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Workshopping a Sustainability Scenario with First Year Engineering Students in a Problem Based Learning Environment

Exploring and Appreciating Complexities of Attaining Sustainable Systems

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Abstract: The workshop activity serves to demonstrate how technological changes impact on society. In this case this is exemplified by the establishment of an irrigation scheme and by the degradation of environmental resources. A side issue is how the impact of the media on peoples perceptions of events. Students are allocated roles and participants of two companies (The Little Rock Company and Aquarius Incorporated) and two shops (The Black Stump Food Market and Aragon Supermarket). All other participants take on the role of workers. Students are provided with organisational performance information (Revenue versus Production) and need to operate, using a designated currency with a changing exchange rate, within an arena of technological changes and environmental impacts with media reporting changes and fuelling perceptions and speculations.

Keywords: Problem based learning, Sustainability, Portfolio, Reflective journal, Team learning

Introduction

RELATIVELY MODERN ENVIRONMENTAL phenomena such as ozone depletion, global warming, salinity and pollution have been implicated in illness, weather changes and once arable land becoming non-productive. The resulting effect on society and the economy, has forced people to reassess many of the industrial, farming and engineering practices of the past. Subsequently, gone are the days when conspicuous and inefficient consumption of the world's finite resources is considered to be acceptable, and sustainable practices in relation to the ecology, the economy and society also known as the Triple Bottom Line (Elkington 1999) have become important criteria to be satisfied in modern ventures.

In line with increased focus on this Triple Bottom Line and other sustainability matters, engineering professionals of today are facing the paradigm shift from old-school thinking and are presented with new challenges when finding sustainable solutions to modern engineering problems. Hence, the onus is on engineering educators to assist our future engineers in gaining an understanding of the complex relationship between the ecological, economical and social elements of the triple bottom line so that the next generation is well prepared to meet the challenge.

During the first year of engineering undergraduate study at Central Queensland University (CQU) students complete a Project Based Learning (PBL) course titled Engineering Skills II. This course aims to develop many generic professional skills such as communication and teamwork but there is also a strong emphasis on sustainability. One of the ways that students may develop a better understanding of sustainability is through participation in a Sustainability Workshop which is offered as part of the course. The workshop enables students to explore the principles of the Triple Bottom Line through the consequences of their actions in a simulation of the changes in economic, environmental and social aspects within a constructed society of Bankers, Shop Owners, Employers and Workers.

This paper will show how the Sustainability Workshop is conducted and discuss some interesting developments that have taken place. Factors for improvement or diversification will be presented.

Background

Sustainability

In the 1987, World Commission on Environment and Development (WCED) report entitled "Our Common Future", which has become known as the "Brundtland Report" after the Commission's chairwoman, Gro Harlem Brundtland, defined sustainab-

ility as "meeting the needs of the present generation without compromising the ability of future generations to meet their needs" (Brundtland 1987). However many definitions of sustainability and sustainable development have evolved since then. Even so such definitions tend to encompass the common thread of living within defined limits, understanding and appreciating the interconnectedness between the economy, society and the environment and the notion of equitable distribution of resources and opportunities. It is this holistic definition that is adopted in our discussion of sustainability.

An important aspect indicated by the Brundtland Report was the call for increased co-operation with industry (Brundtland 1987). Professional engineering bodies recognise the importance of this and have incorporated the need for developing and experienced engineers to be provided with opportunities that challenge them to recognise and exercise sustainable practices. The Engineers Australia Code of Ethics (2000) outlines the responsibility of engineering professionals in regard to sustainability which is stated as; *'Members shall, where relevant, take reasonable steps to inform themselves, their clients and employers, of the social, environmental, economic and other possible consequences which may arise from their actions'* (Engineers Australia 2000). Similarly the Engineers Australia policy on Sustainability and Environmental Practices (2003) states that *'Engineers Australia believes that sustainable environmental practices are important to economic and social development in Australia'* (Engineers Australia 2003). This again acknowledges the interrelationship between social responsibility, environmental quality and economic prosperity in society as seen by the Australian professional body for engineers. From this it may be seen that an holistic awareness of the dynamics that exist between the social, environmental and economic variables is a highly desirable attribute for an engineering graduate. As such, responsibility falls on engineering educators to ensure that undergraduate engineers are provided with the tools they need to develop the holistic awareness of sustainability that is desirable. Professional engineers need to be conversant of the principles and interplays of economic, environmental and social aspects of the Triple Bottom Line (Elkington 1999) and other sustainability issues.

Project Based Learning

Project Based Learning is a learner-centric approach to learning. Emphasis is placed upon the learner being engaged in a manner where they take greater responsibility for their learning while operating within a team environment. Focus is given to developing a range of skills such as discipline specific technical skills, verbal, written and visual communication skills, team building skills and reflective practice which are mapped to graduate attributes defined by the professional body Engineers Australia (Engineers Australia 2005).

Authors such as Schmidt (1989) and Savery and Duffy (1994) highlight that PBL is grounded in cognitive, constructivist theories of learning (ie. people learning by building on and adding to what they already know) and memory. While Gijselaers (1996) and Hmelo & Lin (2000) contend that it incorporates elements of socio-cultural theory. The aim of PBL is to provide opportunities for the learner to develop a high professional competency through the acquisition and exercising of critical thinking skills, problem-solving abilities and new knowledge and promotes their ability to work productively as a team member, make decisions in unfamiliar situations and allows for the acquisition of skills that support self-directed life-long learning, self-evaluation, and adaptability to change (Engel, 1991; Albanese and Mitchell, 1993; Ryan and Quinn, 1994). In particular the problem drives the student's learning with the teacher's role being as a 'facilitator' who guides the students by modelling the investigative process (Barrows 1986; Charlin et al 1998).

Central Queensland University provides a unique combination of PBL, co-operative education and professional practice. Faculty members have published widely in this area for almost a decade with a selection of examples of the latest publications being Toft et al (2000), Smith et al (2002), Howard et al (2003)

and Howard and Jorgensen (2005).

Sustainability Workshop

Learning Objectives, Teaching Practices and Learning Environment

During the first year of engineering undergraduate study at Central Queensland University (CQU) students complete a Project Based Learning (PBL) course titled Engineering Skills II. Engineering Skills II has learning objectives that include the ability to analyse and assess the viability of an engineering project by applying the principles of "sustainability". Students are given opportunities to develop and demonstrate this by three means;

1. By attending sustainability centred lectures where guest speakers present different perspectives of practices of sustainability in their roles and responsibilities. These speakers are diverse and in any one year range from academics and professional engineers to politicians.
2. By completing a major six week team-based sustainability centred project and,

3. By participating in the sustainability workshop. The major component of the workshop consists of role play. By actively engaging in the workshop, students gain a first hand perspective of the issues and aspects relating to the consequences of their actions on the social, economical and environmental aspects highlighted in the workshop.

In particular the objective of the sustainability workshop is to clearly demonstrate to students the relationship between social responsibility, environmental quality and economic prosperity.

Although the students participating in the sustainability activity are from a single cohort, they are not necessarily familiar with all the other participants as they come from three campuses separated by a significant distance. The weekly interaction for the course Engineering Skills II usually includes a video-link between three campuses on the Eastern seaboard of Queensland Australia.

Choosing Rockhampton as the central site, the nearest northern university campus is situated at Mackay some three hours by road from Rockhampton and the nearest southern campus is located at Gladstone, an hour by road from Rockhampton. An order of complexity is introduced to the workshop as students are transported to the Rockhampton campus and conduct the workshop face-to-face. Bringing the campus groups physically together for this activity therefore provides an opportunity for students from the three campuses to socialise. The facilitators in fact encourage this by asking for one student from each campus to form the business and shopkeeper groups.

These mixed campus groups also provide students the opportunity to work with people having differing geographical perspectives. For all campuses, the majority of students are from small to medium-size Queensland towns and cities, with a minority from cattle producing properties and agricultural farms. A student's origin may have an influence on their current perspective on sustainability, as those with a rural background normally work very closely with the land and other natural resources. Thus the activity provides opportunities for the students to further develop teamwork and communication skills.

Although the Central Queensland culture is diverse, there is not the same range of variance in cultural perspectives as would be experienced in a larger metropolitan area. This may be seen as limiting the experience for most students as they are not exposed to explicit cultural influences and perspectives that are beyond their own life experiential norm.

Actions Prior to the Conduction of the Sustainability Workshop

Invited speakers present guest lectures for the first year students which consist of a 40 minute presentation followed by a 20 minute open forum for comments and questions. The speakers include the Queensland Minister for Housing, several practicing professional engineers, the Director of CQU's Indigenous Learning, Spirituality and Research Centre, and the co-ordinator of a local conservation group. They are requested to speak freely based on their personal experience and expertise, and as such provide an important insight into how others define and consider the enactment of sustainable practices. By exposing students to differing perspectives they are encouraged to critique, discuss and distil a more meaningful understanding by distinguishing the rhetoric from the reality of the circumstances and case studies presented to them.

The students are given several weeks notice to enable them to schedule their attendance at the workshop, which is conducted at a time that they do not normally attend university. They are provided with only a brief description of the sustainability workshop purpose and content, to ensure that they do not develop any preconceived ideas of how the activity will be conducted. Attendance is not strictly compulsory but students are encouraged to attend resulting in a participation rate of about 90%. This good attendance rate may be due to the student's clear understanding that they are ultimately responsible for their own learning, and also perhaps due to the opportunity to socialise and interact within the complete first year engineering group.

When speaking to students, the teaching team generally refer to the activity as a workshop or activity rather than calling it a "game" so that the activity is not pre-judged as a waste of time by students. However, students inevitably refer to the activity as a game when reflecting. This is not necessarily seen as negative. After all, game implies fun and there is evidence that when students are engaged and involved, their learning is enhanced (Antepohl & Herzig 1999). However, the activity must have learning outcomes that are carefully planned.

Conducting the Sustainability Workshop

The facilitator begins the workshop by introducing the main concept of the activity which is to demonstrate how technological changes (exemplified by the establishment of an irrigation scheme and by the degradation of environmental resources) impact on society.

Participant roles are explained and allocated – a Central Bank, two retail Shops and two companies (Employers) are created, each staffed by three stu-

dents. The remaining students are Workers and function in pairs as 'single' workers. The currency for the activity is explained and distributed – four different tokens are used: *money, food, work* and *raw material*. Companies combine *raw material* and *work* tokens to yield a final product. As Employers, the companies are each allocated 30 *money* tokens, the Shops are each allocated 20 *money* tokens and each Worker pair is allocated two *money* tokens and one *work* token. Initial token exchange rates are given. Each company is provided with a revenue verses production graph which defines their individual performance.

The interactions and exchange required to enable and define the activity are presented as an Interactions Flowchart (Figure 1).

The activity begins with each Worker having the opportunity to negotiate with at least one company (Employer) and one Shop. Once the negotiations have been concluded, participants may trade by exchanging tokens with each other as defined by the Interactions Flowchart.

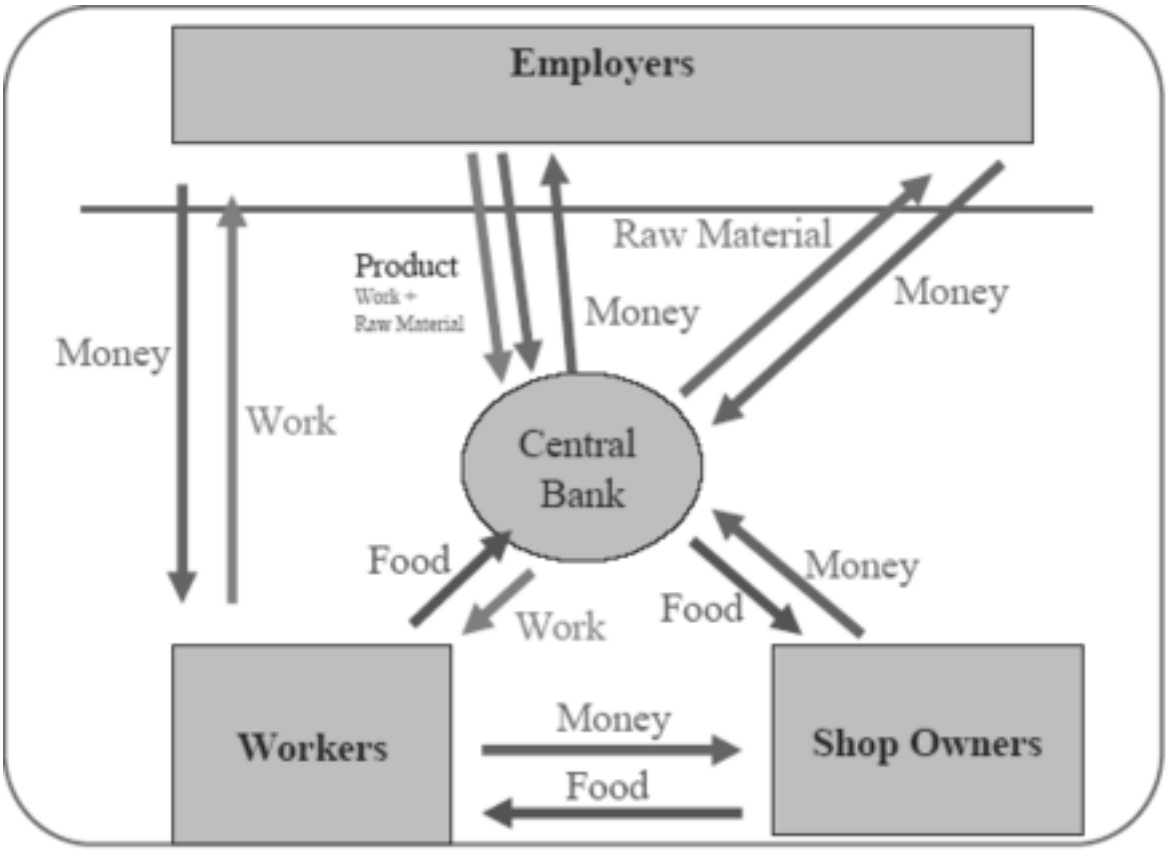

Figure 1: Interactions Flowchart

Once the activity commences, the role of the facilitator is to observe progress in terms of trading and general interactions.

Trading is interrupted periodically by controlled and predefined events that are introduced by the facilitator such as public media releases, a private offer made to one company to invest in new technology, a confidential environmental report, all of which have a significant effect on the environment and economy. Societal impacts and reactions become quickly evident to all participants as the value of the companies, food and work are directly affected (imposed by a facilitator-controlled altering of the token exchange rate).

The interplay of economic, environmental and social factors is demonstrated through the manipulation of the changing profitability of one of the companies. This Employer group is offered an opportunity to invest in new technology. The investment choice has direct environmental and economic consequences for the company (including a change in their revenue verses production graph) and these changes inevitably have implications for the wider society though the students in the company often do not realise this at the time the decision is made.

The workshop is conducted over a period of about 2 hours which has proven to allow sufficient time for the impact of all introduced events to permeate throughout the society.

Debrief and Outcomes

Once the workshop has been terminated the facilitators lead a debrief session. The debrief forms an important part of the activity as students playing the various roles share their experiences with the group.

The desired outcome of the debrief is to ensure that students leave the activity thinking about the workshop as a whole and to stimulate deeper reflection on sustainability issues.

Participants are asked to comment generally on their experiences throughout the workshop: whether they felt they were 'successful' or not. This often leads to questions of what students perceive as 'successful'. Usually their first response is that success is measured by the number of money tokens they have acquired.

The facilitators may then challenge a participant, say a Shop Owner who has many Money tokens but nothing else, as to how they would continue to trade if they have no Food. The response may be that a judgement was made that the workshop was coming to an end and the 'winner' would be the one with most money. The Facilitators should make it clear that there are no 'winners' of the workshop and that Food, Work and Raw Materials are also essential components of a complete system.

The facilitators ask the members of each of the Employer groups about their experiences. Due to the events that have taken place during the activity, members of one of the companies are generally reasonably happy about how the workshop went from their perspective, while members of the Employer team who were offered the investment choice may comment that they were hindered by the circumstances of the workshop. The students in this company, while operating in the context of the effects of profit and loss, have been challenged to understand the implications of their actions if they do not demonstrate socially responsible investment. Facilitators ensure that the disgruntled team make it clear to the entire group how they were disadvantaged if they made a bad environmental choice.

Facilitators ask Workers how they were affected by the changes that occurred throughout the workshop. Workers will often comment that after reading the Media Releases, they changed their behaviour as they anticipated changes in food prices.

It is important to ensure that the session ends on a positive note and that students have heard a range of experiences and opinions that will help them develop an understanding of the interdependence of environment, economy and society. At this point, facilitators may introduce concepts such as "natural capitalism" (Hawken et al 2000), the "Triple Bottom Line" (Elkington 1999), and such provocative ideas as "greenwash". Greenwash (a portmanteau of *green* and *whitewash*) is a term that serves to give a positive public image to putatively environmentally unsound practices. The term arose in the aftermath of the Earth Summit held in Rio de Janerio in June 1992. Students also discuss and adopt aspects of Environmental Management Systems and an appreciation of the mechanisms for responsible environmental benchmarking such as the adherence to a standard (eg. AS 1400).

As part of the model of Problem Based Learning students are required to maintain a reflective journal to record their impressions, opinions, actions and thoughts, critique their contributions and those of others, reflect on the success of learning environments and teaching approaches and make suggestions for improving their practices and the conduction processes of the course.

Interesting Developments

As with any open-ended activity, participants often engage in behaviours that are not specifically defined or encouraged by the rules of the workshop. One example that the facilitators have noted on several occasions is the forming of 'Unions' by groups of Workers. This behaviour, as in the real world, allows the Workers to bargain collectively with Employers, thereby improving their negotiating position. Workers in the 'Union' generally end the workshop in a better financial position than other Workers.

In other circumstances, a group of Workers have asked the facilitators if they can open a Shop, that is become Shop Owners, in competition with the Shop Owners established by the facilitators at the commencement of the activity. The Workers who requested this had accumulated a 'nest egg' that they wished to use as capital to start their business. This entrepreneurial behaviour is not discouraged and in fact adds interest and further realism to the workshop.

Another development noted by the facilitators several times has been some Workers ending up out of the workshop i.e. they have no Money or Work tokens and are effectively destitute. On one occasion, the facilitators decided to introduce 'Social Welfare', giving destitute Workers some Money tokens so they could re-enter the workshop. In the latest instance of the workshop, Workers were placed into groups of two rather than playing alone as had been the case previously. Interestingly in this instance none of the Workers ended up destitute. The facilitators speculate that having two Workers negotiating together as a unit puts them in a stronger bargaining position and results in better decision-making, however further investigation would be needed to validate this.

Participants have also been observed to demonstrate altruistic behaviour, giving money to a friend (Worker) who is destitute. They may also offer a participant who has few tokens a 'better deal' than someone who is obviously profiteering.

Of course, not all participants are so selfless in their behaviour and some nefarious activities also occur. The facilitators have never observed any theft occurring but participants will certainly at times take

part in behaviours that might be characterised as dubious such as trying to cheat when exchanging tokens or offering 'mate's rates'.

Conclusions and Factors for Improvement or Diversification

Reflective analysis of the sustainability workshops conducted in past years has resulted in the following:

- Single Workers replaced with Worker pairs. Facilitators had noticed in previous years that during the activity, some Workers became destitute having lost all their tokens and effectively withdrew. Asking Workers to participate as a Worker pair enables them to practice team work and assists with motivation and involvement.
- Shop and company personnel to consist of 3 students, each from a different campus. This results in a broader range of diversity/experience/perspectives. The facilitators believe that this increased interaction between the campus groups assists in making the workshop more dynamic and also reduces the instances of dishonest activities.
- Social innovation has been allowed to continue i.e. students are free to create shops, companies, banks, trade unions etc. if ethical behaviour is observed. The facilitators believe that these innovations provide valuable experiences that would be sacrificed if these variations were prohibited.

Other changes that could result in further improvement and diversification of the activity are:

- Adding an event or modifying an existing event to incorporate cultural heritage issues. In the Australian context this could consist of one of the businesses having to negotiate with the traditional owners of their new larger factory site.
- At present, participants can take on the role of Worker, Shop Owner, Employer or Bank. The workshop could be made more complex by adding in other categories such as Government.
- Rerunning the Workshop in the final year of the engineering program in order to discover the difference between the perception of students at the beginning of the engineering program and students graduating the program.

This paper has shown how the Sustainability Workshop is presented and how the facilitators, by carefully focussing this open-ended activity, give the participants the opportunity to gain an appreciation of the complexities of a sustainable system. Feedback received from individual participant's journal entries indicates that the activity has a positive impact on perceptions of the importance to the engineering professional and the wider community of considering sustainability in engineering design.

Possible future research could include measuring quantitatively the effectiveness of each of the sustainability learning opportunities i.e. the guest lectures, sustainability project and sustainability workshop, in changing students' perceptions of sustainability.

Although the workshop is by nature artificial, it provides the vehicle for many complex real-world interactions to be modelled in a relatively simple way. As a consequence of this learning experience, in particular as evolving engineering professionals, students are being challenged to appreciate the principles and need for sustainable design and to gain an understanding of the imperative to operate within an adopted mindset that incorporates a perspective of the interconnected influences, implications and consequences of economic, environmental and social drivers.

References

Albanese, M. A., and S. Mitchell. "Problem-based Learning: A review of literature on its outcomes and implementation issues." *Academic Medicine* 68: 52 – 81, 1993.

Antepohl, W. and S. Herzig. "Problem-based learning versus lecture-based learning in a course of basic pharmacology: a controlled, randomized study." *Medical Education* 33: 106-113, 1999.

Barrows, H. *Problem-based Learning Applied to Medical Education.* Springfield, Illinois: Southern Illinois University School of Medicine, 2000.

Brundtland, G (ed). *Our Common Future: The World Commission on Environment and Development*. Oxford: Oxford University Press: 43, 1987.

Charlin, B., K. Mann and P. Hansen. "The many faces of problem-based learning: a framework for understanding and comparison." *Medical Teacher* 20: 323-330, 1998.

Elkington, J. *Cannibals with Forks, The Triple Bottom Line of 21 st Century Business*. UK: Capstone 2, 1999.

Engel, J. "Not just a method but a way of learning." In *The Challenge of Problem-Based Learning*, eds.D. Boud and G. Feletti, 21-31. London: Kogan Page, 1991.

Engineers Australia. *The Institution of Engineers Australia Code of Ethics* 2000, viewed 7 December 2005, http://www.engineersaustralia.org.au/about_us/res/downloads/Code_of_Ethics_2000.pdf .

———. *Policy on Sustainability – Environmental Practices*, 2003, viewed 12 December 2005, http://www.engineersaustralia.org.au/policy/policies.html .

———. *Accreditation Criteria Guidelines*, 2005, viewed 12 December 2005, http://www.ieaust.org.au/membership/accreditation.html .

Gijselaers, W. "Connecting problem-based practices with educational theory". In *Bringing Problem-Based Learning to Higher Education: Theory and Practice*, eds. L. Wilkerson and W. Gijselaers. San Francisco: Jossey Bass Publishers, 1996.

Hawken, P., A. Lovins and L.H. Lovins. *Natural Capitalism: Creating the Next Industrial Revolution*. Boston: Back Bay Books, 2000.

Hmelo, C. E. and X. Lin. "Becoming self-directed learners: Strategy development in problem-based learning." In *Problem-based learning: Research perspectives on learning interactions* (pp.227-250), eds. D. Evensen and C. E. Hmelo. Mahwah, NJ: Erlbaum, 2000.

Howard, P., D. Jorgensen and F. Nouwens. "Enhancing Learning and Employability of Engineering Graduates at Central Queensland University: A Ten-Year Project." *Business/Higher Education Round Table (BHERT) News, Developing Generic Skills: Examples of Best Practice* Issue 16, April 2003.

Howard, P., and D. Jorgensen. "Development of a Professional Bachelor of Engineering Program – A Ten Year Project and Project Based learning and Professional Practice – Enhancing Co-operative Education." *The 14 th World Conference on Cooperative Education, including the 3 rd International Conference on Practice Orientated Education*, June 14-17, Northeastern University, Boston, Massachusetts, 2005

Savery, J. and T. Duffy. "Problem-based learning: An instructional model and its constructivist framework." *Educational Technology* 35: 31-38, 1994.

Schmidt, H.G. "The Rationale Behind Problem-Based Learning". In *New Directions for Medical Education: Problem-based Learning and Community-oriented Medical Education* eds. HG Schmidt, M.L., MW de Vries, JM Green. NY: Springer Verlag, 1989.

Smith, R., D. Jorgensen, P. Howard, I. Devenish and P. Keleher. "Project Based Learning: Challenging Traditional Learning Paradigms". *Smart State - Science Conference*, Brisbane, 24-25 October, 2002.

Ryan, G. L., and C.N. Quinn. "Cognitive apprenticeship and problem based learning." In *Reflections on Problem Based Learning* eds. S. E. Chen, R. Cowdroy, A. Kingsland and M. Ostwald, 15-33. Sydney: Australian Problem Based Learning Network, 1994.

Toft, Y., P. Howard, and D. Jorgensen. "Toward a sustainable future – an alternate model for teaching undergraduate ergonomic and engineering courses." *Ergonomics for life: at work, home, and leisure, Proceedings of the Ergonomics Society of Australia Inc. 36th Annual Conference ,* October 8 – 11, 2000.

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Fae's background is in structural design engineering. She currently works in tertiary education, facilitating students in project based learning courses as well as flexible learning environments. Fae is currently involved with the development of innovative programs that combine flexible delivery with the philosophy of learning in context. Fae's research interests include engineering education, sustainability, scheduling, artificial intelligence, combinatorial optimisation and structures.

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Assoc Prof David Jorgensen

David Jorgensen is responsible for the strategic development, operation and delivery of all CQU engineering undergraduate programs. He has been involved in the design and development, operation and delivery of innovative, flexible engineering programs at several tertiary and TAFE institutions since 1980. This followed a number of years working as a Professional Engineer in the electricity supply industry in the 1970s. His main scholarship interests encompass professional engineering practice and education innovation and development, including co-operative education and project and problem based learning and professional practice.

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Mr Ken Smith
Ken has experience in heavy industries such as aluminium smelting, mining and shale oil production with a focus on project management. Ken has teaching experience in the vocational/post compulsory and tertiary education sectors where he has taught engineering at both a trade and undergraduate level. Ken also has a background in both civil and military aviation and holds commercial pilot qualifications.

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