

Comparing models of first year mathematics transition and support

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Abstract

Mathematics subjects are an important part of many first year degree programs. Many students struggle with maths subjects due to inadequate background or pre-existing maths-anxiety. In response, universities offer additional support: bridging programs, maths learning centres, online resources or one-on-one tutoring. The First Year in Maths Project interviewed academics teaching and coordinating first year maths. We identified that their administrative and managerial role was significant in ensuring the needs of students were recognised and addressed. While many universities don't have a first year maths coordinator, there are many academics who become de-facto coordinators to ensure a consistent approach across first year subjects and support services. Consistency was identified as the most important factor in ensuring the needs of students are met in terms of curriculum, pedagogy, and administration of first year teaching. Case studies of good practice in diverse types of universities will be used to stimulate audience discussion.

Background

First year student cohorts are essentially diverse in background, expectations, commitment, understanding and preparation for university. The proportion of students entering university from high school with advanced or intermediate mathematics is falling (Barrington, 2006; Rubinstein, 2009). This is due to several factors: perceptions that the level of difficulty means only the most able students should attempt it, earlier negative experiences of mathematics, belief that doing less challenging subjects will maximise ATAR scores, that many schools don't offer advanced mathematics due to shortage of qualified teachers and the lack of understanding of the broad importance of mathematics in many disciplines and professions (Brown, 2009).

Another factor is the change in university entry requirements. In science, technology, engineering and mathematics (STEM) degrees there has been a trend in recent years to change entry requirements from requiring students to have studied prerequisite subjects, such as intermediate mathematics and science subjects in high school to merely recommending assumed knowledge (Poladian, 2012). Students are effectively allowed to enrol in programs without assumed knowledge and attempt to catch up during their first year. At many institutions these students may undertake bridging programs prior to starting their first year studies, or enrol in first year subjects which cover the same content knowledge as high school maths.

These are not uniquely Australian issues. In Hong Kong, Luk (2005) suggests ways of dealing with transition in teaching that address the psychological rather than logical barriers to understanding. In the USA McMaster University has a program which involves students

preparing for first year with a review study program, diagnostic testing and a redesign of the calculus first-year courses. A review of this program found that students' success in maths correlated to the cumulative time they had spent studying maths, bridging programs needed to be longer and that students needed to be more prepared to take responsibility for their own learning (Kajander and Lovric, 2005).

In the UK the gap between school and university has been considered a problem since the 1960s (Thwaites, 1972). The London Mathematical Society report 'Tackling the maths problem' (1995) found a decline in student's ability since the 1980s, particularly the high scoring students, and that students seemed less thorough and rigorous. The many changes to the structure of secondary school generally and to mathematics subjects in particular has created issues specific to the UK, but some that may apply to other countries. Hoyles, Newman and Noss (2001) suggest that the move to 'utilitarianism' has meant that maths is viewed more as an enabling discipline with a vocational purpose. This reflects the tension between the role of mathematics "as a service subject for other subjects, such as engineering and economics, and the requirements of mathematics as a discipline in its own right" (Hoyles et al., p834). This mirrors the mismatch between the expectations of vocationally focused students and some of their intrinsically discipline-focused maths lecturers.

Indeed, the approach to teaching used by academics is influenced by many factors including the size of classes, the degree of control they have over content they teach, the level and type of support they receive from superiors and the effectiveness of collaboration with other staff (Prosser and Trigwell, 1997). The academics involved in coordinating and managing large first year mathematics programs typically have an affinity for students' needs and aspirations and play an important role in facilitating successful transition of first year students to university. This is a significantly different role from the typical teaching and research academic.

Our project is investigating how to define and articulate the value of these individuals who coordinate first year mathematics units and programs, and enhance the development of leadership through building a supportive network.

Previous projects and some case studies

This First Year in Maths project is an Office of Learning and Teaching funded project which builds on the outcomes and conclusions of previous and concurrent projects. It is recognised that first year programs should be developed that are "attuned to student diversity" by accommodating the needs of all students, provide appropriate support mechanisms and that pedagogy be student focused (Kift, 2009, p.41).

In mathematics there are many efforts to understand and address the challenges of transition facing first year students (Jennings 2009; Rylands and Coady 2009) and the importance of adapting teaching methods to assist in the transition from school to university learning requirements (Adams et. al 2008; Gahan & Lawrie, 2011). Higgins, Mullamphy and Belward (2010) developed a program where a first year university calculus subject was taught in local high schools, with the ability to credit the subject as a first year subject in a degree. The program was successful in developing the mathematical skills of the students and improved relationships with schools. Jackson and Johnson (2013) developed the Maths Skills program at La Trobe, which supported basic maths skills development relevant to each science discipline in response to underprepared students entering science degrees.

Diagnostic testing for first year students has been used widely to determine the level of mathematical knowledge of first year students (Carmody, Godfrey, & Wood, 2012; Coupland, Stanley, Groen, Bush, & Beames 2013). In engineering the EngCat online self-assessment tool helps students determine their readiness for engineering (Burton et al., 2012).

We intend to build on this work by documenting the diversity in practice, highlighting the key issues and challenges, developing case studies, collecting teaching resources and showcasing good practice as a basis for professional development activities, advocacy and currency of a supportive network. The case studies will feature background on the particular first year cohort at a range of universities, the challenges faced and specific practices in student management, administration, diagnostic testing, teaching, curriculum design, academic support and assessment developed.

Outcomes of interviews

We conducted 36 interviews with academics and coordinators from 22 different universities. The academics ranged from early career to associate professors and the universities represented almost all states and both urban and regional, traditional and technology focused institutions. The information we collected could be classified into four main themes:

- **Responsibilities** – The role of coordinator can encompass a range of responsibilities in leadership, management, administration, teaching and assessment.
- **Personal challenges** – Individuals face many personal challenges in balancing workload and life, managing effective change amongst peers and meeting the expectations of others (peers, superiors and students)
- **Student diversity** - Perhaps the “elephant in the room” for many is the challenge of managing the curriculum and teaching to a diverse student cohort in service subjects, particularly students who are disengaged or maths phobic.
- **Adaptive responses** - Closely associated with theme 3 above, we found a wide range of responses to the challenge of student diversity, including diagnostic testing, online learning, bridging programs, learning support, pedagogical change in assessment and curriculum review.

Expected Impact

The network will help practitioners avoid frustrating non-productive cycles and reinventions of the wheel and lead to significant savings in time and energy, by providing much needed support for people at the coalface, and useful guidance for decision makers in university mathematics departments and schools. The coordinated and collaborative approach will enable first year teaching specialists to build defined leadership roles and form a strong community of shared practice and focused energy, ensuring enhanced learning outcomes for students. The network will work with peak bodies in mathematics and the broader scientific community, including existing discipline networks and forums to build on current initiatives and develop greater awareness of the issues. The network will have a web-based presence providing teaching resources and case studies that describe and evaluate models of First Year Learning and Teaching in the mathematical sciences.

An ongoing series of workshops will establish and reinforce a culture and community of scholarship. The workshops will identify and articulate the unique characteristics of first year learning and teaching, provide an understanding of why students undertake mathematics

study, provide mentorship for staff at various levels of academic appointment and support the ongoing professional development and training of academics and practitioners.

Issues for discussion (Nuts & Bolts)

1. First Year Coordinators may face serious difficulties in meeting the expectations of their superiors, colleagues and students. How can we support these people by raising the profile of their role?
2. First Year Coordinators may be isolated due to workload, geography, departmental or school structures. How can a network provide supportive and useful activities and resources for these people?
3. First Year Coordinators exist in many disciplines as a means to addressing the challenges of managing large, diverse student cohorts. How can we inform the development of the role to improve the transition of students in their first year?

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