Building leadership capacity in the development and sharing of mathematics learning resources, across disciplines, across universities.

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Abstract

In this paper we examine an Australian project in which we seek to develop leadership capacity in staff and students throughout the country, such that they may contribute to and lead others to contribute to the development and sharing of learning support resources for mathematics and statistics across disciplines and universities. One of the tangible outputs is a set of video based learning support resources that can be embedded in subjects across disciplines and shared across institutions. However the guiding aim is to develop leadership capacity, in its simplest form leading others to lead others to contribute to the project. Leadership may also be developed and exercised across different aspects of the project whether it be mapping needs, drawing together disciplines groups, finding ways to recognise and reward those engaged in the process, developing resources and the associated skills, ensuring copyright adherence, creating learning designs for optimal use of resources, evaluating the impact on student outcomes, peer review and the dissemination of findings.

Introduction

Several issues underpin and drive this Australian project, *Building leadership capacity in the development and sharing of mathematics learning resources across disciplines and universities*. The first set of issues relate to the need for resources, while the second relates to the process through which resources are developed.

The need for services and support and more specifically for the development and sharing of learning resources in mathematics at the tertiary level in Australia, can be attributed to the decline in levels of mathematics subjects taken by high school students. This decline is evident worldwide (Luk, 2005; Williamson et al, 2003). Declines in mathematics skills brought about by a lowering of contact hours and entry standard, student ability, lack of engagement (National Symposium on Mathematics Education for 21st Century Engineering 2007) pose challenges for teaching and learning mathematics in higher education institutions. Declining skills impact on students in a diverse range of disciplines, the biological and social sciences (Wilson, 2007), mathematics (Luk, 2005), the physical sciences (Gill 1998) and engineering and science (Williamson et al, 2003).

While there has been a decline in the mathematics skills of Australian students (Barrington & Brown, 2006), there has been no such decline in the role of fundamental sciences such as mathematics. Australian National priorities for research funding recognise that '*Technological advances are often unexpected and a strong foundation in mathematics and the fundamental sciences will provide an environment that fosters creativity and innovation.*' (National Priorities, 2009). Participants at an Australian Symposium on *Learning Support for Mathematics and Statistics* also recognize, '*the critical roles of mathematical and statistical skills in underpinning student success in many courses*'. Associated with this participants recognised: *The need to care for students entering with diverse mathematics backgrounds and skills* and a *need to provide a range of services tailored for needs of relevant courses, circumstances and cohorts (Gadsden, online 1/4/08).*

This project's main goal is to create leadership opportunities for staff to create and share sustainable mathematics and statistics resources to support student learning. This endeavour is too large for a small group of individuals so to adequately address the needs of students, opportunities are provided for academics to share knowledge, skills and experiences through support and regular meetings.

The emphasis on sustainability arises not only from the magnitude of the task but from the tenuous nature of the provision of mathematics learning support in Australian institutions. An examination of this provision in Australia shows a range of approaches (Wilson, 2007). In the Australian context, several universities have no mathematics learning support centre,

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some have lone workers, while a few Universities have a solid core of mathematics learning support personnel. Characteristic of many universities that have mathematics learning support are restrictions in terms of access. Resources may be limited to bridging courses for 100 level students or to small group work as opposed to individual tuition. Diversity in the levels of support has been identified and is often closely related to the strategic priorities given to mathematics support in universities. At the lead institution the need for mathematics support is pervasive across many disciplines. In the search for a model for supporting students, the initial focus has turned to the provision of electronic forms of support. This has been predicated on several initiatives, 2004-2008 which focussed on improving learning outcomes (Porter, 2008). Two of these initiatives involved the development of predominantly video-based learning resources, their placement in E-Learning sites for subjects and subsequent evaluation in terms of impact on learning outcomes (Aminifar, 2007).

The remaining focus on sustainability arises from the stakeholders who have provided funding for this project. The project is funded through the "Leadership for Excellence in Learning and Teaching Program" which supports "systematic, structured and sustainable models of academic leadership in higher education" (ALTC, 2007). In Australia at a national level there is recognition of the need to build leadership capacity in the tertiary sector.

At UOW we recognised that to address the mathematics learning support needs of our students we in fact were addressing a national issue and what was needed was a team of leaders, engaging others as leaders in the development, acquisition, reviewing and sharing of learning support resources across disciplines and universities. Within the mathematics discipline there is a need to develop leaders amongst mathematicians to produce generic mathematics learning support materials and to provide peer review. Across disciplines there is a need to develop leaders who can engage colleagues to define the contexts in which their students confront mathematics, so that learning materials may be contextualised and made relevant. The task is too big for a small group of individuals, hence our emphasis on leadership as engaging others to engage others in this process.

Specific aims included the development of: (1) a framework for building leadership capacity in the development of mathematics learning support resources across disciplines and universities; (2) enhanced leadership capacity to build coherent frameworks that map student need, and develop, acquire and align mathematics learning support resources so as to enhance student learning outcomes; (3) and, advances in the standard of Mathematics and Statistics learning support and resources, across disciplines and across universities.

Description of the model for solution
The project as conceptualised was to build upon cross-faculty networks to encourage the dissemination of knowledge and ideas (Lefoe, 2006). This project sought to extend the model from involving the sharing of creative ideas to the sharing of technology-based resources. It was planned to follow a cascade dissemination model based on the Effects Project in the UK (Fullerton & Bailey, 2001) whereby, at an appropriate point in time, new collaborative partners would be invited to participate in the project. The project was premised on the belief that there is a knowledge base for leaders on how to develop leadership (Marshall, 2006), different assumptions as to what is needed to create or be a leader (Anderson & Johnson, 2006). and different concepts as to the nature of leadership (Marshall, 2006) and these have implications for how leadership is transferred/created/developed. The developmental work at UOW leading to this project has involved a progression of different leadership approaches to complete certain tasks. Recent UOW leadership programs that have been developed have provided for their participants: express outcomes in terms of increased engagement with the university; networking with peers; improved strategic focus; improved work/life balance; improved delegation; specific skill development; and increased levels of confidence (Morgan & Denny, 2007). There was, however, a need to examine how leadership could be developed when it arises in the context of staff coming together to undertake a task rather than undertaking a leadership program.

Planned Approach

This project has an action-based methodological approach (Creswell, 2003), collecting evidence from staff and students in order to define and redefine directions. Using a reflective-practice approach (Schon, 1991), the participants in this study will reflect upon their perceptions of leadership. The planned execution of the project involves a systematic, multilevel building of leadership across two institutions, the University of Wollongong and its collaborative partner, Central Queensland University. The process involves four stages, preparation, assessment of need or review, implementation, and evaluation and dissemination.

(1) Preparation involved: identification of teams and potential leaders within the two participating institutions; identification of a Leadership Advisor in each institution; and leadership building activities that supports participants' reflection on leadership.

(2) Assessment of need and review involved: a self-assessment by team members/potential leaders at all institutions determining the nature of support, needed for developing more effective leadership; mapping student needs in relation to mathematics learning support; constucting a joint action plan for developing, acquiring and sharing resources; identifying an independent evaluator; preparing evaluation surveys to collect baseline and follow-up data; designing a website for, accumulation and housing of mathematics resources; and, investigation of a means to provide academic staff with ready access to video resources which can be directly downloaded into the institutions learning content system."

(3) Implementation included: engaging wider participation and the elicitation of leadership issues through a symposium held early in the project; drawing on materials from other leadership programs to construct a program for building leadership in the development, acquisition and sharing of learning resources; holding meetings and workshops through the Access Grid to address both the leadership issues arising and review developments associated with the learning resources task; making decisions regarding the allocation of resources; determining how to share the resources made during this project and ensuring they are available within and between institutions; developing accountability reporting mechanisms; developing a list of standards for the resources which allows for granularity and sharing among institutions to fit within the institutions own resource needs; and, provision of peer review opportunities to further build a range of resources suitable for the sharing between institutions.

(4) Evaluation and Dissemination were to involve: using the accountability reporting processes within institutions to engage and inform others; iwebfolio to document progress on the action plan ensuring accountability; analysis of all data collected regarding process, content, successes and failures in the leadership program and the impact on student learning; and, a symposium toward the end of the project, inviting the participation of other universities, creating a vision for the future and initiating the mentoring of other universities.

The extent to which the model was successful

As anticipated it was expected that issues and opportunities would present and that both the leadership roles and the approach taken to develop leaders would be further defined and expanded. With the project having only just met its halfway mark there remains much to do and much to learn. However there are several aspects of the project in terms of its commencement that framed its early progress. These included how the project was developed and initiatives undertaken.

(1) The development of the proposal was highly centralized with the project leader having developed the cases for funding of seed projects, having established and worked with teams, having led the discussion with faculty Deans and personnel to identify areas of need (Porter, 2008). The initial phases of the project also involved the project leader in determining direction, chairing meetings and in general assuming the mantle of responsibility. As the project was about building the capacity for leadership distributed across disciplines and universities, this needed to change. Three significant steps have led to a greater distribution of responsibility and leadership. These were the appointment of a project manager who could share responsibility and then the establishment of small committees with areas of

responsibility and the rotation of chairing responsibilities through members of the team. Formal reporting back to the full committee provides an accountability mechanism.

(2) The team had come together with the primary intention of developing and sharing mathematics resources. Many participants did not initially see the need to develop leadership or found this somewhat onerous. There was a need to explore perceptions regarding the nature of leadership required in this project and to focus on how to build leadership capacity which in our instance means preparing and engaging others to take a leadership role in the project. The initial reframing of leadership was to recognise that leadership could be exercised in many ways. We coined the term *leadership spaces* and identified several ways in which members of the team could contribute as leaders. These spaces or areas of activity included: copyright and intellectual property issues to allow sharing of resources; mapping needs in different disciplines and universities; training others to create resources in new technologies such as Tablet PCs; developing effective designs for resources; sharing resources including expertise; providing an easily accessible effective online repository of resources; creating effective learning designs; peer review of resources; use and evaluation of resources; developing effective dissemination strategies for people in the office next door to colleagues in other nations and to present the project to other institutions to invite them to participate.

(3) Holding a symposium early in the schedule of activities has meant the activities dissemination and an invitation to participate are occurring simultaneously. This has meant the early engagement of other institutions with the project and an ongoing process of dissemination rather than the cascade occurring toward the end of the project

Possibilities for transfer of the model to different environments
The intended outcome for this project has been the building of capacity in leadership in the development of mathematics and statistics resources across disciplines and across universities. Early evidence suggests that it is an approach that is building capacity in different disciplines and in other institutions.

At this early stage the UOW teams are optimally operating in three faculties, Science, Informatics and Engineering and would appear to be viable in the longer term with the capability of producing mathematics and learning support resources and extending the work to support learning in other discipline contexts. In these faculties the development of skills training and resource development is underway. The staff and faculties are also purchasing equipment signalling intent to continue. In these faculties, staff members have also engaged in practices inviting their colleagues to become involved. The value of the project from a university perspective is reflected in the participation of staff from core support units, Personnel, Learning Development and the Centre for Educational Development and Interactive Resources. In other faculties, Commerce, Health, Education and Medicine there are participants but not yet momentum in the development of resources or commitment to purchasing suitable equipment that can suggest long-term viability, however the project is only mid-term. University policy in the area of IT specifications and support are also being impacted as new tablet PC technologies are requested by staff wishing to engage with the developments. For long-term viability IT policy changes need to be effected to allow tablet PC technology to be adopted by staff as an option when renewing equipment rather than staff needing to seek additional funding.

In terms of the model working in different environments, our partner institution Central Queensland University has a cross discipline team engaged in the development of resources across several campuses. Two months after our initial symposium, one symposium participant has assisted through negotiating a price reduction for the PC tablet technology and participants from two other universities in Queensland have requested ongoing participation. Participants seek to provide leadership in the area of agricultural mathematics and to join the team working on Maths in Science.

The Access Grid has enabled members from these other institutions to take part in meetings with the University of Wollongong and Central Queensland University and to firmly build what can best be described as a Community of Practice. It is expected that the participation

from other institutions will continue to grow and as sub-groups become larger, specialist groups will emerge setting up hubs of activity, dispersing leadership and thus increasing capacity throughout the sector. These specialist groups we expect to link back to the core through a few participants from each group so that the sharing of expertise and resources may continue.

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