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INNOVATION EDUCATION IN NSW DESIGN AND TECHNOLOGY CURRICULUM

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Abstract
Do technology teachers in secondary schools and academic stakeholders share the national vision of knowledge and innovation when implementing Design and Technology curricula? Directions for an innovation climate have been endorsed by the federal government, and demanded by various industry groups, since 1996. This paper explores the extent to which education providers of secondary schooling have embraced the call for teaching and developing innovation capacities through technology curriculum.

The Australian Science, Technology and Engineering Council (ASTEC) in 1996 underpinned “foresight” as an essential dimension to our thinking which attempts to capture the dynamics of change and the need to incorporate “technacy” in primary and secondary school and teaching practices for fostering innovation capacities among students. Various national reports have since added to this agenda including the Department of Education, Science and Training (DEST) report ‘Australia’s Teachers: Australia’s Future: Advancing Innovation, Science, Technology and Mathematics’ and the posting by DEST signalling Australia’s newest national research priority to foster the uptake of innovation in human capital. There is a need to analyse and understand whether there is a capacity for NSW schools to deliver on the above agenda given historical difficulties within the State’s system to embrace new pedagogy in the field of technology education and associated teacher capital.

Introduction
The aim of this paper is to summarise the basis of a doctoral project commenced this year at Southern Cross University. It explores preliminary issues and sets up key questions to stimulate the proposed research. This paper questions the extent to which education providers of secondary schooling and academic stakeholders of education have embraced the call for teaching and developing innovation capacities through the technology curriculum. In addition, how much of this uptake in knowledge and direction is known or accepted as having status by state schools and universities. It could be argued the aim of education is to develop creative and innovative thinking abilities as well as to develop students’ social, cultural, and environmental responsibility. The conventional approach has been to develop student mastery of methods, techniques and an understanding of materials, processes and information systems through the application of concepts to problems. Consequently, this paper explores current key issues concerning technology and cultural
shifts for teachers in the NSW secondary schools and how syllabus conventions may effect change.

The Design and Technology Syllabus 7-10 when introduced as mandatory in 1991 in NSW was seen as the core vehicle for interpreting the task of innovation based education. At least on paper, and in the intent of the syllabus rational, the Design and Technology 1991 curriculum focused on problem solving skills driving manual skills (rather than the other way around), and as such a move away from the teacher directed “skills’ genre to that of a creative teacher facilitator role. There has long been an accepted opinion nationally and internationally that Technics and Home Economics trained teachers have shown reluctance to venture outside their comfort zone of manual training expertise since the implementation of the technology curriculum. Inappropriately trained in the rationale of the Design and Technology syllabus has seen previous teaching practices lean toward vocational manual skill and specific tool application training. This paper argues these traditional practices remain extant. Consequently, technology education has been fighting for recognition and academic respectability ever since (Barak, Maymon & Harel cited in Davies, 1999, p. 14; Deal, 1999, p. 1; Goodson cited in Davies & Hansen, 1998, p. 19; Lawson, 2000, pp. 3-5; Seemann, 2000a, p. 1, 4).

In 2003 all TAS syllabi were reviewed and changed for implementation in 2005. The new Design and Technology 7-10 Syllabus has been reclassified as elective rather than core with the Technology (Mandatory) syllabus designed as core for years 7 and 8 only. Given the increasing need for society to grapple with the complex and ubiquitous nature of technology in our lives, it is hard to understand the conservative and retrogressive thinking of curriculum designers and their apparent lack of valuing “values” in technology education that deemed the study of Design and Technology as a mere elective subject choice. This is congruent with previous research that postulates “Design and Technology deserves a central rather than marginal place in a curriculum where dynamic, holistic and critical strengths can benefit students” (Keirl, 2000, p. 15). It should be pointed out that the Technology (Mandatory) syllabus reduces its emphasis on design and innovation and largely predisposes a mode of teaching that increases content in more conventional manual skill and tool application. The situation opens a serious disparity between fundamental needs to engender design and innovation skills education for the future and an aging technology teacher skill base in schools not familiar with innovation and technacy based pedagogy priorities. This is supported by Goodyer (1999, p. 8) who states the aging technology teacher skill base in schools suffer a lack of technological familiarity and clarifies this lack of technological familiarity as teaching ‘out of field’. Added to this is a recent trend in NSW to quickly push into schools briefly trained mature age industry trades people (Department, Education, Science, & Training [DEST], 2003, pp. 81-84. It is argued that because of this lack of innovation and technacy based pedagogy priorities other more conventional syllabus will dominate due to their alignment to the skill genre of the aging technology teacher population. With the rapid pace of change in technology and given the
knowledge and understanding of the current pool of teachers, is being and will be substantially challenged.

**Government Initiatives**

**Innovation and Foresight**

Directions for an innovation climate have been evident since 1996, when the Federal Government endorsed the Australian Science, Technology and Engineering Council (ASTEC) for its first comprehensive foresight review that identified essential priorities for the national interest of technology and science. The report consists of a number of mini-studies, broad ranging consultations, literature reviews and overseas analysis of foresight experiences. Hence, the study underpinned foresight and innovation as a necessary ingredient of our thinking which attempts to capture the dynamics of change. The underlying thrust was a need for Australians to develop holistic understanding and skills in technology and be both sustainability and future oriented in the interest of national development (ASTEC, 1996, pp. 9, 10). Of the eight priority actions accepted in the 1996 ASTEC report, priority number eight stated the need to incorporate “technacy” in primary and secondary school curricula teaching practices (p. 21). Technacy education is values based and where the purpose is to begin not only a new epoch in technology education but also to develop innovation skills in technology teachers. Technacy is “the technological equivalent of literacy and numeracy and is defined as competence in science and technology problem solving that develops the ability to integrate the human, social, environmental and technical aspects of technological issues or initiatives” (ASTEC, 1996, p. 20).

Counterpart to innovation, foresight could best be described as “an act or power of foreseeing” based on “what has gone before”. This is not to be confused with “predicting” the future but more so to map the future from a “particular moment in time” (Slaughter, 1999, pp. 151, 152). By mapping the future, one would assess implications; detect problems before they occur; consider present implications of future events and envision desired futures. Foresight is not something Slaughter has invented. Indeed, this is an increasingly used ethic in companies seeking to make sustainable decisions in terms of their contributions to the environmental impact of their products or services. In doing so, foresighting is compelling companies to be more conscious of the impact of their decisions. In addition, the Australian Commonwealth Government presented the Triple Bottom Line Reporting for Australia document in 2003. This “green paper” was a response to global reporting, pinpointing an essential framework for a sustainable culture. Consequently, organisations are recognising the value of accountability beyond the traditional domain (Commonwealth of Australia, 2003, pp. 1-6). The backbone of the framework is essentially “values” driven, and uses the Triple Bottom Line approach. This approach aims to provide good management by measuring and reporting corporate performance against economic, social and environmental parameters. The framework extends voluntary disclosure that includes impact on natural and human capital, as well as financial capital. Historically, society experienced a stable, slow pace of change and simply designed technologies with
limiting impact on society. Today’s society however, experiences rapid change with technologies superseding themselves within months. Therefore a necessary shift is required away from a “materialistic, short-term, high-impact, rapid growth outlook to one that is post-materialist, long term, low impact and low-medium growth” (Slaughter, 1999, p. 151).

Given it is imperative the widespread implementation of foresight is absorbed into the education system, accreditation and advisory boards such as the Teacher Qualifications Advisory Panel (TQAP); the Board of Studies (BOS) and the Department of Education and Training (DET) all need to be foresighting. Peeling back another layer of education, schools need to be foresighting as well as the trainers of teachers, i.e. universities need to facilitate foresighting practices. It is argued that while it may not be important for slow change content disciplines like Maths, English and History to acclimatise, the rate of change and expectations for innovation demands, foresight and ‘insight’ change far more systematically than any other school subjects and in any other time in history than that of technology education. Thus, systematic foresight should be built into educational institutions, in particular universities where “short term politics, boundary-maintenance and credentialism” is too common (Slaughter, 1999, p.162). Another case in point that deserves considerate attention is to what degree are universities controlled by the traditional, conservative thinking of curriculum designers and accreditation boards and their apparent lack of understanding of foresight, innovation capacity building or terminology?

In 2000, the Innovation Summit Implementation Group presented an 18-month analysis report (Innovation: Unlocking the Future) of the strengths and weaknesses of Australia’s capacity for innovation to the Australian Government and the Business Council of Australia (BCA) at the National Innovation Summit. The findings detailed the need for the government, education, research and businesses to develop a necessary partnership for the national interest of sustainable economic growth within the global economy. The thrust of the report signified the importance of creating an “ideas culture” that is not afraid of taking risks and where experimenting and enterprise are rewarded. Of the 24 recommendations the group presented, recommendation 3, 4 and 5 state the need to develop enterprise skills in schools through workplace opportunities with innovative businesses accessing government support; developments in Information Communication Technology (ICT) and a national review of teacher education (Innovation, Summit, Implementation, and Group, 2000, pp. 9-15). This report played a central role in the development of the Federal Government’s “Backing Australia’s Ability: An Innovation Action Plan for the Future”. In this plan a major initiative to stimulate innovation was aimed to foster scientific, mathematical and technological skills and innovation in government schools in those states where the Enrolment Benchmark Adjustment (EBA) is triggered (DEST, 2000, p.5). Although the council recognised previous achievements of Australia’s capabilities for building a healthy economy, it pointed out Australia could well fall behind current international practices, and for this reason “Australia is sitting at a cross road”.

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We are in the midst of a revolution from which a new order is emerging. The solutions of past
decades will not suffice in the new knowledge age. Intangible assets—our human and
intellectual capacity—are outstripping traditional assets—land, labour and capital—as the
drivers of growth. If we are to take the high road, a road of high growth based on the value of
our intellectual capital, we need to stimulate, nurture and reward creativity and entrepreneurship
(DEST, 2000, p. 8).

In support of “Backing Australia’s Ability”, the Federal Government presented a national
priority report for Technology, Maths and Science teacher training in 2003. The basis of
this report states the need to develop a culture of continuous innovation through design,
technology and science education. This capacity to be innovative is noted as an essential
ingredient to support research and development and where education and industry are now
seen as the “twin engines” for innovation. Hence, schools and teachers are the critical factor
for determining the outcome of economic and social success (shared norms, values and
understandings) through human capital (knowledge, capability and learning). In doing so,
innovation in human capital would nurture individuals to be:

- multifaceted but with a skill to identify and exploit cross-knowledge (cross-domain) patterns (also known as transfer and abstraction skills)
- apply ideas into unfamiliar settings
- break boundaries, problem solve and conceptualise as a part of a team.

However, there is noted evidence of a significant proportion of teachers in the technology
field who appear to struggle and resist, more than one would expect, cultural/technology
change with qualifications that fall short of the standards that the profession itself is
beginning to set for teaching technology in secondary schools (DEST, 2003, pp. 5, 17, 18,
67, 84).

The knowledge economy

Today, technology education sits at the forefront in determining Australia’s future through
technological processes, systems, creativity and higher order cognitive skills. The Vision
Statement articulated in the Higher Education Action Plan (Department, Education,
Training, Youth, & Affairs [DETYA], 2000, pp. 1-6) maps a future where technology
teachers will be the core influence for workers of the future. Knowledge development and
management that drive innovation are the foundations of the knowledge economy that
heralds a new economic growth period. Where “land, labour and capital” (plant,
equipment, buildings and goods used to produce other goods and services) were the drivers
for economic growth during the Industrial Revolution, the importance of an idea, not the
object, as a stimulant for economic growth is now seen as the main driver for the
knowledge economy (Romer cited in Fee and Seemann, 2002, p. 3). Traditionally, where
raw materials, production and non-production workers were seen as economic inputs,
hardware (physical equipment), software (codified and transmittable knowledge) and
wetware (tacit knowledge) are now viewed as the drivers for economic input (ibid, 2002,
p.5). In addition, Australia’s National Research Priority number 5 states Australia must be
at the cutting edge of international developments in order to maintain breakthrough science
and frontier technologies. To do this, Australia needs to understand the factors conducive to
and acceptance of an environment that stimulates creativity and innovation through human talent, societal and cultural values (DEST, 2003b).

**What is happening in schools?**

Recently the NSW Department of Education and Training (NSW-DET) invited expressions of interest from teachers to engage in research involving quality teaching, action learning through professional development. DET offered to fund up to $15,000.00 through the Australian Government Quality Teacher programme with the view of improving teaching pedagogy within the priority areas of literacy, numeracy, mathematics, science, vocational education, gifted and talented education and the technology key learning area that includes ICT. To what degree this opportunity was taken up by teachers pose an interesting scenario. One of the conditions to this grant involves the applicant school partners with a university academic to provide external research and practice improvement advice to further develop the quality of their teaching skills. An interesting anecdote has shown a contrast in interest for research and professional development with two schools. One case example school, lead by a teacher strong in Design and Technology, has embraced the opportunity to openly explore improving their faculty’s teaching practice towards innovation. However, another case school, also lead by a teacher strong in Design and Technology, experienced a negative situation with staff members denouncing the opportunity and refusing their Head Teacher to undertake the initiative based on a resistance to the idea that innovation and quality teaching means exposing their practice to external peer processes. The extent to which such negative reaction occurs in state Technological and Applied Studies (TAS) departments is worthy of research as it would be critical that technology teachers, of all teachers in schools, are far more expected to model a progressive approach to the study and teaching of technology and innovation development in schools. Where innovation focuses on “a deliberate action to steer change” (DEST, 2003, p. 3), and given teachers have in the past been reluctant to initiate changes in their teaching practices, and where foresight, innovation and entrepreneurship have been a government agenda since 1996, there are many questions raised concerning school and classroom practices in NSW. For example:

- Are teachers adopting creative approaches by encouraging students to take calculated risks?
- Do teachers embrace technology to enhance student’s learning?
- How are they utilising community resources?
- How accepting are teachers to take up government funding for the purpose of professional development through research?
- Are teachers satisfied with teacher training and what choice of training is involved?
- How well does the emerging 2005 technology syllabi stimulate or develop creativity and innovation, in particular, the uptake of innovation in human capital?

With all of this in mind, and given anecdotal evidence, the state education system appears to be on a backward sliding or at least confused agenda. One may ask how well syllabus conventions affect change? What is the point of changing a syllabus when the evidence for a change in practice is not significant? Is it supposed to reinforce long standing comforts and conventions or effective change in teaching pedagogy and practice? Further, with
In respect to teacher training, what is the systemic affect toward university ethic that is independently driven by research and scholarly work? In other words, will there be an increasing gap between the pattern to remain conservative in many technology school faculties and the obligation of a university education to be forward looking and progressive in technology studies? Consequently there is a need to analyse and understand whether there is a capacity for NSW schools and the new syllabi to deliver on the above agenda given historical difficulties within the state’s system to embrace new pedagogy in the field of technology education and associated teacher capital.

**Research method**
The basis of the study investigates teacher background knowledge, attitude and concerns, as factors that may influence the level of commitment to follow the national innovation agenda, with an emphasis on teacher knowledge of innovation and expected cultural shifts. Given that a significant increase in the knowledge base of new teachers toward the fundamentals of building student capacities in innovation in and through the study of various technologies will emerge, undergraduate students will be targeted from regional and metropolitan universities. In doing so, an extra dimension to the study may well stimulate an interesting setting of graduating students emerging into a traditional school setting. The key question being asked is:

- Do technology education providers and secondary teachers share the national vision of knowledge and innovation when implementing design and technology curricula?

Three sub questions support the main question for the study:
1. How are schools nurturing the uptake of innovation in human capital in design and technology?
2. Does the current curriculum content of technology education at the secondary level support the directions for an innovation climate and how may this impact at university level?
3. What constitutes innovation and how should innovation be assessed?

To propose a way forward, the theoretical framework for the study will be facilitated through innovation and design theories and an understanding of technology (including key technacy concepts) in conjunction with theories of assessment for learning. The methodology applied will involve a multi method or triangulation research instrument using qualitative and quantitative analysis. Using this method would improve internal validity through the use of two or more methods of data collection and analysis. Where quantitative analysis seeks causal determination, prediction and generalization of findings, qualitative analysis through site visits enable the element of human involvement and expansion of opinions expressed through a survey (Burns, 2000, pp. 419-420; Creswell, 2003, pp. 208-217).
Aimed at regional and metropolitan schools, the intended study will include observation of operational classroom applications. Prior to the survey, a general discussion with the participants (teachers and undergraduate students) will include changes in technology and the effect this has had with teaching and learning practices. In order to determine clarity, readability and length, a pilot survey will be distributed to teachers selected at random from within secondary schools. The survey will propose similar questions (demographics, opinions) for teachers and students and are merged for the presentation of this paper.

- **Respondent Profile**
  - age, gender, qualifications, length of service, time at school/university, executive roles; area of expertise, subjects taught, experience teaching the 1991 Design and Technology syllabus/ practicum experiences
- **Knowledge Base**
  - knowledge of previous syllabus and emerging 2005 syllabus, understanding of rationale, pedagogy, curriculum content, professional development, new technologies, involvement in teaching program development, design theories, understanding/awareness of innovation, government initiatives, knowledge economy, qualities of innovative teaching practices, aim of education and technology education, assessment practices
- **Dispositions/Affect**
  - concerns for change required to teaching, available support teacher training; confidence/comfort level, anticipated degree of change required

**Conclusion**

This paper makes the case that from an employers point of view, school leavers seeking jobs will increase their employability if they can show a capacity for sustainable, long term decision making. What the study aims to explore is how well this ethic is entrenched in the secondary and undergraduate setting for technology education. Given the economic climate sets the scene for what tools we work with, technology education should be burgeoning. Instead, the subject has been held in a time warp hung up on specific manual skill training. This begs the question: are teachers only wanting to see in the industry what they are already practicing in the classroom? If schools are not showing this shift then they are producing a view of the world that does not exist (except as a home craft) for emerging students hitting the gate.

**References**


