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Distributed leadership: building capacity for interdisciplinary climate change teaching at four universities

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Publication Details

Davison, A., Brown, P., Pharo, E., Warr, K., McGregor, H., Terkes, S., Boyd, D. & Abuodha, P. (2014). Distributed leadership: Building capacity for interdisciplinary climate change teaching at four universities. *International Journal of Sustainability in Higher Education*, 15 (1), 98-110.

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Distributed leadership: building capacity for interdisciplinary climate change teaching at four universities

Abstract

Purpose - Interdisciplinary approaches to climate change teaching are well justified and arise from the complexity of climate change challenges and the integrated problem-solving responses they demand. These approaches require academic teachers to collaborate across disciplines. Yet, the fragmentation typical of universities impedes collaborative teaching practice. This paper aims to report on the outcomes of a distributed leadership project in four Australian universities aimed at enhancing interdisciplinary climate change teaching. **Design/methodology/approach** - Communities of teaching practice were established at four Australian universities with participants drawn from a wide range of disciplines. The establishment and operation of these communities relied on a distributed leadership methodology which facilitates acts of initiative, innovation, vision and courage through group interaction rather than through designated hierarchical roles. **Findings** - Each community of practice found the distributed leadership approach overcame barriers to interdisciplinary climate change teaching. Cultivating distributed leadership enabled community members to engage in peer-led professional learning, collaborative curriculum and pedagogical development, and to facilitate wider institutional change. The detailed outcomes achieved by each community were tailored to their specific institutional context. They included the transformation of climate change curriculum, professional development in interdisciplinary pedagogy, innovation in student-led learning activities, and participation in institutional decision-making related to curriculum reform. **Originality/value** - Collaborative, non-traditional leadership practices have attracted little attention in research about sustainability education in university curricula. This paper demonstrates that the distributed leadership model for sustainability education reported here is effective in building capacity for interdisciplinary climate change teaching within disciplines. The model is flexible enough for a variety of institutional settings.

Keywords

distributed, leadership, teaching, change, climate, interdisciplinary, capacity, building, universities, four, GeoQuest

Disciplines

Medicine and Health Sciences | Social and Behavioral Sciences

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Distributed leadership: building capacity for interdisciplinary climate change teaching at four universities

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Acknowledgments:

Support for this research has been provided by the Australian Learning and Teaching Council Ltd., (LE9-1183; 2010-2011), an initiative of the Australian Government. The authors also thank the four participating universities for generous in-kind support.

Submitted: 10-Oct-2012

Revised: 20-Mar-2013

Structured Abstract

Purpose – Interdisciplinary approaches to climate change teaching are well justified and arise from the complexity of climate change challenges and the integrated problem-solving responses they demand. These approaches require academic teachers to collaborate across disciplines. Yet the fragmentation typical of universities impedes collaborative teaching practice. This paper reports on the outcomes of a distributed leadership project in four Australian universities aimed at enhancing interdisciplinary climate change teaching.

Design/methodology/approach – Communities of teaching practice were established at four Australian universities with participants drawn from a wide range of disciplines. The establishment and operation of these communities relied on a distributed leadership methodology that facilitates acts of initiative, innovation, vision and courage through group interaction rather than through designated hierarchical roles.

Findings – Each community of practice found the distributed leadership approach overcame barriers to interdisciplinary climate change teaching. Cultivating distributed leadership enabled community members to engage in peer-led professional learning, collaborative curriculum and pedagogical development, and to facilitate wider institutional change. The detailed outcomes achieved by each community were tailored to their specific institutional context. They included the transformation of climate change curriculum, professional development in interdisciplinary pedagogy, innovation in student-led learning activities, and participation in institutional decision-making related to curriculum reform.

Originality/value – Collaborative, non-traditional leadership practices have attracted little attention in research about sustainability education in university curricula. This paper demonstrates that the distributed leadership model for sustainability education reported here is effective in building capacity for interdisciplinary climate change teaching within disciplines. The model is flexible enough for a variety of institutional settings.

Keywords:

climate change teaching, distributed leadership, communities of practice, curriculum greening, leadership in universities, Australian sustainability education

Article classification

Research paper

I. Introduction

Climate change teaching is an integral element in the greening of higher education curricula. Climate change demands innovative, interdisciplinary teaching approaches that emphasize problem-based pedagogy (Dobson and Tomkinson, 2012). However, universities have often struggled to ensure that disciplines work cooperatively to foster coalitions capable of tackling complex problems, especially in relation to teaching. Disciplinary fragmentation in universities is reinforced by hierarchical, top-down modes of leadership, individualized and competitive pathways of career

progression, and administrative and financial structures premised on competition between sub-organizational units (Pharo and Bridle, 2012). This means interdisciplinary teaching is often restricted to small organizational units offering niche programs for a minority of students, rather than being embedded across the curriculum and available to all students through collaboration between disciplines.

Disciplinary fragmentation constitutes a barrier to interdisciplinary education for sustainability. As a result, achievements in physical campus greening have not been matched by achievements in curriculum greening (Tilbury 2011; de la Harpe and Thomas 2009). These failings in higher education are a contributing factor in the wider social struggle to address serious interdisciplinary environmental problems, including climate change.

This paper reports on a case study of four Australian institutions applying a distributed leadership methodology to the goal of promoting interdisciplinary teaching about climate change. The project partners were University of Tasmania (UTAS), University of Wollongong (UOW), Murdoch University (MU) and University of New South Wales (UNSW). The investigation reported in this paper centres on the research question: can distributed leadership enable teachers to embed interdisciplinary climate change teaching within their institutions?

II. Distributed Leadership

Hierarchical leadership models have long been central to the functioning of higher education institutions. Indeed, recent decades have seen even greater emphasis on 'top-down', 'command and control' leadership practices as a way of increasing the accountability and efficiency of these institutions through corporatist and managerial reforms (Readings, 1996; Deem and Brehony, 2005; Bolden *et al.*, 2009). While there is widespread acknowledgement of the need for universities to become more responsive to rapidly changing social contexts, there is also growing awareness of the limitations of conventional forms of 'top-down' leadership. These limitations include a lack of flexibility and accountability, and they prompt confrontation and resistance, undermine academic freedom and collegiality, and fail to harness the leadership potential of those at levels below senior management (Avolio *et al.*, 2009; Gronn 2002).

Alternative models of 'authentic' leadership emphasise both collaborative forms of leadership and the organisational context of leadership development (Avolio *et al.*, 2009; Bennett *et al.*, 2003; Freiderich *et al.*, 2009). Emphasis on authentic leadership challenges conventional understanding that leaders are individuals who stand out in front, setting the direction for others to follow. Models of authentic leadership conceptualise leadership as a quality of interpersonal relationships that empowers all participants to imagine and grasp opportunities for change. One of the most prominent of these new models is 'distributed leadership', a model that relates generally to the behaviour of organisations, but is also specifically suited to educational contexts (Gronn, 2002; Bennett *et al.*, 2003). While now influential in many secondary and primary teaching institutions, distributed leadership remains an under-utilised approach within the higher education sector, although there are some indications that this is changing (Bennett *et al.*, 2003; Bolden *et al.*, 2008, 2009; Harris, 2003). It has also attracted surprisingly little attention amongst proponents of education for sustainability (Pepper and Wildy, 2008).

Distributed leadership is regarded as an 'emergent property of a group or network of interacting individuals' (Bennett *et al.*, 2003: p.7). It is characterised by leadership activities enacted within and by groups, rather than by individuals acting out prescribed hierarchical roles. It promotes concerted action by combination and interaction of individual interests and capacities to produce outcomes beyond those that could be achieved by individuals alone. The distributed leadership model does not negate the importance of formal, delegated leadership in providing 'top-down' inspiration, guidance and instruction or the relevance of individual initiative. Indeed, one of the strengths of distributed leadership is emphasis on the potential for concentrated and distributed forms of leadership to be mutually supportive (Bolden *et al.*, 2008; Gronn, 2002). Distributed leadership highlights the benefits of collaboration, reciprocity, shared purpose and shared ownership in leading institutional change (Lefoe *et al.*, 2008). This form of leadership resists representations of heroic leaders and passive followers, and implies that boundaries of leadership are inclusive rather than exclusive. Distributed leadership is a fluid potential held by a group that enhances the capacities of individuals to take the lead and that aligns this capacity with specific challenges and organisational environments. This implies that different individuals, alone and collectively, are likely to lead the group at different times depending on the specific challenge being faced and on the specific context in which it is to be addressed (Gronn, 2002; Bennett *et al.*, 2003).

To test the potential of distributed leadership development to enable teachers to overcome current barriers to interdisciplinary climate change teaching in higher education, the authors implemented distributed leadership in four different institutional contexts, as described in the following sections.

III. Approach: developing leadership in communities of practice

In 2010, following a 2008 pilot project at UTAS (Pharo *et al.*, 2012), the four partner institutions commenced a two year program, funded by the Australian Learning and Teaching Council (now the Australian Office of Learning and Teaching) to establish teaching collaborations with the intention of advancing interdisciplinary climate change education through teacher leadership. Each university established its own 'Leadership Network for Climate Change Teaching', through structures and group-building activities consistent with what Wenger (2000) describes as 'communities of practice', and Cox (2001) describes as 'faculty learning communities'. This dimension of the project is detailed in [Names withheld for review (b)] (2013).

The framework at each institution

The UTAS pilot project established four essential specifications for each network or community of practice:

1. An 'activator' – a teaching academic who initiates and/or catalyzes peer collaboration, recruits other teaching academics and students to participate in the community, and who oversees processes of evaluation and reflective learning within the community.
2. An 'integrator' – an administrator or academic appointed by the 'activator' who maintains an adaptive role in the community, facilitates cross-disciplinary communication and collaboration, manages the practical needs of the community, supports consensus-based decision-making, provides curriculum design and teaching support, maintains a resource repository, and documents and disseminates the activities and outcomes of the community, including

- evaluation processes.
3. Recruitment, through self-nomination, of a cross-disciplinary team of teaching academics involved in class (or unit or subject) coordination and classroom teaching, drawn from a diversity of disciplines and intra-institutional units, who are motivated to improve climate change education across the university.
 4. The collaborative development and implementation by the community of innovative peer-led professional learning activities, student-led learning activities, and institutional change strategies.

These four requirements provided the framework for distributed leadership development by ensuring that involvement in the community was based on shared interest in climate change and interdisciplinary teaching, as well as shared professional skills and responsibilities related to curriculum development and delivery. The requirements also ensured that the pre-defined leadership roles within the community (the activator and integrator) were explicitly collaborative and reflexive in nature, ensuring that the work was underpinned by open and transparent forms of evaluation. While participation was open to people at all levels of the formal vertical hierarchy of academic promotion, recruitment specifically targeted those at more junior levels, who often have disproportionate responsibility for roles such as class coordination, and who stand to benefit considerably from activities that build their leadership capacity.

The four generic requirements were broad and open to some interpretation. Thus, for example, the mix of disciplines and of senior and junior staff differed at each institution. This flexibility was deliberate, so as to allow for the local autonomy and context-dependent adaptation that are central to distributed leadership development. This autonomy enabled the goals and approaches taken by each community to be substantially shaped by its members, rather than being imposed by the activator acting on instructions from the national project team. Each community was able to shape itself in relation to their significantly different administrative and curricular structures, scales of operations, and histories of interdisciplinary sustainability education.

Cross-institutional links

Beyond the objective of enhancing leadership and interdisciplinary teaching within institutions, the project sought to develop distributed leadership across the four institutions ([Names withheld for review (a)], 2012). The motivation for building inter-institutional distributed leadership development was threefold: first, to enhance potential for institutional communities of practice to learn from and be inspired by each other; second, to further develop the model developed in one institution by applying it in different institutional settings; and third, to thereby contribute to change within the higher education sector as a whole by implementing the model in different institutions disseminating findings, sharing resources and building partnerships. The chief mechanisms for building the cross-institutional community of practice over the two years of the project were: a) establishing 'critical friend' partnerships between one of the three leaders of the UTAS pilot project and the activator and integrator at each of the other participating institutions through site visits and regular two-way communication; and, b) four face-to-face two-day workshops and regular electronic conferences involving all activators and integrators, as well as information exchange between institutions through quarterly project newsletters.

Evaluation

The methods of evaluating the project are detailed in [Names withheld for review (a)] (2012) and were approved by the relevant research ethics committee in each institution. Integrators and activators played a central role in continuous formative evaluation in four ways. First, they documented the activities and achievements of each community of practice as part of the requirements of bi-annual reporting to the funding body and of the production of quarterly newsletters distributed at all four universities and through wider networks. Second, they evaluated qualitative effects of distributed leadership within their community by conducting semi-structured interviews with individual members and by facilitating reflexive discussions within the group about challenges and opportunities faced. Third, integrators and activators themselves engaged in reflexive practices, including journaling and discussions with their 'critical friend' peers. Fourth, in their role as members of the cross-institutional project team, activators and integrators met regularly, both electronically and face-to-face, to report on successes and challenges, to pool experiences, and to adapt the project in light of lessons learnt. A senior academic external evaluator who participated in project team workshops and meetings and who provided guidance to the UTAS project leaders reviewed the evaluation material generated by activators and integrators. The report of the external evaluator has informed the present paper and is available in [Names withheld for review (a)] (2012). Finally, the independent formative evaluation was provided by an international reference group which met bi-annually to review progress ([Names withheld for review (a)], 2012).

The following sections outline the activities undertaken at each institution and evaluate the effectiveness of distributed leadership development as a way of overcoming barriers to interdisciplinary climate change teaching. A key goal of each community of practice was to improve interdisciplinary student learning outcomes, with assessment of these outcomes over time ongoing. The focus of this paper, however, is on already identifiable outcomes related to teacher collaboration and professional development.

IV. Outcomes: Building capacity for interdisciplinary climate change teaching through distributed leadership

A key preliminary outcome of the project was the establishment of close-knit communities of teaching practice at each participating institution, drawn from a wide range of different disciplines and administrative units. While preliminary, this achievement is not trivial, and there is evidence that using a distributed leadership model is conducive to the success of these communities. The detailed outcomes achieved by each community were tailored to their specific institutional context. General achievements included the transformation of climate change curriculum, professional development in interdisciplinary pedagogy, innovation in student-led learning activities, participation in institutional decision-making related to curriculum reform, and formal recognition of leadership capacities through career advancement. Each of the four institutional communities of practice is described below, before their key outcomes are reported.

Four communities of practice

At UTAS the community of practice involved junior to middle level academics. The community varied from between eight to ten teachers, spread across two distant

campuses, with more than half of the members participating in the community for several years, with other members participating for at least one year. The UTAS community's key achievements included the implementation of interdisciplinary activities in classes taught by individual community members, the introduction of a new interdisciplinary undergraduate class, the seeding of a new community of practice in education for sustainability and the adoption of the project's model of distributed leadership development as part of an institution-wide community of practice scheme supported by senior management.

At UOW, climate change was taught through a newly established first year 'Climate Change' class, and as an 'add-on' in the curriculum of several faculties. The UOW community of practice, totaled 15 members spanning the Faculties of Science, Law, Commerce, The School of Business Studies, Education, and the Academic Services Division. The members took up the key challenge of more fully integrating climate change teaching both within the Climate Change class, and across subjects and faculties. A number of innovative, student-led, cross-disciplinary activities were implemented over the life of the project. These included new climate change teaching modules, international collaborations, and changes of teaching practice by individual community members.

The MU community of practice numbered fourteen at the end of the two years and included staff from disciplines including physics, marine science, Asian studies, sustainability studies and politics. Through regular meetings, shared projects and co-teaching this community that comprised both senior and junior academics enabled members to: share, reflect upon and change their teaching practices; engage in collaborative curriculum design; and, host public events on campus raising awareness of climate change and showcasing undergraduate student work. The community focused not only on connecting climate change teachers, but also on connecting researchers with teaching staff.

The largest of the partner institutions, UNSW is a highly complex organization in which most formal 'leadership' training focusses on managerial compliance as well as staff and budget management. Academic leadership in teaching is generally not well promoted. In this context, and activated by a Head of School, the UNSW community of practice was designed to align with university-wide strategic objectives, structures and agendas while demonstrating leadership through interdisciplinary teaching development. With a membership of forty five at the end of the project, this diverse group of staff and students was organized into four working groups focused on the following activities: Curriculum Development, Survey and Analysis, Communications and Filmmaking, and Public Events.

The following sections explore the three main types of outcomes achieved by the communities of practice: curriculum innovation, professional learning and career development, and institutional change.

Curriculum innovation

One example of a specific and enduring outcome resulting from the development of distributed leadership is the instigation of a new interdisciplinary undergraduate unit, 'Making Sense of Climate Change' at UTAS. The class was developed collaboratively by community members and students and has been taught for three years by a collaborative group of teachers encompassing the physical and social sciences, and the humanities. Establishing this new class entailed significant leadership

development for staff and students involved. Students played a key role in the evaluation, development and critique of the unit, demonstrating their capacity to lead pedagogical design and curriculum development. Students from across a range of disciplines took leading roles in organizing public presentations about the relevance of climate change in a variety of vocations and fields. UTAS also initiated, designed and developed interdisciplinary teaching activities implemented in classes taught by individual members. While individuals maintained responsibility for the design and delivery of their own classes and curricula, the community facilitated sharing of resources and ideas, collaborative design, co-teaching, and the transfer of specific teaching activities between classes of students in different disciplines.

Like UTAS, the UOW approach included development of both discrete new teaching modules and renewal of teaching practice by individual community members. In 2010, a joint activity was devised involving first year students from the Faculties of Science and Law, who worked in lawyer-scientist teams to respond to a fictitious scenario involving issues of coastal development, climate change, and endangered species law. Each team developed their case and presented it in a mock trial situation. Another example was an international collaboration between UOW and University of San Diego science students who conducted a video conference to compare climate change attitudes in different cultures. In 2011, two community members initiated a joint multidisciplinary poster activity involving students of finance, environmental accounting and indigenous studies. Also, the group significantly influenced the curriculum in a number of subjects involving teachers from outside of the community. For example, a first level climate change subject now incorporates interdisciplinary student-led assessment. In addition, many community members are contributing to subjects outside their disciplines, bringing their different expertise and experience of climate change into new subjects.

The UNSW experience was somewhat different, related to its larger scale of operation. As the community of practice grew, it achieved interdisciplinary teaching and research collaborations through the creation of effective working groups that provided a structure based on distributed leadership. For example, in a Curriculum Development Working Group, postgraduate students initiated climate change research projects within their courses and brought these to fruition; while in a Survey and Analysis Group, students took the lead with innovative methodology and practical tasks, using student and staff surveys to scope and document key issues for climate change teaching and curriculum development. The Executive Director of UNSW TV became the leader of a Communications and Filmmaking Group focused on producing a series of videos called 'Climate Change Simply Explained'. These videos were the result of collaborations between media students, UNSW TV, the Institute of Environmental Studies and the UNSW Climate Change Research Centre. Meanwhile, a Research Fellow in the Faculty of Law became the leader of a Public Events Group that developed models for a 'mock trial' and a 'climate adaptation game', as well as a series of debates and conference presentations involving staff and students.

In MU's community of practice, individual community members made a number of changes to their curriculum with a particular focus on developing climate change related assessment. The group also scoped research about student behaviour change, which would use an ecological footprint tool to chart changing climate change impacts across a semester. Notably, the group motivated and inspired individual members to show new forms of leadership (their own and their students') within their teaching units, and to provide a space to reinvigorate teaching and think through 'teaching as leadership'. Distributed leadership fostered two main events

that members coordinated. In the first year of the project, a 'Bike to Work Challenge' saw several community members take the lead in organizing weekly activities – an example of distributed leadership bearing fruit without external activation or integration. In the second year of the project, a 'Tackling Climate Change Student Creative Exhibition' promoted creative arts responses to climate change; while 'Climate Talk', engaged students, staff and the wider community in conversations about climate change in conjunction with poster design and panel presentations by public figures involved in climate change decisions.

Professional learning and career development

In all four communities of practice, members made the decision to voluntarily collaborate with colleagues outside their school/department, thus taking on activities in addition to formal, and burdensome, workloads. Initially this was motivated by a strong sense of personal responsibility to improve climate change teaching and/or to improve interdisciplinary teaching. But in fact members also discovered that collaboration and innovation led to more effective workload management, and greater achievement of professional development goals.

Enhanced career development is an important effect of the project's deployment of distributed leadership. This in turn has enhanced the success and longevity of each community of practice. At UTAS, professional development and career advancement included appointment to permanent positions and promotion, the winning of external grants, recognition of teaching excellence (in the form of national and institutional awards and fellowships), membership of institutional and cross-institutional committees on learning and teaching, scholarly publications and conference presentations. Another key professional development outcome, arising from the creation of a new teaching unit, was that the community's 'integrator', who was employed in the university in an administrative capacity, became one of the coordinators of the new unit, effecting the often difficult transition from administration into teaching.

Leadership experience through community activities at UNSW provided individuals with professional development: for example members of the student Environment Collective used their involvement in the community to strengthen their hands as student leaders and advocates and to gain additional leverage on 'Green Campus' initiatives, while throughout the project the group integrator achieved significant professional development and leadership experience.

Student-led activities were important for fostering distributed leadership among members of the teaching network at UOW. In designing a mock trial on climate change issues, the activator and integrator took lead roles together with a lecturer in environmental law; while in the poster project, leadership provided by the UOW Academic Services Division was essential to the project's implementation. This unit supports UOW curriculum development, professional development of staff, and the development of students' academic literacy. Some of the division's staff were familiar with distributed leadership models and were pleased to have the opportunity to assist with putting this model into action. Involvement in the community of practice gave significant opportunities for leadership development for early career academics, including the activator and integrator. The activator developed skills and confidence in leading cross-disciplinary and cross-institutional teaching activity, while for the integrator, her networking role has opened other doors at the university and in 2011 and 2012 she worked with several faculties on curriculum design.

Although the activator-integrator and support staff initially drove the community's activities at MU, other members actively supported the process and took lead roles in script writing, provision of materials, preparation of posters, and promotion of the event. These experiences highlight that, for the MU community, distributed leadership came about in a framework supported by the activator and integrator, but once activities were initiated, others were quick to respond and 'step up'. As the community evolved, its integrator role was itself distributed amongst members.

Institutional development

The four communities of practice, underpinned by distributed leadership, themselves emerged as models in interdisciplinary and sustainability education in the broader University context. For example, at UTAS this is evident in the project's community of practice model being adopted in 2011 by the university's learning and teaching centre. Partly as a result of the activities of the group since 2008, the university's 2012-2014 Strategic Plan for Learning and Teaching affirms the central importance of cross-disciplinary curriculum and of making positive responses to the sustainability challenge. Meanwhile, at UOW the group's activities also gained significant recognition across the university and beyond. For example, the network's teaching activities were showcased at the 2011 UOW 'First Year Experience' workshop, and in 2011 the group's teaching innovations were communicated to the Federal Government's preeminent Climate Change Commission concerned with educating society on climate change issues.

V. Discussion: towards distributed leadership in universities

Across the four case study institutions, the outcomes of distributed leadership development demonstrate several viable possibilities. As indicated, the teams in each participating institution were encouraged to establish intrinsic goals relevant to their context and membership. As a result, four tailored and mutually informing approaches to distributed leadership were developed. The MU and UOW case studies show that motivated early career academics, supported within a multi-institutional framework of mutual learning, can take on leadership roles independent of their positions in a formal hierarchy, with achievements in interdisciplinary teaching that are recognised and celebrated within their institutions. At UTAS, where the community developed for over four years, specific leadership roles evolved over time while demonstrating robustness in furthering the ambitions of members to increase their influence and status within their institutions and advance their careers through sustainability education initiatives. UNSW showed how a community activated by relatively senior staff can create conditions conducive to leadership initiatives and therefore interdisciplinarity across a wide range of academic, administrative and student roles.

The project has provided general guidance to implementing distributed leadership as a means to advance sustainability education and evidence that this approach is relevant to a wide variety of institutional settings. The problem-based approach took advantage of the dispersed and specialized nature of academic knowledge about climate change as an opportunity for collaboration, professional learning, interdisciplinary innovation and institutional reform. The approach integrated informal and peer-based forms of leadership development as a foundation for interdisciplinary collaboration, rather than conceiving leadership development as a

discrete add-on activity delivered by 'leadership' experts.

Empowerment

The project outcomes demonstrate the general importance of empowering teaching staff through peer mechanisms. In all four communities of practice, empowerment of members through distributed leadership produced significant individual achievements. Empowerment is also evident in the development and exercise of initiative, vision, strategy and advocacy by each group as a whole, which enabled them to be agents of change within their institutions. Finally, empowerment was evident at the multi-institutional level of the project, where collaboration and peer-mentoring within the inter-varsity project team allowed the four communities opportunities to lead each other through acts of shared learning, inspiration and initiative and to share their learning through the sector more broadly.

Harnessing aspirations and meeting expectations

Meeting the expectations of university teachers is both a challenge and a necessity in establishing and harnessing distributed leadership. Most face conditions of increasing academic workload pressures (Jacobs 2004), devaluation of teaching and teaching development relative to research in these workloads (Chalmers 2011), and growing emphasis on competition associated with the corporatization of the academy (Deem and Brehony 2005). In this context the establishing of communities of teaching practice through voluntary means is significant. While grant funding enabled the part-time employment of a community integrator at each institution, community members were offered no direct incentive to participate, such as financial resources or workload compensation. Interviews with community members revealed that many felt under considerable time pressure and that giving time to participate in the community was not a decision taken lightly ([Names withheld for review (b)] 2013). This demonstrates that the focus and methodology adopted by the project was targeted to address needs and aspirations shared by academic staff in a diversity of career stages, roles and disciplines.

While individual participants had different motivations for being involved, a desire to overcome barriers to collaboration across disciplines was shared by all. Some were passionate about the need for university teaching to be relevant to the interdisciplinary complexity of climate change problems, although some participants were also interested in the relevance of the project for other complex real-world problems. Some were passionate about the value of peer-led approaches to professional learning in teaching, finding them preferable to the expert-led approaches to professional development that have become common in recent years in many universities.

Structures that facilitate leadership and confidence

Project outcomes underscore the importance of having appropriate structures for group facilitation in the development of distributed leadership. The facilitative leadership provided by activators and integrators was critical to the success of the project at each institution. While the inspiration and organization provided by the activator was crucial in the creation of the teaching community, the relationship-maintenance performed by the integrator proved essential to the longevity of the community, amidst the unfavourable institutional conditions reproduced by 'top-down' and 'siloes' forms of administration ([Names withheld for review (b)], 2013).

The emphasis on adaption to institutional contexts, voluntary participation, informal relationship building and consensus decision-making within the communities of practice (Cox, 2001) provided ample opportunity for all members to develop confidence and leadership skills, through displaying initiative and taking responsibility for collective outcomes. The leadership capacity of those in the roles of activator and integrator were also developed through the task of building trust and reciprocity in collective endeavors, while respecting the autonomy and individuality of participants. Explicit attempts to distribute leadership fluidly within the group became a framework in which both shared vision and diverse individual aspirations were expressed through pragmatic actions.

VI. Conclusion

Over coming decades, university graduates will be required to shoulder responsibility during their professional and personal lives for responding to climate change and related sustainability challenges (Burandt and Barth, 2010). In meeting their responsibility to support graduates in this regard, universities need to increase the extent and pace of reforms if they are to embed sustainability education as 'part of the core curriculum across all disciplines,' as is the aim expressed in the 2012 Rio+20 *Commitment to Sustainable Practices of Higher Education Institutions* (UNCSO, 2012).

As a means to achieve this, this paper argues that collaborative and networked forms of distributed leadership empower proponents of education for sustainability within universities to bring about innovation in teaching practices, curriculum design and institutional structures across disciplinary boundaries. The project reported here demonstrates that interdisciplinary climate change teaching is promoted by leadership that is spontaneous in response to environmental problems; that arises where it is needed rather than as dictated by hierarchy or job description; that is shared across groups and therefore arises from collaboration; that empowers all ranks of academia and also students; and that sometimes arrives unannounced and modestly and therefore needs recognizing, naming and celebrating.

The communities of practice described here built mutually beneficial collaborations between previously disconnected academics who shared the aim of improving interdisciplinary education about climate change. The case studies show that in building capacity for interdisciplinary climate change teaching in four Australian universities, a distributed leadership methodology was found to be an effective, flexible and pragmatic approach. Distributed leadership broke down hierarchical and disciplinary barriers between members to enable creativity and courage in design and delivery of climate change teaching, and to facilitate wider institutional change supportive of education for sustainability. Each university developed an ongoing, reflexive interdisciplinary community of climate change teaching leaders that supported student-led interdisciplinary learning, developed teaching resources, enabled continuous professional development and helped foster institutional change for sustainability education.

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