zammit, M. 2010. 'Exploring Transition to Postgraduate study: Shifting Identities in Interaction with Communities, Practice and Participation.' *Educational Research Journal* 36:261–78.

Symons, M. 2001. 'Starting a Coursework Postgraduate Degree: The Neglected Transition.' Paper presented at the Changing Identities: Language and Academic Skills Conference. University of Wollongong, 29–30 November.