Innovation – the key to success

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Abstract
Industry research has shown that the companies that grow are the companies that innovate. Opportunities to teach the principles of innovation in education, and schooling in particular, have rarely been explored in any serious way. No doubt there has been substantial growth in this area in the last decade. The paper discusses the need for instruction in innovation in schools and overviews projects in a number of countries, and the relative success of each. The majority of these projects were conducted outside what we have considered for centuries as 'the traditional classroom'. This raises questions about the adequacy of the speed at which education is changing and to challenge educators to remove their rather 'blinkered approach' to 'incrementalist creep' as the basis of developing future possibilities for education and schooling. Observers would say that education is not keeping pace with societal changes and is in line for a good dose of innovation itself. Research to discover the students' perceptions of current education, support this observation. The paper concludes with suggestions for a more innovative approach to education and the role of technology educators as catalysts for change.

Keywords
innovation, idea generation, Key Stage 4, analysis matrices, design and technology education, risk management

Why teach innovation?
Innovation commences with the work of creative people. If creativity is not nurtured in a society and its workforce, and a respect for the creativity of others is not promoted and rewarded, there will never be a creative and innovation culture. (Ellyard, 1998) The Report on New South Wales Teacher Education sited the opinion of Frank Blount, former CEO of Telstra, that education systems need to be:

' ... turning out a competent, effective workforce within a well-rounded, creative and confident civil society ... In a changing technology-driven world, workers need to be active, creative and capable of continuous adaptation if they are to contribute fully.'
(Ramsay, 2000: 23)

In a country like Australia, and in many countries with abundant natural resources, there has been little recognition of the economic power of a nation's most creative people. Like many other countries, Australia is starting to understand that creative artists, scientists and technologists are the source of economic as well as cultural prosperity. Government funded programmes around the world reflect a growing trend toward the acknowledgement of the need to encourage innovation. Any society that does not support its most creative elements as a mainstream, rather than as a marginal activity, is not likely to prosper, in either an economic or cultural sense.

Countries such as Japan, South Korea, the Netherlands and Switzerland have also invested in the creative power of their people and combined these efforts with mission-directed industrial policies to expand into new industrial areas.

Projects to encourage innovation
One of the measures of whether a true innovation culture is emerging, is the vitality of the venture capital market and its willingness to support the development of new mission-directed innovations instead of problem-centred innovations, and new start up enterprises as against existing enterprises. Companies that aspire to compete globally know that the sole, permanent, competitive advantage that any firm can have is to be a faster innovator, learner and adapter than its rivals.

The Australian Schools Innovation Kit was developed through the TCFL Design and Technology Centre, funded by the Commonwealth Government. The centre was set up to assist the turn-around of the
shrinking textile, clothing and footwear industries. They found very early in its development that innovation was the key to success. The centre headed by managing director, Allan Ryan, set out to find the most effective tools available to inspire innovation in Australian Companies. A rigorous research and interview process arrived at Roger La Salle’s Innovation Matrix®. The Matrix was developed from Roger’s philosophy for successful business, ‘the most of the best for the least’, Roger La Salle. He believes that a successful company needs to be able to deliver the most of its product of the best quality for the least effort and cost. So as well as inspiring innovative directions for new products, he is mindful of the risk analysis needed to overcome the innovation/successful product gap. This also translates into a valuable lesson for secondary students.

Many will relate to Homer Simpson’s attempt to become an inventor as he sat with pen and paper in his hand saying, ‘invent, invent, invent’. At the end of the day there wasn't one idea on his page. It is relatively easy for creative people to be confident enough to come up with numerous ideas. History has shown that very few creative ideas become successful products. Effective market research can be the difference between a good idea for the time and a good idea, wrong market climate.

Roger’s definition of innovation is ‘a change that adds value’. This works on the premise that the most successful ideas come from an association with familiar objects and experiences. The programme looks at the consumer’s assessment of products and problem solving both in the design and the manufacturing of a product.

The La Salle Matrix® is capable of generating 48 ideas in one think process. This is done through working on a grid with four seeds for innovation (or things that can be done to change or enhance a product) and 12 catalysts to stimulate creative thinking about the seeds. This provides a worksheet for cognitive processes beyond the ‘parallel thinking’ proposed by De Bono.

A training package used for industry was the first stage and was successful with companies in developing both successful products and providing them with a vehicle to make improvements to manufacturing environments. Workshops were conducted using ‘Zing Technology’ that allows all participants to generate their ideas simultaneously onto a data screen. The information was posted by individual keyboards. The beauty is that everyone can keep their thought processes moving and every idea is recorded, for a group theme breakdown and analysis. There may be up to three people at each data entry point and once the ideas, inspired by The Matrix, are flowing, hundreds of ideas can be generated in a 10-minute brainstorming session.

Innovation in Australian textile, clothing and footwear (TCF) industries

The textiles industry is at the beginning of a major revolution that will change the way we interact with our environment and each other. It is true that the UK is at the forefront of this revolution. (Boston, 2002) The first “Smart Textiles” seemed futuristic and limited to textiles with copper circuits woven into their structure. This presented limitation on handle.

The new soft switch technology will enable fabrics to be made with electronic circuits that can be handled like traditional cloth that can be crumpled, machine washed and ironed. Developing the technology is just the start, innovating products that utilise the technology is where Australia wants to position itself. Such developments include textiles for car seat covers that sense the weight and height of the driver and passenger so that the required pressure of airbag is applied – airbags have been killing passengers and drivers as the technology was designed for the average male.

CSIRO Australia have been working on their Keratin polymer so that wool can compete with synthetics in production and product design. CSIRO and researchers at the Intelligent Polymer Research Institute (IPRI) at the University of Wollongong Australia are investigating ways that these plastics can be combined with traditional fibres to create fully functional fabrics and clothes. IPRI Director Professor Gordon Wallace says, ‘we’ve already developed an intelligent knee sleeve that tells you if you have landed the wrong way, and it is envisaged that wearable biomonitors with direct feedback will find application in a range of sports training and rehabilitation field’.

It is considered that promoting innovative thought patterns creates the environment to take advantage of the best technological advances from around the world and give Australian industry a unique opportunity to corner important future markets.

Australia’s Innovation for Schools Kit

I was consulted to work with Dr Peter Auer, the developer of the TCFL industry package, on the development of an Innovation for Schools Kit for the teaching of innovation in secondary schools. The programme for schools was first presented to trainee technology teachers for their input and was then presented at three secondary schools to gauge secondary student response to the programme. On each occasion, it was met with an enthusiastic
In the first six months since its release, 22 schools in NSW have used the kit to encourage innovative thought in the development of project work in design and technology and business studies. As with most innovative teaching programmes, it is difficult to gain statistical information on the benefits of the programme. Anecdotally, it prevents the designer block and forces the students to seek out solutions beyond the obvious. Once they have generated ideas, the kit follows a design process that imitates the industry experience. The schools innovation programme encourages the students to look at a logical sequence to complete a quality product from their design. It facilitates analysis in problem solving and designing creative solutions.

The kit also offers opportunities to set up a real or imagined company for group participation. This provides the students with situations that require communication with others, justification of design choices, analysis of risk in design creation and idea promotion and marketing.

Teaching resources in the past have presented case studies of companies who have successfully innovated their products and processes but few actually offer teaching materials on how to innovate their own products.

**Innovation programmes in other countries**

Austria has offered a young innovators scheme since 1989 to support cross-subject project work in upper secondary schools, to foster the ability of students to solve problems independently, and help them to gain real-world experience. Students are provided with a grant after submitting a project report. The winning teams of a nation-wide competition are enabled to participate in international competitions.

The United Kingdom have had innovation for industry conferences running for 11 years but only appear to have set up mentoring programmes for secondary schools since 1999. These initiatives complemented the Competitiveness White Paper. UK Online has a goal ‘to promote a significant increase in innovation and future thinking throughout the economy’. The annual innovative lecture has been offered for 11 years and this year’s lecture entitled ‘Living Innovation – Learning from the Best’, is expected to reach a direct audience of 8,000 business people from the Eden Project in Cornwall via satellite to approximately 40 venues around the United Kingdom.

Innovation in secondary schools in the UK appears to have been introduced in 1999 and concentrates on a mentoring approach. Changes to the Education Bill will give some schools more freedom to introduce innovative programmes. It was reported that Unions representing classroom teachers have mixed opinions about the Bill – but many have criticised plans for more links with the private sector, and to allow more schools to sell their own services to others.

Doug McAvoy, the general secretary of the National Union of Teachers, gave the legislation a partial welcome. He said Ms Morris had shown faith in teachers’ abilities to identify practice which is good for their pupils. It doesn’t appear, however, that money will be made available for secondary schools to develop innovative projects.

The government’s identification of the need to strengthen the UK’s ability to generate scientific and technical knowledge, entrepreneurship and innovation led to the allocation of EURO 40.3 million 1999–2000 for the setting up of eight centres of enterprise in UK universities. The only secondary school programme for students is the Science and Engineering Ambassadors Scheme where top science students are expected to form links with their old school to provide coaching and mentoring and inspire young people to take up studies and careers in science and engineering.

In a White Paper on Enterprise, Skills and Innovation Implementation Plan (31 January, 2002), it was reported that the UK government will foster creativity and enterprise across the education and training system. As with many countries the opportunities are translated into computer skills. The plan reports to introduce modern processes into the curriculum by training 4,500 more teachers in, and equipped with CAD/CAM software by March 2004. A more exciting development that will encourage true innovation, is in the offer of funding to the value of EURO 120.9 million for 75 incubators, (http://www.dti.gov.uk/opportunityforall/whitepaper.html#A1). As stated earlier, this is a true sign of innovative culture development.

America’s innovation project that has been running for six years, is seen as a solution to the cycle of poverty in some disadvantaged areas. The Technology Innovation Challenge Grants (TICG) programme in USA, supports partnerships among educators, business and industry, and other community organisations to develop innovative applications of technology and plans for fully integrating technology into schools. The programme provides competitive five-year awards to consortia that include at least one local educational agency with a high percentage or
number of children living in poverty. Priority is given to consortia that serve areas with high numbers of disadvantaged students or with the greatest need for educational technology, as well as consortia that provide direct benefits to students, ensure sustained professional development for teachers and other educators, and devote substantial additional resources to the project.

Over the past six years, the TICG programme has supported partnerships among educators, business and industry, and other community organisations to develop innovative strategies that fully integrated technology into standards-based curricula. The programme has funded 100 projects. The last five-year grants were allocated in 2000 to be completed in 2005 and range between $3.5–$10 million. It appears to be an attempt to bridge the technology gap between the economically sound city communities and disadvantaged remote communities.

Germany and France have a very different approach to innovation in schools. With the lack of education and instruction focusing on innovation in the standard curriculum, German Education and Training introduced a two-year project in 2000 to increase the awareness of the importance of innovation at an early stage in education and aims at improving the atmosphere for innovation in Germany. The JUNIOR project in Germany, set up in 1994, provides support to schools for incorporating entrepreneurship, i.e. an enterprise offering real products and services, mainly to their local environment. Pupils learn the different aspects of setting up a firm, including financing, marketing, organisation, administration and planning. Another programme in Germany set up in 2000 aims at promoting life-long learning and the development of a ‘learning society’ by supporting the building of networks of educational organisations on a regional level, as well as by developing innovative measures for implementing the principle of life-long learning.

The Youth and Innovation project in France set up in 1996 aims to support 15–25 year olds who want to develop an innovative project. The scheme contributes to a better professional integration between education and enterprises and costs KEURO 2,286 per year.

**Rapid societal changes and innovation**

The traditional vision of the classroom has changed very little, but the potential to develop key learning environments with self-paced systems and interactive environments will be seen in the home and place of work before the classroom.

A vision of the home waking up when we do, the lighting and temperature programmed for our personal comfort. Smart sensors and voice activation devices will replace switches and locks. The garden will be watered when sensors indicate that the optimal moisture content has not been maintained by rainfall.

We will have a robotic home-helper that wakes us gently at dawn or the programmed time with the news – the media of our choice. When we enter the kitchen, the screen on the wall reads our iris and knows our preferred coffee choice and toast requirements and the fridge screen tells us we are almost out of milk. Do we want the automated order sent to the supermarket via internal Internet? And of course, in the living room the furniture will be designed to change colour to suit our mood.

Our mobile phones will have built in tracking devices that will not only tell others where we are but also a local Thai food shop may e-mail us when we are close-by saying, ‘you are 15 steps from a Thai meal, pop in, we have a table ready’. Alternately, we could be mountain climbing in a jacket that interfaces with mobile phones, GPS systems and a heating system that can maintain a temperature of 42o for five hours and monitor your heart rate all within fabric that feels like a second skin.

Can schools continue to lag behind in this climate?

**What do the clients need?**

Innovation can be added as a separate subject into the curriculum. Often this is the only way in which an area can be given legitimacy in a school setting. However, there is already an overcrowded curriculum and the struggle to include yet one more subject may fail to achieve the objective. Where possible, innovation study needs to be incorporated into all areas of study. In an era when there have been many times more knowledge produced in 50 years than that in the previous centuries, the old forms of discipline knowledge are becoming significantly under question so the advent of innovation study may provide a way to discuss re-organisation of the curriculum.

In the last decade, the disciplinary structure of schools has become very obvious. We set boundaries around the ways in which teachers can be registered and certified by the ‘teaching subjects’ that are certified as normal and expected. Anything outside that is too difficult. A number of changes made beyond this disciplinary organisation has recently been attempted, in Australia as elsewhere.

People with technical experience or industry background are faced with almost insurmountable barriers to enter teaching and yet with the shortage of teachers in the area, these people are a valuable resource with tangible benefits to teaching colleagues and potential clients, the students.
The Key Learning Areas are enshrined around Australia in the various curriculum statements and demonstrate the disciplinary organisation that will be quite familiar to most students of the past several generations, even if there have been several different amalgamations and name changes. Employment-related key competencies developed as a result of the Finn committee report by the Mayer committee in 1992, introduced the concept of areas of study beyond subject restrictions. This generated statements of generic and transferable competencies across education and training with schools, where there are no specific contents assumed.

This trend was further developed by UNESCO, with Jacques Delors’ (1996) paper on the four pillars of Life Long Learning, used mainly in the post-school training sector but with potential to work back into schools, especially through vocational education. These include: learning to know; learning to do, learning to live together and with others; and learning to be. Efforts in three different Australian state/territory public education systems have taken on the challenge of new kinds of organisation as a priority in the knowledge privileged in schools. Debates in the ACT (Brennan, 2000) tries to link generic skills with some ethical debate about what kinds of content might be worth studying in high schools. Luke et al. (1999), in Education Queensland’s ‘New Basics’, sum it up best in their consideration of how new forms of knowledge and technology demand new priorities for schools – their ‘New Basics’ is a strong argument for re-conceptualisation of knowledge relations in schools around life pathways and social futures. South Australia’s ‘essential learning’ proposes to build their future curriculum around Identities, Thinking, Futures, Interdependence and Communications.

There is a growing literature that shows how little trust many young people have in their futures. (Beare and Slaughter, 1993; Johnson, 1987; Hicks, 1991) Hutchinson (1992) in his PhD thesis surveyed 650 Australian young people and followed up with a sample through interviews on their hopes and fears for the future. He found six major themes in their views of the future:

1. a depersonalised and uncaring world
2. a violent world, with a high likelihood of war occurring
3. a world divided between the ‘haves’ and the ‘have-nots’
4. a mechanised world of violent technological change
5. an environmentally unsustainable world, with continued degradation of the biosphere
6. a politically corrupt and deceitful world, where voting is seen as a waste of time.

Hutchinson did not leave the study as one focused on fears. He also explored young people’s preferred futures and found four recurrent themes:

1. ‘dreaming’ in which students uncritically accept ‘techno-fix’ solutions for all problems (most popular amongst boys)
2. a demilitarisation and ‘greening’ of science and technology to meet genuine human needs
3. intergenerational equity, as well as an acceptance of our responsibility for the needs of future generations
4. making peace with people on the planet through a re-conceptualisation of both ethics and lifestyles.

Studies such as this go some way towards demonstrating the potential contribution students can make more broadly and the importance of students as active partners in their own education. If students are to be partners in a curriculum, which actively considers innovation studies, then education systems can become in Jane Page’s (1996) term, ‘agents of change’. Without this shift, students cannot become citizens of their own schools.

Technology educators as catalysts for change
I was delighted to hear of the conference on 21 June 2002. The conference, held in the Design Museum on the south bank of the Thames in London, titled exploring doors – a chance to relinquish the shackles of the syllabus we teach and imagine what our future students might be learning in design in 10–20 years.

I wanted very much to attend the conference to participate in the discussion of the questions raised for the conference and posted on the DATA web site. So I present here my own answers. Will the classroom change? It must and there are moves to make real advances in this area. The technology is available for self-paced learning, we have read the research that indicates that the students have great contributions to make, which starts to answer the next question. Will the teaching style change? Many teachers resist learning with their students. Many don’t want their students to gain a knowledge of areas ahead of their own learning. The challenge in teaching today, is to facilitate learning by keeping close contact with industry and develop a strong network with professional associations locally and internationally.

In his address to the Curriculum Corporation National Conference, Australia, Ken Boston (May, 1999) made the point that individual Australian schools are pioneering classroom-based applications of digital teaching and learning, which exemplify and take forward the educational possibilities signalled by researchers.
Amongst the cyber-educationists’ list of claims are that:

- multi-media accommodates multiple intelligences
- children could be taught to think using procedural logic, like a computer.

Through simulation in virtual environments, the theatrical possibilities open to human identity will be endless and that children will inhabit their own electronic worlds. To promote all the pillars of life long learning, there needs to be human interaction. This needs to occur between teacher and student, student and student, teacher and teacher and community. Traditional schools seem to best at meeting that need.

The content is becoming less prescriptive and more relevant. Design and technology is a perfect vehicle to facilitate change. It should really be at the centre of all relevant. Design and technology is a perfect vehicle to facilitate change. It should really be at the centre of all.

To the question – what do we want the students of tomorrow to learn, understand, appreciate, to think? – I am reminded of a passage from the book Education for the Twenty-first Century. (Beare and Slaughter, 1996) Professor Anne Naess, a Norwegian scholar in the philosophy of science, reported to have argued that ‘self-interest’ has to be raised to a new level where we realise that we contribute to everyone’s well-being by loving our environment and that we underestimate ourselves by being selfish, for we are ‘much greater, deeper and capable of more dignity and joy’ than we think. (Naess, 1986 sited in Beare and Slaughter, 1996) I would want students to learn the value of cooperation and collective thought. I would want them to understand that every decision made has a consequence. In making decisions regarding product design or processes, consequences of choice needs to be considered so that positive outcomes exceed negative consequences.

To the question of appreciation, I would want them to appreciate the contribution made by all in society. Some people are better at generating ideas, others better at making them happen. Some need to lead, others need to follow. Although it may appear simplistic, appreciating where they fit and the contribution they make should be a source of pride at whatever level they are functioning.

Finally I would like them to think beyond the obvious and believe that what they think makes a difference. Let them have their dreams and visions. It is a very rewarding experience to start on a challenge raised by a student that seemed beyond their capability only to find that persistence, determination and a will to succeed leads to a realisation of their goals.

When considering the statement that ‘we are the product of our past’, I would have to argue that it is possible for students with a less than productive past, to blossom with inspiration and learn the skills and gain the knowledge required to achieve. It is just as possible to have someone with all the foundations for a positive future to lose motivation and momentum. In the words of Robert Schuller, ‘Failure is never final and success is never-ending. Success is a journey, not a destination’. (Mills, 1993)

What has happened in that time? I am not sure of the timeframe but I imagine it to be the time since the introduction of design and technology. I had been a teacher for 10 years before one of my students suggested that I had not ever worked in the ‘real world’. I remember being grateful for the student’s perception, wrong as it was, because it motivated me to leave the security of the teaching environment to experience the ‘real world’ again. I feel blessed in having an adventurous spirit to take on life’s challenges. After I had been working for myself for five years, I heard of the introduction of design and technology into the school curriculum and immediately related to it. I did value the high skill level that developed out of a prescriptive syllabus that was common before the introduction of design and technology. It is a concern that new graduates that do not come from a culture that value skill acquisition finds it hard to provide the guidance needed for quality skill development. Some will argue that you only need to develop the skills that you need to do a good job on whatever it is you are doing. This is fine so long as there is an appreciation of quality and what it takes to achieve it.

Can we learn from what has been? We still have skilled craftsmen and women who can provide the just-in-time skill development. I hope that there will be people with sufficient interest in traditional skills to take them through to future generations. Innovation is as relevant in changes that add value to traditional technologies as to the new. Pills or psychological counselling were considered the only options for the treatment of depression. A doctor recently confided that his self-help for depression was traditional embroidery. An innovative approach to skill development for micro-surgeons involves learning petit point embroidery for the development and maintenance of fine motor skills without the pressure of the work environment. The curriculum as it exists today is not assisting in the connection of students to concepts that are vital for future survival. Technology education offers many opportunities to address needs from basic to analytical
within the framework of design and technology and home economics (food, textiles and family studies). There are opportunities to teach literacy, numeracy, technacy, science and innovation in meaningful applications. The students learn in a less threatening environment and can be seen to achieve at many different levels from academic to creative. Learning to know; learning to do; learning to live together and with others; and learning to be … innovative.

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