COVER PAGE

PROJECT TITLE: *The art of interconnected thinking – Starting at the beginning*

AIM

Our aim is the evolution of typical, simple cause and effect, linear thinking among students to more sophisticated and realistic 'interconnected' thinking. Participation in a stimulating simulation introduces new ways of thinking and behaviours across the curriculum, enhancing the capacity of students, preparing them more effectively for a complex and challenging future as leaders or citizens.

ABSTRACT

There is an urgent need for innovative ways of thinking and a fresh approach to dealing with the unprecedented and complex challenges facing our world. It is essential for future leaders and citizens to be prepared for 'interconnected' thinking to deal with complex problems in a systemic, integrated and collaborative fashion – working together to deal with issues holistically, rather than simplistically focussing on isolated features.

An educational tool promoting the evolution of thinking skills and new behaviours from typically linear and narrow to holistic, broad and deep will be introduced across the curriculum. The *Ecopolicy* simulation 'game' is a challenging but playful method by which students are introduced to the idea of thinking in terms of relations, in feedback cycles, in patterns, in networks, and in systems.

Based on the European experience, we will introduce this simulation on August 1, 2013 across the University faculties to students in first year ("Starting at the beginning").

KEYWORDS: systems thinking; complexity; curriculum; future; issues; *Ecopolicy* simulation game; lifelong learning; evolution; cultural evolution

The art of interconnected thinking – Starting at the beginning

RATIONALE FOR AND AIMS OF THE PROJECT

The fundamental assumption underlying this project is that we are surrounded by systems, and are, indeed, a part of systems. However, humans are not in the habit of seeing this or thinking systemically. Evolution has favoured mechanisms tuned to dealing with the immediate surface features of problems, and the complexity of systems tends to overwhelm our cognitive capacities (Checkland 1999; Leveson 2011). Even when we can see that 'something is wrong with the system', we tend to analyse the problem by breaking the system down to smaller parts looking for *the* problem until we begin to lose sight of the interactions between all the elements (Ackoff 1999; Dekker 2010). That is, it is mentally easier to break something down to inspect an individual component than to study the component and its relationship to other components simultaneously. Actions are often difficult to understand; interactions multiply that difficulty.

Despite many efforts to deal with various complex issues facing our societies, from city planning to international relations, plans and problem solutions are therefore seldom long lasting, because we, as individuals, and our leaders, are most likely to fall into the evolutionary trap of using traditional linear thinking. It is natural and easy, but does not usually deliver long-term solutions in the context of highly complex modern communities (Brooks 2006; Land, Hauck et al. 2009; Thomas and Amadei 2010). Linear thinking might be satisfactory if you are deciding where to build a house if there are no councils, no neighbours and no environmental regulations. And powering modern economies would be easy if we could burn oil and coal without consequence. But these activities, like all activities, have consequences. And current approaches to complex consequences and 'wicked' problems are almost universally ad hoc. Silos of ideas, policy and activity abound, while issues bubble along without satisfactory resolution, ranging from environmental protection to city planning.

It has become clear, therefore, that some cultural evolution is needed so that current and future decision makers consciously consider the dynamic interplay of all the elements in a system when complex social, economic, or environmental issues are being tackled (Bosch, King et al. 2007; Dodgson, Hughes et al. 2011; Keegan and Nguyen 2011; Nguyen, Bosch et al. 2011). More comprehensive and cross-partisan approaches are required (Nguyen, Graham et al. 2012; Walker, Porter et al. 2012), including the encouragement of interconnected or systems thinking.

Encouragement must be conscious and active, since systems thinking is not common. Results from a study with middle school students (Assaraf and Orion 2005) indicate that most of them encounter difficulties in all aspects of systems thinking, even in the very basic ones, and must be 'trained' by experience. According to Jacobson and Wilensky (2006), even university students tend to solve complex systems problems using simplistic arguments (linear thinking). It is suggested, however, that skills for comprehending the structure and the visible aspects of the behaviour of a system are most easily acquired by young students (Hmelo-Silver and Pfeffer 2004), and systems thinking skills are important in helping students understand the many complex relationships that exist in the natural and social world (Maani and Maharraj 2004).

Some studies have investigated college students' systemic thinking skills in specific domains and proposed ways to improve them through learning interventions (Richmond 1994; Golan and Reiser 2004). Evagorou et al. (2009) have reviewed the work of many scholars highlighting the importance of elaborating systems thinking skills in the learning routine of specific scientific fields such as ecology, physics, and social sciences as a prerequisite for conceptual understanding of the topics taught (Hogan and Thomas 2001; Klopfer and Resnick 2003; Wilensky and Reisman 2006). However, Evagorou et al. (2009) claim that there are limited resources for teaching systemic thinking within science, especially for younger students. They also argue that learning about complex systems is hard and it has proven difficult to improve under current educational settings. This argument is in line with findings from many previous studies (Penner 2000; Sheehy, Wylie et al. 2000; Richmond 2001).

> *Young people are at an age in which they can access interconnected thinking with the greatest of ease. As a matter of fact, training in interconnected thinking should start early – before specializing in a certain field of study. We need experts who do not pursue their special topics in isolation, but in an end-to-end context, integrating it in a systemic overall understanding* – Prof Fredmund Malik (renowned international management expert), Malik Management, Switzerland.

The aim of this project is therefore to enhance the skills and capacity of students in Australian universities by creating new ways of thinking, shifting away from traditional linear, simple cause and effect thinking to systems and interconnected thinking. The ways in which the students will benefit from learning to look at the world in a more comprehensive way are numerous. We hope to introduce practices and concepts into the curriculum (OLT 2013) that will enable students to look at the trees and also see the woodland; to look at the illness and also see the whole person; to look at a business and see a whole community; to look at a building development and see a whole neighbourhood; to look at a painting and see mastery and history.

First year (at the *beginning*) students at The University of Adelaide (UA), therefore, will be introduced to the concepts of systems and interconnected thinking through the *Ecopolicy simulation game* (see Approach).

APPROACH

The educational systems-based *Ecopolicy computer game* (Malik 2010; Vester 2010) will be used as a main tool in the implementation of the chosen approach. Ecopolicy uses the simulation of cybernetic processes to introduce people to the art of interconnected/systems thinking (Vester 2007). In the game the players/teams act as the government of a country (in despair), with the goal to stabilise the country. The actions of the government are simulated according to systemic rules in order to develop a balance between key areas including politics, production, environment, quality of life, health, education and population. Teams build up a score that reflects the number of decisions made to develop a sustainable system, the effectiveness of their actions to address the complex issues involved, the ease of getting out of trouble after wrong decisions have been made, and the feasibility of proposed policies.

The project will begin on 1 August 2013 (see Timeline for details of proposed activities) with 500 students from all five UA's faculties (25 teams of four students per team from each faculty – practising and competing to select the winning team). The winning team from each faculty will participate in the final round (UA *Ecopolicyade*). This final round (having invited guests from relevant and real government departments and educational institutions) will serve as a promotion for extending the approach to other educational institutions in South Australia and eventually Australia as a whole.

The proposed approach is innovative, user-friendly and enjoyable. This is not an extra curricular activity for the students, but built into the curriculum of selected courses. They are not required to have any special knowledge or mathematical skills to be able to take part in the implementation and evaluation of this approach. This simulation game has proven highly attractive to young people. The increasing uptake of the *Ecopolicy* game concept has led to several countries in Europe (e.g. Germany, Switzerland, Austria) running the game as an annual competition between classes and schools in regions and finally as a national competition called *Ecopolicyade* (Management 2011) – an Olympiad for this evolutionary thinking game in education. In Europe, it already takes place in the presence of policy makers in government, business managers and other decision makers to create an inter-generational and inter-cultural co-learning experience for all involved (see Endnote). The running of a national competition has far reaching implications and provides clear evidence of the usefulness of this approach to achieve the main aim of this project – an evolution in ways of thinking. In Germany alone, more than 200,000 students nationwide now take part in the annual *Ecopolicy* competitions and the final is held in the German Parliament.

Ecopolicy has also been introduced to other countries including the USA, Australia, Vietnam, Argentina, China and Japan. The team for the proposed project has so far introduced *Ecopolicy* to 16 selected high schools in Adelaide; four universities and 18 high schools in Haiphong City, Vietnam (see Endnote). At UA, the team has already received substantial interest and willingness from faculties' academic staff and students to participate in such a seed project (after giving a university-wide *Ecopolicy* seminar in July 2012).

Evaluation of the success of the *Ecopolicy* game concept as a mechanism for achieving the main aim of this project will be done through questionnaires and surveys (e.g. uptake by the students, effectiveness of team working, scores of competing teams). These will be carried out prior to, at implementation, and six months after. Scientifically designed questions that will specifically unlock the way students think about an issue (e.g. holistic or linear; systemic or systematic; etc.) will provide qualitative and quantitative evidence and data that will be used to model the nature of change in the mindsets of students and the degree to which the systems thinking approach has contributed to instilling those attributes that will be required from future leaders and decision makers.

This seed project will be a pilot project strongly aligned with two of the university's strategic plans including "a centrality of small-group discovery" and "a beacon for research – focusing around 'wicked' problems and grand challenges" (UA 2012). It is envisaged that the successful implementation of this seed project will lead to a larger project extending to other Australian universities. Sustainably, the project team will also incorporate this approach into the newly developed systems thinking courses at the UA.

In addition, lessons learned from this seed project and close collaboration with the Swiss and German counterparts will be used to develop a model for the establishment of regional competitions and eventually a nation-wide *Ecopolicyade* in the Australian Federal Parliament.

ANTICIPATED DELIVERABLES, OUTCOMES AND VALUE OF THE PROJECT

The anticipated deliverables and outcomes of the project relate to and address a majority of the key issues under the program priority "Curriculum design" (OLT 2013, pp. 4-5), including:

- inclusivity
- promotion of cross- inter- or trans- disciplinary programs and pedagogies
- re-positioning or re-shaping of discipline-based courses
- revision of assessment practices in the context of curriculum development
- the evolution of the teaching model from first to final year
- the future direction and coverage of programs of study
- use of information and communication technologies

The project will produce the following deliverables/outputs:

1. A conference paper on the effect of this research and how it has changed the ways of thinking of the students.
2. A journal article – developed from output 1.
3. A conference paper on the process to extend the *Ecopolicy* program to other Australian universities.
4. A journal article – developed from output 3.
5. Interim and final reports.
6. "A new way of thinking" and integration skills for the students and those involved.

Outcomes and value of the project are multiple. Participation in the *Ecopolicy* program by the students will lead to the development of principles and testing of theories around awareness and personal responsibility in discipline areas, society, economy and politics (Management 2011). In addition to the benefits of "Starting at the beginning", it is expected that the learnings about interconnected thinking during the UA *Ecopolicyade* and during the competitions will create a deeper awareness of the usefulness of systems thinking by all participants, including current and future policy makers, planners and managers in all walks of life. This awareness and new skills and tools will inform policy changes in education, as well as policies and management strategies that will have sustainable and long-lasting effects.

Importantly, the project (and its envisaged larger scale project) will contribute significantly to the provision of new and innovative guidelines and actions in tertiary educational institutions. This would lead to a new generation of Australian leaders and citizens with personal and professional skills that include the ability to contextualise, to better grasp the interconnectedness of the many variables that determine the personal, professional and above all, societal environment in decision-making processes, and to self-determine the need for team work and collaboration across different areas of interest. They will further be able to identify systemic interventions that will address the root causes of complex problems rather than focusing on "treating the symptoms" with "quick fixes", to interact and communicate meaningfully, and to build resilience and be adaptable. Students will not only understand the disciplines they study, but also how their area of interest fits into the larger societal and global systems picture. These all lead to the creation and development of a new generation of effective leaders in all fields in the learning society we envisage for the future of Australia – leaders who will have the ability to promote environmental, economic, social, and culturally important issues, nationally and globally.

This project will also significantly enhance our knowledge of why and how to facilitate a highly needed societal/cultural change that is extremely difficult to achieve – that is, shifting away from traditional, mainly linear, thinking towards "a new way of interconnected thinking". The outcomes of early intervention through

the inclusion of interconnected thinking skill development in educational programs will greatly contribute to the effectiveness of education in relation to the ability to achieve productive livelihoods, to develop integration skills and to develop pathways to enable lifelong learning.

The deliverables of this proposed research will be disseminated to a wide range of audiences including scholars, the general public, educators, and policy makers. Outputs of each stage of the project will be presented at relevant national and international conferences and revised as manuscripts to be submitted to high ranking journals. Key findings of the research at each stage will also be released to the general public via the media. Reports will be submitted to the OLT and policy makers at relevant levels of governance for consideration of embedding the recommendations from the research into future policy making and changes to the educational curriculum.

The project leader will also disseminate and promote the research outcomes through the extensive network that he has been built at the annual Future Summit (in which he was an Australian Leadership Award Recipient in 2011). The Future Summit provides "a collaborative framework for Australia's established and emerging leaders to share ideas and exchange views to help shape Australia's future". In addition, this seed project will have the readily available assistance from the UA's Research & Innovation Pty Ltd, South Australia's premier commercial research company, to disseminate and promote the research outcomes.

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Endnotes: Media reports and links providing useful and additional information about *Ecopolicy* and *Ecopolicyade*:

1. Ecopolicyade in Europe:
   - http://www.video-artwork.ch/vorschau/ecopolicyade_en.htm
   - http://www.frederic-vester.de/eng/ecopolicy/
2. Introducing Ecopolicy to high schools in Adelaide:
   - http://blogs.adelaide.edu.au/business/2013/01/24/systems-design-complexity-management/
   - http://business.adelaide.edu.au/documents/Starting-with-the-Young-Brochure.pdf
3. Introducing Ecopolicy to Haiphong City, Vietnam:
   - http://baohaiphong.com.vn/channel/4920/201208/15-truong-hoc-tai-Hai-Phong-tham-gia-chuong-trinh-Tro-choi-phat-trien-ben-vung-2187381/
   - http://www.youtube.com/watch?v=Oj7TlZYKQj8

PROJECT TEAM

Dr Nam Nguyen (*project leader, home page: http://www.adelaide.edu.au/directory/nam.nguyen*)

Qualifications: BA (NEU, Vietnam); MA (University of Adelaide); PhD (University of Queensland)

Experience: Dr Nam Nguyen is one of the founding members of the newly established Systems Design and Complexity Management Alliance in the University of Adelaide Business School. He has been awarded a number of nationally and internationally competitive academic fellowships and research grants worth more than $1 million (including three University of Queensland ResTeach Fellowship grants for teaching the systems thinking courses at UQ). He is also a recipient of the prestigious Australian Leadership Award 2011 (awarded by the Australian Davos Connection - ADC) and a Vice President of the International Society for the Systems Sciences.

Dr Nguyen has taught and published extensively in the fields directly related to this proposal (please see *homepage*). As a very active early career academic, Dr Nguyen has started to develop a strong national and international reputation. Nationally, he was invited to join the Advisory Group contributing to an Australian L&T Council project on Decision Support Systems in Australian Universities. Dr Nguyen had also contributed advice to the 'Australia Reports 2011 & 2012: Risks and Opportunities' prepared by ADC and KPMG. In addition, he has successfully coordinated two Australian Leadership Award Fellowship programs funded by AusAID.

Internationally, his research is attracting much attention from systems scientists. This is evidenced in the recent publication of four articles in the official *Journal of the International Federation for Systems Research* (IFSR); these articles are all related to the proposed project. He was one of the only 28 systems scientists from around the world invited to attend the 2012 IFSR Conversations in Austria, participating in the Conversation of the Theme 'Designing Learning Systems for Global Sustainability'.

Proposed role:
- 20% time commitment
- Taking responsibility for managing the proposed project, its design, conduct and results, coordination of the competitions and gathering of data and information, and publications.

Prof Ockie Bosch (*project team member: http://www.adelaide.edu.au/directory/ockie.bosch*)

Qualifications: BSc (Potchefstroom University); MSc (Potchefstroom University); DSc (University of the North West, South Africa)

Experience: Prof Ockie Bosch is the Leader of the newly established Systems Design and Complexity Management Alliance in the University of Adelaide Business School. He was previously Head of the School of Integrative Systems at the University of Queensland, where he was responsible for a highly successful repositioning of the School as a reference point for systems research and education in Australasia and beyond. Through his efforts, systems concepts have been successfully incorporated in all discipline areas/Faculties with systems courses that added value and contributed significantly to the work and life readiness of students in any area of interest.

Through his role as Vice President of the International Society for the Systems Sciences (ISSS), active involvement in the International Federation for Systems Research (IFSR) and an academician of the International Academy for Cybernetics and System Sciences, Prof Bosch is a leader in research on the worldwide development of systems curricula for different types of students. He has played a major role in the redesigning of the Adelaide MBA to become a cutting edge 21st century program. He is one of eight designers in five countries who, due to their recognition of the potential of Evolutionary Learning Laboratories (ELLabs) as effective mechanisms for dealing with complexity, are currently developing a sophisticated platform and virtual environment to enhance the effectiveness of the Global Evolutionary Learning Laboratory (GELL) through collective intelligence concepts.

Prof Bosch's current position is research intensive. His teaching at the University of Adelaide, Keio University in Japan, Sonoma University in California and the University of Patagonia is part of his research methodology to experiment in the ELLabs with different teaching and learning strategies to effectively instil the graduate attributes that employers want and that will create new era leadership.

Proposed role:
- 10% time commitment
- Contributing to the training of lecturers for the proposed project, project design, coordinating the running of the competitions and gathering of data and information for modelling, publications.