Sustaining new approaches to learning and teaching with technology - more than just a Wicked Problem

Janet Buchan
Division of Learning and Teaching Services
Charles Sturt University

The basic premise of the 2012 Ascilite Conference theme is that; 'what happened in the past is no longer a reliable guide to the future'. However, if we do not learn from what happened in the past, it may well be a reliable guide to an unsustainable future. In the face of constant change, in order for higher education institutions to achieve the goal of creating sustainable approaches to new models and learning and teaching with technology a fundamental paradigm shift in management approaches is required. To address this, an interdisciplinary focus is introduced and two key concepts from environmental management: Wicked Problems and adaptive management are applied to the higher education environment. Using evidence-based practice these aspects have been researched in-depth in a large, mixed-mode university.

Keywords: learning environment, educational management, change management, wicked problems, adaptive management, sustainability

Introduction

Information technology has brought about much of the economic growth of the past century, accelerating globalization and fostering democracy. Such broad impacts would be impossible if "information technology" were only a set of technologies. As our use of mobile devices, games, and social networks illustrates, information technology can create new experiences. But more important, information technology enables new models. It can disaggregate and decouple products and processes, allowing the creation of new value propositions, value chains, and enterprises. These new models can help higher education serve new groups of students, in greater numbers, and with better learning outcomes.
As important as information technology might be, technology does not have impact in isolation—it operates as one element in a complex adaptive system... (Oblinger 2012)

When embracing technology and new models of learning and teaching in higher education there is a degree of hesitation noted in our sector. The themes of recent professional conferences in the area of educational technology give some idea where our preoccupations lie and where our recent research focus has been:

- Ascilite 2010 Conference – 'Curriculum, technology and transformation for an uncertain future.' (Available from HUhttp://www.ascilite.org.au/conferences/sydney10/UH);
- DE HUB/ODLAA Summit 2011 – 'Education 2011-2021. Global challenges and perspectives of blended and distance learning.' (HUhttp://www.dehub.edu.au/summit2011/about.htmlUH);
- Association for Learning Technology UK, 2011 Conference – 'Thriving in a colder and more challenging climate.' (Available from HUhttp://www.alt.ac.uk/altc/alt-c-2011UH);
- Association for Learning Technology UK, 2012 Conference – 'A confrontation with reality' (Available from (HUhttp://www.alt.ac.uk/altc2012UH);
- Tertiary Education Management Conference 2011 – 'Riding the Waves.'(Available from HUhttp://www.temc.org.au/temc-2011UH).

An example of the challenges we face in higher education is given by Diana Oblinger, President and CEO of EDUCAUSE who put forward some 'Questions for the future' in an article that is the result of global collaboration on the future of higher education (Oblinger 2010).

Oblinger (2010) notes that higher education is:

A complex and adaptive system [and] … is influenced by trends in the larger society. Although Australia, the United States, the United Kingdom, and the Netherlands differ in many ways, similar forces are driving change in higher education in all four countries…

Higher education faces numerous challenges posed by the drivers of change, including worldwide demand for education, financial constraints, and a constantly changing knowledge base. Those of us involved with information technology in higher education thus need to ask ourselves several critical questions:

- How can we accommodate the increase in numbers of students without compromising quality?
- What can we do to lower the cost of learning resources?
- How flexible is our higher education system? Does it provide paths to degree completion that suit all students?
- If we were to transform the student experience, what would it look like? What would we do differently? How would those changes affect the individual? The workplace? Society?
- Can we create a better linkage between research and instruction, creating new opportunities for discovery and community?
- What can we do to speed the translation of research into solutions that benefit society?
- What type of administrative services and support will allow the institution, faculty, and students to optimize their time and talents?
- If the college/university metaphor today is a network rather than a campus, what does that mean for our work in information technology?' (Oblinger 2010, p.52)

Those of us who have been involved in higher education for any length of time will probably be thinking, 'familiar', 'not again', 'we went through that X years ago'…These challenges equate to Wicked Problems - the types of problems for which there could be important potential application for the findings of this research.

Approach

An interdisciplinary focus is introduced by examining two key aspects of environmental management - Wicked Problems and Adaptive Management. Evidence-based practice has been applied by drawing on documented evidence, practical experience and research conducted within the context of the author's institution over a period of nine years. These research studies have applied a variety of environmental management concepts and theory to aspects of management of the learning environment, with a particular focus on the use of educational technology in the technology-enhanced learning environment (Buchan and Buchan 2003; Buchan 2008; Buchan 2010). The breadth and depth of insight from this evidence-based research gives rigour to the findings of this exploration.

Wicked problems

> Some problems are so complex that you have to be highly intelligent and well informed just to be undecided about them. (Laurence J. Peter quoted in Conklin 2005. P.1)

An exploration into environmental management gives us the wicked problem (Buchan 2012)**.** The perspective afforded by a study of the wicked problem contributes to our understanding of the variety of challenges in our broader environment, including an understanding of organisational management.

The term was first introduced into practice in 1969, in an address by Rittel and Webber to the Panel on Policy Sciences, American Association for the Advancement of Science, Boston. It is introduced into the literature in 1973 in Rittel and Webber's definitive article, *'Dilemmas in a general theory of planning'*. It is interesting to note that this article is published in the journal *Policy Sciences*, which is appropriate since policy and planning are fundamental to all organisational, educational and environmental fields of practice (Buchan 2012 in prep).

A search for references to wicked problems reveals thousands of references. References range from personal blog references, daily news items and company reports to scientific and academic research. In the contemporary literature the wicked problem is used widely in formal research as well as informal discussion. The concept of the wicked problem has been applied to Indigenous policy, juvenile justice (Murphy 2010), healthcare systems (Periyakoil 2007), public service policy, software solutions (deGrace & Stuhl, 1990), international enforcement of unregulated fisheries (Osterbohm et al 2010, Wang 2002) and business strategy (Camillus 2008). The use of the wicked problem is widespread in environmental management (Allan 2008). In this field it is more than simply a convenient term, since it is supported by research into management solutions (Allan 2007; Fazey and Schultz 2009; Stankey and Allan 2009).

'Wicked problem' is a term originally used in social planning to describe a problem that is difficult or impossible to solve because of incomplete, contradictory and changing requirements that are often difficult to

recognise. Moreover, because of complex interdependencies, the effort to solve one aspect of a wicked problem may reveal or create other problems (Conklin 2005) .

At its simplest, a wicked problem can be described as having the following defining characteristics:

- You don't understand the problem until you have developed a solution.
- Stakeholders have radically different world views and different frames for understanding the problem.
- Constraints and resources for solving the problem change over time.
- Wicked problems have no stopping rule (the problem is never solved completely).
- Every wicked problem is essentially unique and novel.
- Solutions to wicked problems are not right or wrong.
- Every solution to a wicked problem is a 'one-shot' operation. (Rittel and Webber 1973; Conklin 2005)

'If a problem involves many stakeholders with conflicting priorities; if its roots are tangled; if it changes with every attempt to address it; if you've never faced it before; and if there's no way to evaluate whether a remedy will work, chances are good that it's wicked.' (Camillus 2008 online)

Given the basic characteristics of the Wicked Problem, it aptly identifies many of the managerial situations found in higher education. There are, however, relatively few substantial references to wicked problems in the field of education and this is a new and growing area of research (Bore and Wright 2009; Krause 2010; Trowler 2010).

Every Wicked Problem is essentially unique and novel.
Case study institution scenario – The following scenario was reported on in Buchan, Rafferty and Munday (2009); *'An investigation into the enhancement of blended learning environments – towards an effective pedagogy and practice'.* The study took place between 2005 and 2009 in the form of a Scholarship in Teaching project. The ambition was; '…to improve the educational experience of tertiary education students through engaging emerging technologies … The primary aims of the study were to develop an effective pedagogy for flexible and blended learning and to examine the values and limitations of blended learning opportunities offered through technology-enhanced learning experiences.' (Rafferty, Munday et al. 2011) . This was done through the use of heuristic inquiry process in an extensive case study. If the basic features of a wicked problem are applied to this scenario, what began with a simple ambition to teach better grew into what we can now recognise as a 'Wicked Problem'.

Stakeholders have radically different world views and different frames for understanding the problem.
Some of the practical outcomes of the research were summarised in this checklist. These organisational limitations and implications were identified in the case study within a particular institutional context and originally identified from the data as *issues*. The checklist frames the issues, the questions to be asked and it gives a hint of some of the solutions.

A checklist of organisational limitations and implications for blended and flexible learning in practice:.

- For a university to be committed to blended and flexible learning it should have a stated definition of blended learning in its own context that is shared across the institution in order to guide the development of appropriate administrative and support processes
- Distance teaching and resource based blended learning approaches require significant time investment in order to fully engage students
- The academic who writes and plans the subject may not always be the person responsible for teaching the subject
- Academic fatigue can result in staff taking the path of non-excellence.
- Where there are staffing changes and academic buy-out for marking, adequate guidelines and detailed expectations should be provided for the markers
- Staffing allocations, and formulas for such, should account for varying class sizes, and [should] factor in the time taken to design and develop subjects for blended learning
- Timetable systems may not accommodate flexible use of learning spaces (classrooms)
- Student enrolment options should support blended learning
- The blended learning experience can be enhanced by active engagement in improving the learning environment of staff and students through scholarly research.

- Investment in educational designers and learning technologists can provide useful support for academics in designing effective blended learning experiences. (Rafferty, Munday et al. 2011)

You don't understand the problem until you have developed a solution.
The aim of experimenting with the use of digital media and technology to improve student outcomes was the starting point. The research problem being addressed was the perception that digital media could be used as part of a more effective way to teach students - not exactly a problem. However, the lived experience of the study uncovered a number of organisational limitations and implications which all contributed to the identification of a *complex problem*. This involved multiple stakeholders across the regional, mixed mode university and it became evident that there were different world views in this complex institution. There were institutional inconsistencies in the definition of flexible learning and in how the practice was actually supported on the ground. The interpretation of blended and flexible learning with which the researchers began in 2005, was a personal one and not necessarily shared by the university as a whole (Buchan, Rafferty et al. 2009).

Constraints and resources for solving the problem change over time.
Fast forward to 2012. Since 2005 when the blended learning study began there have been significant advances in providing support for the use of technology and exploring alternative models for learning and teaching with technology at CSU. This support ranges from hands-on practical centralised support to a long term strategic focus through the development of an institutional Educational Technology Framework (Uys, Keppell et al. 2010)

There have been some practical institutional advances such as a new electronic timetabling system (introduced in 2012) and advances in achieving consistency in workload policies to address the different modes of teaching. At a University level there have been structural organisational changes to support and foster learning and teaching. Some of these changes are represented in Figure 1. There has also been a significant investment in initiatives associated with the Flexible Learning Institute which are reported on in an inter-institutional DE HUB project (Buchan 2012).
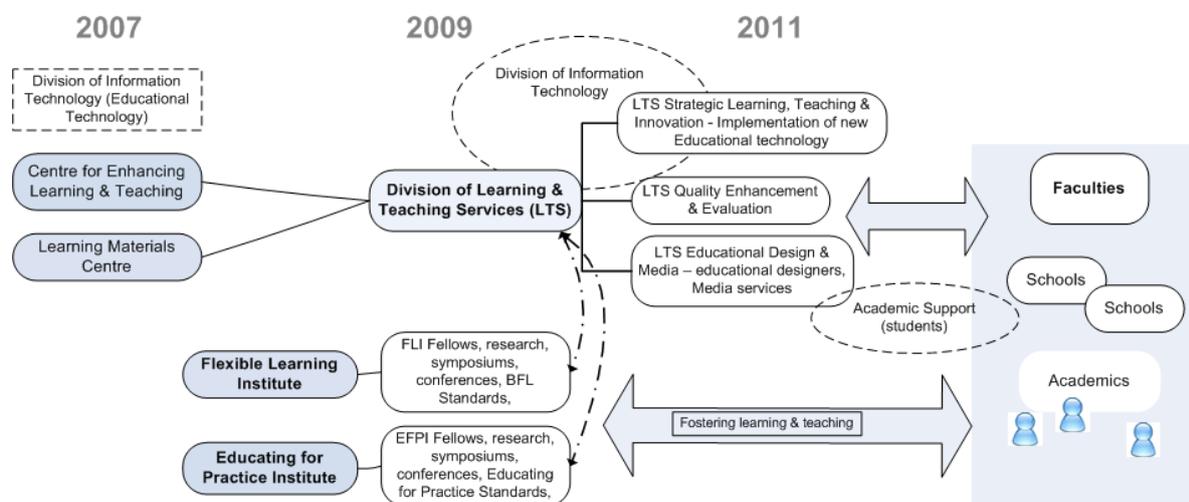

Figure 1: **The changing organisational structure of CSU: focusing on educational institutes, divisions, and units which support and foster learning and teaching (Buchan 2012)**

Wicked Problems have no stopping rule (the problem is never solved completely).
Educause Review's top Ten IT issues (Camp, DeBlois et al. 2007; Ingerman, Yang et al. 2010) are a good indication of current areas of concern in educational technology management. A Wicked Problem may never be solved completely, but only resolved again and again. This is not intended as flippant or critical, but realistically suggests that we need to consciously employ particular approaches to the management of truly wicked problems. When a wicked problem is identified there needs to be a tacit acceptance that there can be no single solution. One needs to be prepared to monitor, reassess and identify issues continually to address current progress.

Adaptive management

Adaptive management techniques are used extensively in natural resource management in an attempt to manage the uncertainty and complexity associated with natural resource management (Lee 1999; Allan and Curtis 2003; Allan 2004). The promise of adaptive management is that it has the potential to allow use of the management process as a way of understanding complex processes (Stankey and Allan 2009). The origin of adaptive management is in work done in the 1970's where scientists began looking for alternatives to existing environment assessment methods (Holling 1973).

Adaptive management combines management, research and monitoring and is a means of changing practices so that credible information is gained and management activities are modified by experience (Allan and Curtis 2003). Briefly, the adaptive management cycle begins with using indicators to benchmark and determine the current state of the environment. Planning is then done, the plans are implemented and the effects of the changes/new systems are monitored and reviewed. At each stage in the adaptive management cycle there is active reviewing of the current situation and learning from action that informs ongoing changes and improvements towards desired outcomes (Figure 2).

An important part of the process of policy and managerial decision making is adaptive management (Allan 2007). The essence of adaptive management is that it contributes to improved governance (policy and organisational processes). By using adaptive management the governance process itself is seen as 'experimental' and there is an in-principle agreement amongst contributing stakeholders to continually change things. While the term 'governance' may not sit comfortably with many academics, it is a part of our university management system and one with which we need to engage.
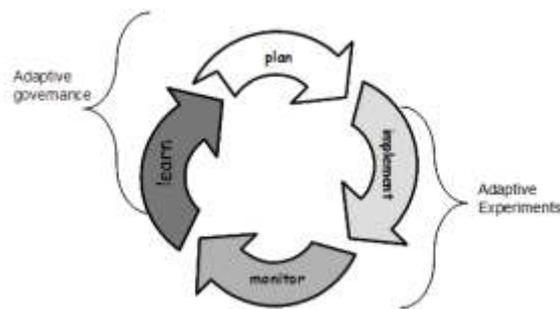

Figure 2: A simple conceptualisation of adaptive management (Allan 2007, p.2)

Adaptive management has promise in the educational management field because it ensures a focus on the *shared values* of the learning environment. It could potentially provide a way of developing dynamic policy and management decisions that can last beyond the lifecycle of a research or institutional project and could contribute to the ongoing management of the learning environment (Buchan, Rafferty et al. 2009). The promise of adaptive management also provides a way in which the evidence from academic research can inform management decisions to help a university truly become a learning organisation (Watkins and Marsicr 1993; Somekh and Thaler 1997; Dealtry 2008), thus making the most of its core business – learning.

Exploratory research into adaptive management

Since 2003 I have explored the application of adaptive management in educational management in a number of separate studies. These include exploring the use of adaptive management in: course (program) and subject management; environmental sustainability education programs; institutional project management and institutional change management for educational technology. A brief summary of the key aspects of the studies are provided here and readers are referred to the original research works for more detail.

Adaptive management was first introduced for use in educational management through a conceptual study; 'Lessons from nature: Developing an adaptive management model for sustaining quality learning environments' (Buchan and Buchan 2003). The original study drew heavily on environmental theory, metaphor and technical terminology. The outcome of that original study was the Adaptive Management Model which could be used as a framework for planning and analysis in educational environments. This original framework drew on principles of management for our natural environment to develop a values-based decision-making tool.

In 2004 the Adaptive Management Model was refined into the Adaptive Management Conceptual Framework and applied to the field of sustainability education in the paper: 'Successful Environmental Education: Adapting to the Educational Habitat'(Buchan 2004). A conclusion from that study was:

> 'Introducing adaptive management to the educational environment shifts the boundaries of the paradigm of educational management. It ensures that management of the learning environment is holistic; that the decisions made feed into actions and the effects of those actions are measured, with any necessary improvements made in the future. Most importantly, it ensures that the decision making processes controlling environmental sustainability education programs are grounded in appropriate values. Environmental sustainability education programs should be a fundamental part of our survival and it is only once something has an intrinsic value that its future is secure.' (Buchan 2004, p.54)

Adaptive management and blended learning

Between 2005 and 2008 adaptive management was incorporated into the longitudinal study; 'An investigation into the enhancement of blended learning environments – towards an effective pedagogy and practice' (Buchan, Rafferty et al. 2009; Rafferty, Munday et al. 2011). This research resulted in a refined Adaptive Management Framework (Figure 3) that is more suited to practical use in the educational environment paradigm than the more detailed original 2003 model and 2004 framework. The important focus of this Framework is the *learning* that takes place throughout all the stages. Moving through the cycle may take days, weeks, months or even years as appropriate. The timescale is essentially dictated by what and how one is measuring, what feedback one is gathering and the rapidity with which feedback is fed into each stage.
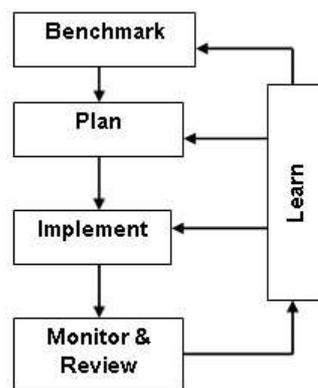

Figure 3: An Adaptive Management Framework (Buchan, Rafferty & Munday 2009, p.16)

> The Adaptive Management Framework was successfully introduced as a technique for managing the individual subjects over a number of teaching sessions (2005-2008). The researchers found the adaptive management steps; benchmark (learn), plan (learn), implement (learn), monitor and review (learn) (see Figure 2) to be a good way to focus on continuous improvement in the learning environment for the students subjects and the overall subject learning environment over time. The reflective learning process that is fundamental to successful adaptive management complemented the heuristic inquiry method used in the research. Learning from one's actions in adaptive management ideally feeds directly into policy changes that help to improve the learning environment. (Buchan, Rafferty et al. 2009)

Application of adaptive management to institutional project management 2007 to 2011

Adaptive management was explored for its possible contribution in institutional educational technology project management. This was done through one of the Online Learning Environment Programme Project teams of which I was the Project Lead. The study took place during 2007. A participatory action research model was trialled in the Project team. The key outcomes of the trial are summarised in this extract from my reflective journal.

> 'I had the feeling early on that using adaptive management in its purest sense in a project situation would not give a true reflection of adaptive management, because adaptive management is about

defining policy, taking a certain approach, and then reflecting and changing that approach according to the outcomes monitored. Projects are finite, and quite simply, the project cycle of a well run project contains the Plan-Implement-Monitor-Review cycle as part of its normal functioning…

This intuition was confirmed during the project, and I would say that the project cycle is probably closer to the action research cycle than adaptive management *per se*. This is because we were not trying anything new, and good project management requires that all team members are constantly learning from the situation as they go, and adapting accordingly…

[However] I believe that there is room for adaptive management in managing activities in the learning environment. Perhaps the critical difference between the very efficient project management approach to our operations and an adaptive management approach is perhaps that adaptive management has that longer term focus. adaptive management I would say supports the development of long term strategies, requires one to look at the big picture and not simply to focus on the current task, or at least to know where that task fits into the bigger scheme of things.' [2007 10 05 Buchan Reflection]

A more detailed understanding of the intricacies of institutional project management and the potential of projects as a means of implementing widespread (institutional) change and transformation has led to new understandings around project management for e-learning (Buchan 2010).

Using adaptive management in institutional-level change management for educational technology
Since 2010 the University's Interact2 Project has been exploring a new system to replace the LMS which underpins our existing online learning environment, *CSU Interact.* As Change Management Lead in the Interact2 Project Team, I have introduced the Adaptive Management Framework into the Interact2 Change Management Plan.

The Adaptive Management Framework is a guiding strategy for the processes and temporal aspects of the change management plan. The essence is benchmarking i.e. identifying *where we need to* be as a 'benchmark', and where the different parts of CSU (schools etc.) *actually are*. This provides a starting point for developing needs analysis tools and processes as part of the change management process. Benchmarking leads into Planning and then Implementation. Adopting an adaptive management approach ensures that we not only build continual monitoring and feedbacks into the implementation process, but importantly continue to learn along the way to inform improvements at each stage of the process. (Buchan 2012).

Further lessons from adaptive management

Stakeholders - the importance of stakeholders in the adaptive management feedback loops within the technology-enhanced learning environment was identified and some limitations in current models of using stakeholders were highlighted. A common link between environmental management and organisational management is that of shared resources and interests and thus a focus on the differing needs of stakeholders. The OLE Programme brought academics and professional (general) staff together in teams of multiple stakeholders. This foreshadowed changes to organisational structure and policy to support educational technology and we saw 'unprecedented inter-divisional and faculty cooperation' (Buchan 2010. P.71).

Organisational learning - single and double loop learning as principles of organisational learning were explored in relation to adaptive management. These principles are pre-cursors to complex systems thinking, and were explored for their potential in developing resilience at a whole-of institution level (Buchan 2012 in prep). Single loop learning within prescribed processes makes existing processes more efficient. Double loop learning means knowledge generated from single loop learning is internalised in the organisation (Argyris and Schon 1978). Double loop learning effectively supports the concepts of the learning feedback loops in the Adaptive Management Framework (Figure 3 above) where, at all stages of the adaptive management process, there is the opportunity for learning within the organisation.

Governance and policy - towards a dynamic approach – There were observed limitations in university policy development and governance in support of new models of learning and teaching. I was advised that an 'organic' approach to policy development was appropriate: 'Don't write policy in advance, once people begin using *Interact* the Learning and Teaching Committee and Senate can respond to required changes.' Taking the 'organic' approach, however, can leave the university in a precarious position where one may have been introducing new models of learning and teaching and new educational technology without the support of appropriate policy and guidelines (Buchan and Swann 2007; Buchan, Rafferty et al. 2009). Another observed limitation was that the changes in governance and policy can be independent of other initiatives. Policy changes thus end up being reactive and not proactive or anticipatory.

A final perceived limitation in policy development is inadequate feedback processes. In the absence of true lines of feedback such as those afforded by the adaptive management approach, on-ground experience and needs do not necessarily translate to changes to policy, governance and practice.

Conclusion

This paper only touches the surface of what is needed in order to effect a paradigm shift. That shift is to acknowledge a changing goal: that in our higher education environment there can be no single, stable state and change will be a constant.

I have taken some licence in drawing on the aspirational potential of adaptive management, as seen within the original context of environmental management in Allan and Stankey's 'Synthesis of lessons' (2009. p.346)

> Think then, what could be achieved in [educational management] by adaptive people, working together in trusting relationships, and within supportive organisations and institutions. When these types of processes become the norm and the standard – rather than the exception or the noteworthy – we will have made significant process *(sic)* to the goal of sustainable [environmental management of our technology-enhanced learning environment].

'We need courageous management if Adaptive Management is to work.' (Allan 2007). The reality of adaptive management in practice is that it does not always work (Smith 2009; Stankey and Allan 2009). However, one can sometimes learn as much from what did not work, as from what did. While there are limitations to applying adaptive management at an institutional level, some principles and concepts can contribute towards the development of strategies for managing a changing learning environment. The application of adaptive management in its broadest sense requires decision makers to: be prepared to come together for a common cause; be open to change and experimentation in governance and policy; plan with the intention to learn; learn from their actions; make use of multiple points of learning throughout the management process; use evidence-based practice to make their decisions and to be aware there can be no single optimum solution to a problem.

It will also be a courageous management which takes the essential step towards acknowledging that the many challenges we face in higher education are *simply* wicked problems. The wicked problem confronting us is that of creating sustainable approaches to new models of learning and teaching with technology *while managing for a changing environment*. Our management approaches need to reflect that there are no silver bullet solutions (for today's Wicked Problems the solution may need a scattergun or shotgun).

To return to the basic premise of the 2012 Ascilite Conference theme that; 'what happened in the past is no longer a reliable guide to the future'. If we do not learn from what happened in the past, it may well be a reliable guide to an unsustainable future. This is evidenced in this research which has proposed some ways forward as to how we can learn from the *past and the present* to inform a more sustainable future.

Moreover, real change will come through understanding the complex system which is the learning environment. This is the area being documented through the application of a social-ecological systems' approach to managing change through doctoral research into 'Developing resilience and managing change in technology-enhanced learning environments' (Buchan 2012).

References

Allan, C. A. (2004). Improving the outcomes of adaptive management at the regional scale. School of Environmental and Information Sciences, Faculty of Science and Agriculture. Albury, Charles Sturt University. Doctor of Philosphy

Allan, C. A. (2007). Can adaptive management help us embrace the Murray-Darling Basin's wicked problems? 5th annual Stream Management conference. Australian rivers: making a difference. 21-25 May 2007. Charles Sturt University.

Allan, C. A. and A. Curtis (2003). "Regional scale adaptive management: Lessons from the North East Salinity Strategy (NESS)." Australasian Journal of Environmental Management 10: 76-84.

Argyris, C. and D. A. Schon (1978). Organizational learning: A theory of action perspective. Massachusetts, Addison-Wesley Publishing company.

Bore, A. and N. Wright (2009). "The wicked and complex in education: developing a transdisciplinary perspective for policy formulation, implementation and professional practice." Journal of Education for Teaching 35(3): 241-256.

Buchan, J. (2004). "Successful environmental education: Adapting to the educational habitat." Australian Journal of Environmental Education 20(1): 45-56.

Buchan, J. (2008). Tools for survival in a changing educational technology environment. Where are you now in the landscape of educational technology? Proceedings ascilite Melbourne 2008 Melbourne, Ascilite.

Buchan, J. (2010). "Putting ourselves in the big picture: A sustainable approach to project management for e-learning." Journal of Distance Education 24(1): 55-75.

Buchan, J. (2012). The changing nature of learning and teaching at Charles Sturt University 2008-2011. A paper commissioned for Childs, M., Brown, M., Keppell, M., Nicholas, Z., Hunter, C. & Hard, N. (2012). Learning leadership in Higher Education: the big and small actions of many people. . M. Childs, Brown, M., Keppell, M., Nicholas, Z., Hunter, C. & Hard, N., DeHUB.

Buchan, J. (2012). Developing resilience and managing change in technology-enhanced learning environments. Faculty of Education. Toowoomba, University of Southern Queensland. Doctor of Philosophy.

Buchan, J. (2012). Interact2 Change Management Plan. Bathurst Charles Sturt University.

Buchan, J. and A. Buchan (2003). Lessons from nature: developing an adaptive management model for sustaining quality learning environments. 16th Biennial Forum Conference proceedings Open and Distance Learning Association of Australia. Canberra, Open and Distance Learning Association of Australia.

Buchan, J., J. Rafferty, et al. (2009). An Investigation into the enhancement of blended learning environments – towards an effective pedagogy and practice. CSU Scholarship in Teaching fund project final report, Charles Sturt University.

Buchan, J. and M. Swann (2007). "A Bridge too Far or a Bridge to the Future? A case study in online assessment at Charles Sturt University." Australasian Journal of Educational Technology 23(3): 408-434.

Camillus, J. (2008) Strategy as a Wicked Problem. Harvard Business Review 2008: a year of management ideas

Camp, J. S., P. B. DeBlois, et al. (2007). Top 10 IT Issues. Educause Review. 42: 12-32.

Conklin, J. (2005). Wicked problems and social complexity. Dialogue mapping: Building shared understanding of wicked problems, Wiley.

Dealtry, R. (2008) The design and management of an organisation's lifelong learning curriculum.

Fazey, I. and L. Schultz (2009). Adaptive people for adaptive management. Adaptive environment management. A practitioner's guide. C. A. Allan and G. H. Stankey. Collingwood, Australia, Springer Science+Business Media B.V. and CSIRO Publishing: 323-338.

Holling, C. S. (1973). "Resilience and stability of ecological systems." Annual Review of Ecology and Systematics 4.

Ingerman, B. L., C. Yang, et al. (2010). Top-ten IT issues, 2010. EDUCAUSE Revies, Educause. 45: 4-60.

Krause, K.-L. (2010) The 'Wicked' Problem of Quality in Higher Education: Macro, Meso and Micro Perspectives.

Lee, K. N. (1999). "Appraising adaptive management. ." Conservation Biology 3(2).

Murphy, N. (2010). "Juvenile justice – a wicked problem. Reflections on a strategic review of the NSW Juvenile Justice System." from http://www.aic.gov.au/events/seminars/2010/murphy.aspx.

Oblinger, D. (2010). "From the campus to the future." Educause Review 45(1): 42-52.

Oblinger, D. (2012). IT as a game changer. EDUCAUSE Review, EDUCAUSE. 47: 11-24.

Rafferty, J., J. Munday, et al. (2011). Ten rules of thumb in blended and flexible learning: a study on pedagogies, challenges and changing perspectives. Education 2011-2021 SUMMIT. Global challenges and perspectives of blended and distance education. Sydney, DE HUB - ODLAA.

Rittel, H. and M. Webber (1973). "Dilemmas in a general theory of planning." Policy Sciences 4: 155-169.

Smith, A. C. (2009). Lessons learned from adaptive management practitioners in British Colombia, Canada. <u>Adaptive environmental management: a practitioner's guide</u>. C. A. Allan and G. Stankey. Collingwood, Springer- Science+Business Media: 39-55.

Somekh, B. and M. Thaler (1997). "Contradictions of management theory, organisational cultures and the self." <u>Educational Action Research</u> 5(1): 141 - 160.

Stankey, G. H. and C. A. Allan (2009). Introduction. Chapter 1. <u>Adaptive environmental management. A practitioner's guide</u>. Melbourne, Springer Science+Business Media b.v. and CSIRO Publishing.

Trowler, P. (2010) Wicked Issues in Situating Theory in Close Up Research.

Uys, P., M. Keppell, et al. (2010). CSU Educational technology framework. Bathurst, Charles Sturt University.

Watkins, K. and V. Marsicr (1993). <u>Sculpting the learning organization. Lessons in the art and science of systemic change.</u> San Francisco, Jossey-Bass.

Author contact details:

Janet Buchan, jbuchan@csu.edu.au

Please cite as: Buchan, J. (2012) Sustaining new approaches to learning and teaching with technology - more than just a Wicked Problem.In M. Brown, M. Hartnett & T. Stewart (Eds.), Future challenges, sustainable futures. In Proceedings ascilite Wellington 2012. (pp.164-173).