

INTERNATIONAL TECHNOLOGY EDUCATION SERIES

Environment, Ethics and Cultures

**Design and Technology Education's
Contribution to Sustainable
Global Futures**

Kay Stables and Steve Keirl (Eds.)



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Environment, Ethics and Cultures

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Scope

Technology Education has gone through a lot of changes in the past decades. It has developed from a craft oriented school subject to a learning area in which the meaning of technology as an important part of our contemporary culture is explored, both by the learning of theoretical concepts and through practical activities. This development has been accompanied by educational research. The output of research studies is published mostly as articles in scholarly Technology Education and Science Education journals. There is a need, however, for more than that. The field still lacks an international book series that is entirely dedicated to Technology Education. *The International Technology Education Studies* aim at providing the opportunity to publish more extensive texts than in journal articles, or to publish coherent collections of articles/chapters that focus on a certain theme. In this book series monographs and edited volumes will be published. The books will be peer reviewed in order to assure the quality of the texts.

Environment, Ethics and Cultures

*Design and Technology Education's Contribution to Sustainable
Global Futures*

Edited by

Kay Stables and Steve Keirl
Goldsmiths, University of London, UK



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SECTION 1

KAY STABLES AND STEVE KEIRL

1. INTRODUCING THE BOOK

INTRODUCTION

At the joint PATT/CRIPT conference in London in 2011 a small number of very interesting presentations were made that each linked in some way to concerns for sustainability and the contribution Design and Technology (D&T) Education can make to positive futures. From these presentations a discussion arose around the need for stronger representation in the literature on the topic of sustainable futures – and the idea that became this book was born. In exploring the tricky issue of sustainability, we felt that three particular dimensions – environment, ethics and cultures – could provide a valuable and inclusive approach to a book that would draw together both theories and practices to enrich understandings of sustainability and support approaches to enabling learners and teachers to contribute, through D&T education, to sustainable futures.

An international collection of authors, representing all levels of education, offer chapters articulating how D&T research, curriculum theory, policy, and classroom practices come together to positively contribute to the education of children for sustainable global futures. The chapters provide a balance of theorised curriculum positions, political and policy analysis, and case studies of successful school practices.

For us as editors, a key word in the title is that of *contribution* and this is construed in several senses: first, of D&T as a vehicle for understanding the range of political and social values that arise with such a major educational challenge; second, of D&T as an agent of critical and practical action for students as global citizens; third, by taking global and multiple perspectives (rather than, say, Western or mono-cultural positions); and, fourth, by demonstrating D&T education's capacity for working in holistic and integrative ways.

A key aim of the book is to demonstrate how learners can learn about their potential as humans-as-designers but can also develop designerly capacities that enable them to contribute meaningfully in practical ways to their communities and to wider society. Thus, there is a sense of developing global citizens who can apply design capability in ethical ways that are respectful of peoples, cultures and environments.

The book is divided into three sections. The first opens up each of the three dimensions, providing a broad backcloth to key concepts, issues and challenges that are addressed in more depth in the following sections. Section two offers a series of chapters that each take a broadly theoretical stance, providing insights into specific

areas through a combination of environmental, ethical and cultural lenses. Section three provides a grounded approach through a series of case studies that bring issues to life by illustrating ways in which D&T makes a tangible contribution to learning for sustainable futures.

SECTION ONE

Section one opens by exploring the dimension of environment. In this chapter Kay Stables starts by providing some background to the environmental movement from its early history to the current day and explores some of the issues, approaches and challenges it presents. Raising an overarching difference of stance between an anthropological and an ecocentric position, she provides further background on the emergence of Environmental Education (EE) and more recently Education for Sustainable Development (ESD) as the two main driving forces that have sponsored approaches to learning and teaching. She then moves to consider the ways in which designers have addressed (or not addressed) environmental matters and the contribution that is being made to sustainable futures by design. Finally she explores concepts and issues raised in the context of D&T Education, focusing on the contributions of a small but vibrant group of researchers in this area and outlining important aspects that are developed in more depth through chapters in Sections' two and three.

Focusing on the dimension of ethics, Steve Keirl discusses the interdependence of a triad of sustainability, education and democracy and how their interplay must be understood by D&T in order to clarify its own challenges. He shows that what binds all of these together can be described as global ethics – a concept he opens up by discussing ethics itself as well as how our ideas about 'self' and 'self interest' can be understood positively in how we act towards the world. In doing this he draws on the German concept of Bildung and how it might serve an education that works for the common good – for self and others alike. He shows that our ideas of 'human' and 'nature' are problematic for how we understand our interactions with other people, other species, technologies, and the planet. He also discusses scenarios in which the idea of sustainability may itself become unsustainable simply because of the ways that humanity may cease to be. Reflecting UNESCO's recognition of the need for global ethical dialogue, and considering ethics as practical philosophy for practical action, Steve offers a spectrum of futures-oriented concepts that can inform an ethics of sustainability that D&T can draw on to inform its own sustainable future.

Taking a slightly different approach Kurt Seemann opens up the dimension of cultures through an account of his professional experience of working in cross-cultural settings as a Design and Technology practitioner and educator. He draws attention to the ubiquitous nature of culture in contrast to its lack of active presence as an embedded element of learning and teaching in D&T. Raising the importance of designers showing empathy for the values and belief systems of the users of design outcomes, Kurt reflects on what this means for classrooms and pedagogy,

identifying the challenge of helping learners step out of their own cultural frames. He develops an approach formed around four areas humans create to manage their lives: systems, services, symbols and artefacts and makes a link to understanding the cultural and social significance of these in designing and making. Drawing on his own experience of working in cross-cultural settings in contexts of technology transfer between communities, he illustrates the challenges, issues and opportunities of learning that are presented. Through these examples, Kurt reveals the rich potential for a D&T curriculum that explicitly encourages learners to engage with matters of human beliefs, values and cultures.

SECTION TWO

Section two begins with a dialogue between Coyote and Raven – Peter Cole and Pat O’Riley “animating an ecological cross-cultural conversation” to explore the traditional ecological knowledges, values and beliefs of often marginalised Indigenous Peoples. Through their dialogue on D&T education, they juxtapose the conventions, regulations and assumptions of an economically, politically, culturally and socially domineering ‘west’ with alternative worldviews. This is presented in ways both serious and amusing that highlight the idiosyncrasies, injustices, contradictions and inconsistencies of western practices in relation to ecological matters. Through their conversation they open up the design and technological challenges that have been created through ‘modern’ scientific and technological actions, highlighting issues of ethics, health, consumption and economics alongside an overarching concern with ecology. Threaded through the discussion is a careful and detailed analysis of the impacts of new technologies, the affordances of traditional technologies and the pedagogical approaches available to D&T education that could provide emancipatory and transformative learning, highlighting the concept of “in(di)genuity” as a way forward. The chapter provides a critical and colourful backdrop to the following chapters by highlighting the value of alternative worldviews and the importance of a D&T education that manifests greater respect, inclusion and understanding between communities and with the environment.

Margarita Pavlova follows this to take a detailed look at the ways in which D&T education can support developing learners as global citizens. She presents a case for a social emancipatory approach that supports transformative education. Unpacking different views on global citizenship, and drawing on the work of policy groups such as UNESCO she argues for a balance of positions that puts ethics and critical thinking at the core of the curriculum that nurtures the development of cultural sensitivity, of creativity and innovation and skills to deal with economic uncertainty and that fosters responsible citizenry, civic values and sustainable consumption. Drawing mainly on the new Australian curriculum for Technologies, she illustrates how attitudes, skills and understandings can be embedded in curriculum and highlights this particular curriculum’s emphasis on addressing issues of sustainability. She then considers further the ethical issues that arise and some underpinning conceptual

and philosophical perspectives. Finally, she considers approaches to learning and teaching in D&T that help learners develop skills and understandings of global citizenship in ways that allow them to translate intentions into actions.

This chapter is followed by Kurt Seemann introducing ideas from Design Anthropology that explore how understanding culture can scaffold designing and the roles design and technology play in developing humankind. The latter, he argues, is the most potent reason for D&T's inclusion in mainstream schooling. Focusing on socio-cultural aspects, he stresses the importance of context and the need to shift away from design briefs that present archetypal end users, to designing for end users that are members of social groups and who have values and beliefs to be understood and given consideration. He also makes a case for more collaborative approaches such as participatory and co-design. Presenting case studies of how communities deal with litter, he illustrates how a co-design approach, using narrative and life-cycle analysis, allowed a community to see a 'bigger picture' that expanded from litter to include disposal of other domestic waste. Designers working with the community developed a deeper understanding of the cultural context that supported a more appropriate design of a new waste management system. He moves from the broader position of designers and technologists working with communities to the value of a design anthropological approach within D&T education. Highlighting the importance of the interplay between social and material cultures he discusses a potential co-transformation whereby in designing objects within a cultural context humans are also developing their own capabilities and understandings – literally making 'stuff' and 'making' themselves. Supporting this through leaning activities that engage in cross-cultural design settings brings greater richness and value to the outcomes.

In the next chapter Kay Stables continues with a focus on the relationship between the activity of designing and the development of a human being, paying particular attention to how this can support the well-being of the designer in all humans, such that a sense of agency is created. The case is made that enabling learners to engage in D&T activities in socio-cultural contexts, that learners find relevant and motivating, provides a rich learning environment to cultivate the skills and understandings that can support a sense of agency. Taking as a starting point the idea that humans are at their best when they are productive and creative, positively challenged and have a real purpose, she explores the impact that humans can have by acting in designerly ways, but also the impact that these actions have on themselves and those they are designing for. Opening up the positive and negative impact that design and technological outcomes can and have had, notably in the context of sustainable futures, she draws attention to the importance of developing a critical capability that links directly with the human capacity of making and of a holistic approach that supports a broader development of cultural, ethical and environmental understandings. Turning to some of the challenges of such an approach within D&T education, she highlights the dominance of the product paradigm in much of what happens in classrooms and explores the potential of alternative approaches that position socio-cultural challenges at the centre of D&T challenges and a transformative pedagogy that

allows for the development of both agency and understanding in enabling learners to take on the challenges of creating sustainable futures.

With Susan McLaren's chapter, this section moves to consider the impact of policy as an enabler or inhibitor in changes in practice that could lead to D&T education making a real contribution to sustainable futures. Making a case for the need for transformational change, she explores the drivers for change and the impact of stakeholders, recognising the ways that innovations can be both disruptive and catalytic. Stressing the importance for collaboration and consensus amongst stakeholders, she presents a model for integrated action that involves stages of motivation, action choice, volition and action implementation. Taking the policy formulation in Scotland as a case study she illustrates a process of change that embedded sustainability, education for sustainable development and global citizenship in governmental policies and practices for education, industry and society and specifically for Design and Technology education. Providing a historical background of twenty years of development, she outlines how the key players drew broadly on insights, innovations and broader policy development within and beyond Scotland to articulate an integrated approach, based on clear principles for sustainable development education that drew together education for sustainable development with global citizenship and essential learning themes to create a framework and guidelines that supported the development of D&T education through a 'Curriculum for Excellence' that provides the basis of learning and teaching for all 3-18 year olds. She provides insights into the broader context into which D&T is embedded that the specific role it plays.

Moving to a focus on curriculum, Steve Keirl offers a political engagement with what he sees as a prime driver of the need for sustainability education. He discusses three phenomena that have emerged in parallel over the last three decades – extreme capitalism, multiple globalisations, and heightened awareness of sustainability issues. He shares some insights into international curriculum theory and offers a critique of how a particular curriculum model has been intentionally shaped by the neoliberal agenda and how D&T in turn is being moulded globally to socially unjust and narrow ends. He introduces what he calls the sustainable-democratic curriculum and discusses how D&T might consider its own curriculum components and players – learners, teachers, ideas around knowledge, ethics, pedagogy, and curriculum organisation. He argues the case for learner-centred, ethically justified curricula as opposed to system-centred, academic-rationalist curricula that serve only instrumental ends. Steve draws attention to three 'curriculum characteristics' – consciousness, discomfort and conversations – and discusses their significance to a sustainable-democratic curriculum that talks of activism, resistance and subversion. He notes that D&T has a central role to play in education for sustainable global futures and that this means some challenging questions for teachers themselves. He closes his chapter by pointing to how D&T teachers' personal values and identities matter to sustainable global curriculum futures.

The final chapter in this section presents a sustainable pedagogical approach to knowledge and learning. Christine Edwards-Leis draws on a history of development

of pedagogical practices to explore those that support a model of education that creates autonomous learners, capable of critical thinking and dialogic debate, that has supported the development of a designerliness with skills that enable them to contribute to sustainable futures. Considering ideas that stretch back to Dewey's views of the dynamic nature of knowledge, of Freire's concept of critical pedagogy and on the concerns of ecopedagogy, she shows how these collectively support the importance of authenticity and transformative learning as learners construct and reconstruct their understandings of the world. Discussing the connections between learning and acting upon learning, she brings to the fore the need for multiple perspectives that are 'problem-posing' and that allow learners to engage in solving challenges for themselves in ways that are emancipatory. Linking this to D&T education she introduces the value of an approach that allows for the development of learners' mental models, and for the learning that takes place as they use and remodel their knowledge. Through a case study of research she provides insights into mental model theory and how, using this theory, learning of individuals can be analysed as they take on and solve a design challenge. Using stimulated recall as a means of exploring learners' understandings, she illustrates how engaging in designerly behaviour provides a rich opportunity for learner centered approaches with emancipatory potential so vital for enabling learners to take on the challenges of enabling sustainable futures.

SECTION THREE

Section three brings to life the issues and concepts of the first two sections by providing case studies of practice.

We begin with Tristan Schultz who describes a participatory, socio-culturally situated pedagogic tool – Kartogrifa In-Flux (KIF) - and reports on its application in a post-compulsory design education setting. The context for the tool and the case study is that of 'decolonial/design-thinking' and its purpose is 'unravelling the concealment' of Australian Indigenous Knowledge. Providing insights into facets of environment, ethics and culture, Tristan makes a case for decoloniality in the context of sustainable futures, asking the question 'what situated knowledge destroys futures and what creates futures?' and making a case for breaking the hold of modernity that has created many of the challenges to sustainability we now face. Through using narrative and objects, participants explore alternative routes that a cartographer, arriving with the 'first fleet' in Australia in 1778, could have made – one with indigenous people, encountering indigenous knowledge, one without. Using the narrative and the objects to explore the two worldviews presented, the participants are encouraged to consider the differing relationships between the humans and the land as revealed through Eurocentric and Aboriginal practices and within this, the contrasting views of aspects such as progress, ethics, commodification and values. The chapter provides a description of how KIF was developed and the impact of trialling its use in two different situations, one with a facilitator and one without and

the impact in each of these, highlighting the value of the tool, and important insights into how design can be used to ‘unravel’ Eurocentric thinking.

From a case study exploring indigenous knowledge in Australia, we move to Botswana for insights into the challenges of introducing sustainable development into the D&T curriculum. Michael Gaotlhobogwe begins his chapter outlining government policy for education and the development of Botswana that focuses on industrial growth. While this sits comfortably with an original aim for introducing a design and technology curriculum into Botswana, he suggests that this original aim was founded in Euro-Western thinking and culture and these aims have conflicted with those of achieving sustainable development.

Describing a context in which there is limited understanding but much potential for of ESD in D&T in Botswana, he points to Government policy that has focused on issues of the economy and globalisation and failed to recognise the values perspective and the negative impact on sustainable development. These policies, plus high youth unemployment, have resulted in a skills led curriculum in Secondary schools. Although the primary curriculum has a broader content, including important aspects for sustainability such a waste management, recycling and reuse, energy conservation, indigenous material and climate change, teachers have limited understanding of making links between these and D&T, which is incorporated into a creative and performing arts curriculum.

Exploring tensions between a Euro-Western approach and an Indigenous Knowledge approach in D&T, he identifies a problem in the perceived superiority of ‘foreign’ consumables. Seeing this as a critical mindset to change in taking more sustainable approaches, he describes the difference between two sets of coasters, one of African Indigenous design, one of Euro-Western design, as a way of illustrating the problem of valorising the latter whilst providing insight into the potential of the former for linking Indigenous Knowledge with D&T. Finally, in referring to a new national ‘Vision 2016’ that takes a more integrative approach to addressing change while maintaining culture and values, he sets out priorities for a D&T curriculum that can contribute to sustainable futures.

Taking a direct focus on D&T in the context of globalisation, Tony Lawler describes a simulation and role-play workshop ‘The Shoe Show’, that enables learners to gain an understanding of ethical consumption in an age of globalisation by exploring the role of the designer/maker as well as the roles of those in the chain of production and consumption. Developed for London school aged learners coming to experience learning in a university setting, the workshop aims at addressing contradictions commonly witnessed in teenagers as they express concern for the environment, but still want the ‘latest’ branded goods.

Tony begins by opening up issues about attitudes, values, beliefs and changing behaviour and provides a rationale for the use of role play as a way of suspending reality to engage in activities that can later be analysed. The activities are designed to provide experience of what it feels like to be a designer and maker of training shoes, to be a part of globalised production, to be involved in trading activity and, in the

process, to have one's own values, attitudes and beliefs exposed. The learners first designed and prototyped a 'training shoe of the future', and then explored the chain of production by role-playing stakeholders from each part of the chain in a trading game moving through a factory in China, a parent company in the USA and a retailer in London. The workshop begins with stakeholder groups negotiating with each other, opening up issues around industrial relations. They are then given new information - for example a natural disaster has struck, new legislation has been introduced around ethical trading - and the trading is then re-negotiated in response. The role-play is followed by viewing a documentary about making footballs in Pakistan, opening up further global issues such as child labour. Finally, through discussion, their new understandings around designing, manufacturing and consumption are explored. The chapter presents results of a 'before and after' questionnaire that indicated a likely change in behaviour, but also differing views and values evident, for example in what was seen as a 'better' training shoe.

A longer term project that involved learners understanding the true cost of a product is presented in the case study by Terry Wilkinson and Larry Bencze that focuses on a sustainable engineering design project with 12 year-old learners. The project was part of a larger researcher study and was developed in the context of the Science and Technology curriculum in Ontario, Canada, that highlights the development of critical literacy in relation to issues of fairness, equity and social justice. It aimed to develop learners' design thinking by opening up issues of life cycle, sustainability, capitalist principles and perceived obsolescence.

Terry and Larry provide background to the research context of the project and then describe its structure, beginning with a viewing of 'The story of stuff' to engage the learners in the production and consumption life cycle of products. Learners then analysed commercial locker shelving devices that they use to store books etc at school and then re-designed and made their own locker storage systems. In doing so, the learners considered the 'costs' of their outcomes – including 'hidden costs', 'true costs' and 'fair price', taking into account the information on the 'materials economy' presented through the 'Story of Stuff'. The chapter provides insights into the impact on the learners based on data gathered through analysis of their written reports on the project and through semi structured interviews held with four learners. In addition to an increased sense of capability and agency, the learners also felt they had a deeper awareness of the real cost of a product and of designed obsolescence. While Terry and Larry have critiqued the project in terms of long-term effect, they express 'cautious optimism' for the path towards ethical consumption the learners have started on, and account for this in terms of the content and approach that enabled the learners to engage with head, hand and heart.

The next chapter also focuses on the chain of production and consumption through the holistic concept of a circular economy. In a case study of the work of the UK based Ellen MacArthur Foundation, James Pitt and Catherine Heinemeyer first provide an introduction to the concept including its roots in systems thinking, 'cradle-to-cradle' philosophy and biomimicry. They illustrate these ideas through a comparison

between a linear economy and a circular economy, highlighting the problems of recycling as ‘downcycling’ in the linear model as opposed to ‘upcycling’ in the circular model, and present the challenges that are preventing a shift to a circular economy. They then present one learning resource created by the Foundation as a case study of teaching the circular economy to both teachers and learners of D&T. The learning resource – ‘System Reset’ - is a set of six activities aimed at introducing the principles of a circular economy to 12-18 year-olds. To illustrate the activities, examples are provided of exploring the eco-effectiveness of the design and use of buildings, of a card game that allows learners to evaluate the differences between linear and circular economies, of an approach to product analysis – teardown labs – that involve the analysis and then re-design of a product for a circular economy and the use of ‘handling collections’ that provide scope for exploring a circular economy from a multi-disciplinary perspective.

Presenting findings from using the resources with both learners and teachers, James and Catherine highlight the ways in which the resources can help teachers re-think their approach to teaching D&T but, within this, the challenge for teachers to move beyond pre-existing models of sustainability, such as recycling. They have found that 11-16 year-old learners have been able to engage with the core concepts and older learners have grasped the wider dimensions. They also report indications that the approach has found favour with both girls and women teachers.

The final three chapters present case studies of approaches that centre on environmental issues – the first of the understanding of climate change by primary aged learners, the second of the use of ‘fun theory’ as a stimulus to engage secondary age learners and the final chapter sharing an integrative, whole school approach.

Iris Lüschen provides a background to existing research into the understanding that young children have of climate change and then introduces a research project, set in the North West of Germany, that contributes to this field and that focuses on 8-10 year olds. The aim was to gain insight into the children’s perception of climate change and the research was conducted through a semi- structured concept-mapping interview that made use of concept cartoons and images. This approach provided data that enabled qualitatively different descriptions of levels of perception amongst the children allowing for distinctions to be made between understandings of complexity and also for how connections in thinking were made.

Using quotations from the children, Iris illustrates the qualitative differences of understanding within the age group on topics such as the causes of climate change, the causes of global warming and the ways the children perceive their possibilities to take action. From the study it is apparent that not all learners in this age group are aware of climate change as an environmental problem, but where they are, it is an area about which they have a good many questions. Based on the results of the study, and using quotations from the children as a spur, she proposes that teachers should engage children in the discussion and help them express their perceptions, help them judge the quality of information, help them develop a critical-constructive stance and help them develop creative ideas to build positivity.

In a chapter that takes fun as its starting point, Ben Chapman presents a case study of using Volkswagen's 'Fun Theory' within a pedagogic model that centres on developing capability and activism to shift D&T education further towards addressing issues of sustainability. Presenting work undertaken with a class of 14 year-olds in a suburban English school, he draws on Emily Pilloton's 'Project H', identifying his aims of enabling learners to 'develop their own truths', to become activists, and to do so within their own 'micro' community. In his case study the school is the micro community and the challenge to the learners is to change the behaviour of their peers. He presents a transformative model where the 14 year-olds move from being learners of sustainability, to becoming experts in designing for sustainability, and finally teachers and activists as they lead others towards sustainable behaviour. Sharing the stages of his project, he explains how he draws on a range of existing resources to support the 'learner' stage and then provides a detailed account of how, using Volkswagen's 'viral' Fun Theory campaign as an inspiration, the 14 year-olds design their own campaigns to change behaviour in their school through, for example, the design of a 'do not touch' light switch and a 'paper aeroplane landing' recycling bin. In analysing his approach he suggests the value of the 'learner' phase as being the range of issues introduced through active means such as debate. The expert phase allowed the learners to take an active role as ethnographic researchers with an awareness that they had responsibility to teach the rest of the school community. The teacher/activist phase was supported by the inspiration to be provocative in a positive manner and by doing so, feel the power of change in their community.

In the final case study we return to Australia and, as with Ben's chapter, take the school community as the core to education for sustainability. In Larry Spry's account of two different whole school projects we conclude this section showing how D&T can be at the core of sustainable futures in an integrated and holistic approach. Presenting his philosophy for learning as inclusive, learner-centred, socially and culturally relevant and collaborative; through high expectations, learners building a sense of self and positively, confidently and independently contributing to their community; Larry provides two case studies set in the context of South Australia, its curriculum and a long-standing commitment to environmental issues.

Making a case for D&T as a learning integrator, he sets out core principles as the basis for both case studies of drawing on and nurturing the individual, taking an integrated approach to curriculum, and combining hands-on learning and risk-taking with fun, enjoyment and achievement. The first case study describes how a rural primary school (5-11 year-olds) created a futures-focused sustainable community. Sharing values of quality over quantity, restoration of resources over exploitation of environment, long term planning over short-term reactions and values orientation over technologically based operations, all classes worked cooperatively to build a sustainable model city. Through the description of the project Larry also provides insights into how links were made with the South Australian D&T curriculum. The second case study involved all 5-11 year olds within a 5-18 year-olds boys

school creating a sustainable community garden. The aim of the project was to raise understanding of sound environmentally sustainable practices and positive food education whilst also complementing existing sustainable learning approaches within the school. Larry describes how the project involved teachers and learners, support staff, groundsmen, parents and other volunteers from the local community. It included preparing the site, critiquing its suitability and the suitability of what was to be planted, creating raised beds and gravel paths, a chicken run and ‘Chook’ House, and fruit, vegetable and fruit tree planting.

Reflecting on the project he describes the wide range of educational benefits, plus the excitement, community awareness and pleasure of growing, harvesting, preparing and sharing of food. Considering the benefits of both projects, in addition to the articulation with the South Australian curriculum framework, he identifies the learning that took place for leadership, teamwork, values, problem solving, resourcefulness, and communication. In doing so he provides a fitting conclusion not just to this section, but to this book by illustrating how D&T’s contribution to sustainable futures can go way beyond its disciplinary merits to creating a learning environment that brings a truly rounded educational, futures-facing experience.

When we set out to construct the framework for this book we believed that it was needed to fill a gap in the literature around D&T’s contribution to sustainable futures. Now that it is complete, we are delighted with the quality of insights, the range of perspectives, the commonality and diversity of thinking and innovative ideas that, collectively the authors present.

We salute the writings and practices of each one of them – and we hope that you enjoy and benefit from engaging with what is presented.

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KAY STABLES

2. ENVIRONMENT

Contributions of Design and Education to the Sustainment of Planet Earth

INTRODUCTION

Any book that aims to deal with issues of sustainable futures will necessarily have a significant focus on environmental sustainability. Historically, concerns over sustainable futures were predominantly focused on the environment, with references going back as far as, for example, the 7th century when legislation was introduced to protect birds in the Farne Islands off the north east coast of England. More recently there has been recognition that sustainable futures depend on complex sets of relationships. Frequent reference is made to what are termed the (ubiquitous) ‘three pillars of sustainability’: environment, society and economy. Alternative models that unpack this complexity include ‘four circles of sustainability’: ecology, culture, politics and economics (United Nations Conference on Environment and Development, 1992) and Forum for the Future’s ‘Five Capitals’: Natural capital, social capital, human capital, financial capital and manufactured capital (Porritt, 2005). Whatever the model, there is recognition that sustainment of the environment – planet Earth – is non negotiable. While the dependencies of sustainable futures may be complex, without environment the pillars of society and economy will crumble.

This chapter will explore early developments of concern for the environment and of what has come to be called ‘environmentalism’. This will lead to an exploration of how these concerns have come to highlight the importance of environmental education and, more recently of education for sustainable development. Alongside this will be a focus of the particular role that design and designers play in environmental issues. Finally the collective issues will be explored in relation to how they impact on the way in which Design and Technology education can play a positive role in preparing young people to contribute to environmentally sustainable futures.

ENVIRONMENTALISM

With the emergence of industrialisation came a concern from individuals within societies for how industrialisation, and the related issue of consumerism, has impacted on the environment. These individuals have, variously, grouped together to create a social movement referred to as environmentalism. We often think of this as being a phenomena that emerged in the 20th Century, spearheaded by activists and writers such

as Aldo Leopold (1949), Rachel Carson (1962) and Donella Meadows (Meadows et al., 1972), but modern environmentalism can be seen in earlier, 19th Century activism – for example in the UK by people such as John Ruskin and William Morris and in the USA by people such as Henry Thoreau. This activism has led to important legislation, for example in the protection of various species and in anti-pollution laws. Environmentalists have also made visible issues that have created, for some, a sea-change in the way the world is viewed and for others a resistance to change wherein presenting issues such as climate change are seen as propaganda, a threat to the status quo and often a threat to the protection of personal interest. Laying bare the negative ecological, sociological, cultural and economic impacts of environmental degradation has sometimes been seen as presenting ‘doom and gloom’ scenarios. In a prominent analysis of environmentalism Shellenberger and Nordhaus (2007) identify what they see as recent failures in the movement. The authors suggest that there has been too much ‘laundry listing’ of disaster scenarios and too little positive vision of the benefits that action to protect the environment can bring. Despite the ubiquitous nature of what Shellenberger and Nordhaus describe as nightmare (as opposed to dream) scenarios, the general public’s imagination and interest in sustainability-related issues has been captured, for example as witnessed by the increase in sales of products labelled ‘fair trade’, the numbers of copies of texts such as Naomi Klein’s ‘No Logo’ (2000) being sold, or the number of viewings of Al Gore’s 2006 documentary ‘Inconvenient Truth’. But even with the growth of understanding of imperatives for sustaining the environment making their way into what might be seen as popular culture, the harsh reality is that the wisdom of early environmentalists has yet to be realised in the majority of human activity. Looking back at early writings, there is a clear history of concern for the impact of human development on the environment. But what is also clear are the ways in which impacts from changes in the environment are like the ripples of a stone in a pond as they circle out to affect so many further aspects of life.

David Orr (2002), referring to the writing of Smil (1994) identifies an issue at the core of challenges to creating ecologically sustainable futures.

The perennial problem of human ecology is how different cultures provision themselves with food, shelter, energy, and the means of livelihood by extracting energy and materials from their surroundings. (Orr, 2002, p.14)

He goes on to make the link to the fundamental role of design in human ecology.

Ecological design describes the ensemble of technologies and strategies by which societies use the natural world to construct culture and meet their needs. Because the natural world is continually modified by human actions, culture and ecology are shifting parts of an equation that can never be solved. Nor can there be one correct design strategy. (Orr, 2002, p.14)

Taking this discussion one step further he captures a critical reality of the complexity of human ecology – that to focus exclusively on the environment is to ignore relationships with other societal implications.

How and how intelligently we weave the human presence into the natural world will reduce or intensify other problems having to do with ethnic conflicts, economics, hunger, political stability, health, and human happiness. (Orr, 2002, p.14)

Recognition of the importance of seeing environment in a broader context is highlighted by the increasing shift to focus on sustainability, of which environment is one element – as indicated at the start of this chapter. Viewing sustainability through an environmental lens recognises the complex relationships of sustainability whilst exploring aspects that either derive from or impact on the environment.

Worldviews

An environmental lens has enabled a range of crucial aspects of sustainability to be unpacked, not least an understanding of the impact of different worldviews. Broadly speaking, two overarching and contrasting perspectives demonstrate a fundamental difference: anthropocentrism, which takes a human centred view of environmental issues - predominantly concerned with the impact of environmental issues on humans; and ecocentrism, which takes an ecological view. The former is more prevalent in westernised positions in which humans are supreme and arguments for environmentalism focus on the ultimate goal of human wellbeing. The latter can be illustrated by the ethical position of Aldo Leopold (1949) who took an ecocentric position in which a human is seen as a ‘plain member’ and citizen of the land, not its controller or conqueror. For many environmentalists who subscribe to an ecocentric perspective, anthropocentrism is a root cause of environmental problems. This position is presented clearly by Rowe (1994).

Because “environment” means that which encircles something more important, literal “environmentalists” are willy-nilly anthropocentric, placing less value on the surrounding world than on humanity and self. If that causes uneasiness, the central position of the self can be retained painlessly by redefining it as a broad field-of-care embracing Earth. But this is an ineffectual gesture if, when push comes to shove, humanity is always accorded top billing. ... It is time to eschew human self-interest and recognize the inherent worth and surpassing values of Earth's miraculous ecosystems whose workings we do not understand. *Anthropocentrism says we know how to control and manage them; ecocentrism says ‘not yet; maybe never.’* (Rowe, 1994, p. 106)

This latter position is also at the basis of what is described as deep ecology – a movement that draws from the writings and ideas of Aldo Leopold and Rachel Carson, and initiated by Arne Naess (1973), that recognises complexity and interconnectedness; a holistic viewpoint. Deep ecology also builds on spiritual and philosophical traditions that have resonance with religions such as Buddhism and indigenous cultures such as those within Native Americans. The holistic stance

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creates a more pluralistic view of environment and also provides a useful tool for critiquing approaches to design and also to Design and Technology Education – both of which we will turn to later. But first we turn to education – and the ways in which the growth in focus more generally on environmental issues has been paralleled by the growing importance that has been placed on bringing such issues into the arena of education.

ENVIRONMENTAL EDUCATION TO EDUCATION FOR SUSTAINABLE DEVELOPMENT

Historically, concerns for the environment have emerged in the curriculum under headings such as ‘conservation education’ and ‘environmental education’ – both areas largely linked to subjects such as biology and geography. The Environmental Education movement developed strongly through the 1960s, 70s and 80s, with landmarks such as the Stockholm Declaration (UNEP, 1972), The Belgrade Charter (UNESCO-UNEP, 1976) and the Tblisi Declaration (1977, ref), building commitment and then more detailed goals, objectives and principles for Environmental Education across nations and supported by United Nations Environment Programme (UNEP) and also by the United Nations Educational, Social and Cultural Organisations (UNESCO).

Writing in the early 1990s, Huckle refers to the lack of impact of the early years of environmental education and makes the case for the shift towards a focus on sustainability that “must be grounded upon an appreciation of the root causes of environmental problems in the global economic system” (Huckle, 1993, p.43). He describes Environmental Education as existing in three forms: education for environmental management and control; education for environmental awareness and interpretation; and education for sustainability. At the time of writing he saw the first of these dominating classrooms and curricula, but emphasised the importance to a shift towards the latter that he describes as that “which predominantly serves the critical human interest, is based upon critical science, and coheres most closely with the notion of education *for* the environment” (Huckle, 1993, p.63).

Over the last two decades there has been considerable debate about the labels of Education for Sustainable Development, Education for Sustainability and even Education for Sustainable Living (which has an implicit focus on individuals, rather than policies). What is clear across all of these is the broadening of the debate around sustainability that goes beyond a specific environmental focus to see this in the wider context of economic, political, cultural, social and ethical issues. Policy development, led largely by the United Nations, has been a major factor in setting the agenda for development and key landmarks in terms of education have run in parallel with broader discussions of environment, development and sustainability. These landmarks have seen the qualification of goals and objectives for Environmental Education (as mentioned above) and also for a shift in focus to Education for Sustainable Development (ESD), the latter being signposted by the Bruntland report

(1987) and being presented more fully in 1991 (in terms of policy) as a result of the Rio Summit through Agenda 21 (United Nations Conference on Environment and Development, 1992). Despite developments after 1991, by the early years of the 21st Century there was concern for regeneration and further development of ESD. One concern was that, despite what was seen as the broader perspective of ESD (for example as including the pillars of economic, social and environmental sustainability), there was a perceived need to re-orientate from an ongoing focus on Environmental Education. As a result the Decade of Education for Sustainable Development (2005-2014) was launched with a clear aim to

Integrate the principles, values, and practices of sustainable development into all aspects of education and learning. This educational effort will encourage changes in behaviour that will create a more sustainable future in terms of environmental integrity, economic viability, and a just society for present and future generations. (UNESCO, 2005, p.6)

The brief history above implies one of consensus, both about the aims and scope of ESD and also that its prominence presented a welcome and progressive shift from EE. The reality presents a different picture. Exploring some key ideas and themes in different perspectives allows a clearer understanding of the position of environment within debates and also insights into important considerations in moving forward in terms of sustainable futures.

Debates, Perspectives on EE and ESD

Pavlova (2013b) discusses the shift from EE to ESD that came partly through policy developments at UNEP and UNESCO but also cites those who didn't see ESD as the successor to EE as a better way to deal with socio-environmental issues. She makes a case for both, by considering their potential in terms of transformative learning. Sterling (2001) describes transformative learning as "third order" or "deep" learning that is when "we are able to see things differently ...involv[ing] a deep awareness of alternative worldviews and ways of doing things". He contrasts this with first order learning that "takes place within accepted boundaries; ... is adaptive learning that leaves basic values unexamined and unchanged" and second order learning that "involves critically reflective learning, when we examine the assumptions that influence first-order learning" (Sterling, 2001, p.15). All three types of learning are needed in different situations but it is the "shift of consciousness" that Sterling considers is needed "that radical movement towards sustainability requires" (p.15).

Pavlova uses transformative learning as a lens to analyse pedagogical approaches in EE and ESD, as expressed at policy level, and sees many similarities such as

an emphasis on life-long learning and inclusion of formal and non-formal education; interdisciplinarity; inclusion of social, environmental and economic realms; and use of a variety of pedagogical techniques that promote

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participatory learning, first-hand learning and development of higher order thinking skills. (Pavlova, 2013b, p. 667)

She does highlight however a significant difference in the way in which they differ, for example with EE focusing on local-global links related to the learner's own community as opposed to ESD that embeds learning into contexts that support capacity building within communities and a focus on socio-ecological structures. In focusing on policy she also acknowledges the reality of policy and practice not always lining up.

She identifies a significant difference in worldview between the two, as expressed by the concern of EE advocates that ESD is largely driven by capitalistic views and an anthropocentric stance, including the perspective presented through UN policies and reports. This point is also made by Bonnett (2013) who sees this position being present in early key documents, including the Brundtland Report (United Nations, 1987), a document often seen as setting down leading principles for sustainability.

Kopnina (2013), writing from environmental anthropology refers to the difference as "the 'elephant in the room', namely robust anthropocentric bias" (p.609). She distinguishes anthropocentrism as being either self-interest or altruism but still considers the stance to display "moral human superiority" (p. 610). Analysing current discourse on ESD she identifies no more than passing reference to ecocentric views or ethics and concludes that in some policy documents the priorities are clearly economic and social – environment coming a poor third and only in relation to environmental care in respect of the wellbeing of humans.

Further internal debates include a critical theory and eco socialism paradigm presented by Huckle (1993) that contrasts with Webster's systems thinking, ecological worldview, explored through the new economics of the concept of a circular economy (Webster, 2007). Stephen Stirling also advocates an ecological worldview and a holistic approach, seeing this as a "shift of emphasis from relationships based on separation, control and manipulation towards those based on participation, empowerment and self-organization" (Sterling, 2001, p.49). The focus on a holistic perspective has resonance with David Orr's concern for an ecological literacy that emphasises not disciplines and knowledge, but wisdom and the education of the whole person (Orr, 2004) and Michael Bonnett who introduces the importance of

sustainability as a frame of mind [that] is not simply the issue of our attitude towards the environment, that represents a perspective on that set of the most fundamental ethical, epistemological and metaphysical considerations which describe human being; a perspective which is both theoretical and practical in that it is essentially concerned with human practices and the conceptions and values that are embedded in them. (Bonnett, 2002, p.14)

Writing in 2013 and reflecting back on the development of EE and ESD, Bonnett presents a position where EE is the more inclusive and broader of the two and makes a case for ESD to be re-located into EE to make it more effective. His argument is

that ESD is too instrumental and that to embed it into EE would allow for a less anthropocentric, economic approach and would provide room for the spiritual and aesthetic, “in which the intrinsic worth of the natural world is respected” (Bonnett, 2013, p.252).

Vare and Scott (2007) have undertaken a different approach by presenting what they see as two different perspectives of ESD – one that promotes “informed, skilled behaviours and ways of thinking” and a second that builds “capacity to think critically about what experts say and to test ideas, exploring the dilemmas and contradictions inherent in sustainable living”. In making this distinction they are actively avoiding an either/or debate but seeing a need for both – the ying and yang of sustainability that allows for short term actions and long term learning.

The above perspectives on EE and ESD are presented to give some understanding of a range of views on how education can contribute to sustainable futures. Laying out some breadth and providing some insight into the conflicts in different viewpoints provides a context through which to explore the related developments in Design and Technology and what is largely unrealised potential, as will be discussed in detail later in this chapter. But of equal importance are the writings and practices of designers concerned with issues of environmental sustainability and it is to these that we now turn.

DESIGN, SUSTAINABLE DESIGN AND THE ENVIRONMENT

Consumption and the Product Paradigm

The Industrial Revolution heralded an age of consumption never before witnessed and set in motion an era of production that has grown massively, like a snowball rushing down a hill, to a point where the desire to possess more and more stuff has become an addiction that has caused massive impact on the environment both in the depletion of resources and the creation of (often toxic) waste products. In describing designerly thinking as “one of the most dangerous of all human characteristics”, Ken Baynes highlights the role of designers in contributing to the mass expansion of production in the ‘developed world’ of “taken for granted products and services”. He makes the point that extending these practices to all humans would likely cause “catastrophic environmental collapse” (Baynes, 2009, p.5). While designers are not the sole culprits here, the ways in which designers have become collaborators in the development of a product paradigm based on desires and wants rather than needs have contributed to the creation of (paraphrasing the words of Stan Laurel) the fine mess a section of the world’s population have got us into.

Unlike the haphazard antics of Laurel and Hardy, the development of a paradigm of consumption came from planned activity, as was highlighted over fifty years ago by Vance Packard (1960) in his important text ‘The Waste Makers’ in which he lays bare the marketing machinery created to produce and sell more and more of things we didn’t (and still don’t) need. In a book dedicated to his parents “who have

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never confused the possession of goods with the good life” (p.5), he describes his nightmare scenario of an over-producing America, driven by an economic strategy fuelled by design for obsolescence and aggressive marketing policies.

While there is plenty to witness globally that suggests that no lessons have been learnt from Packard’s analysis, slowly but surely groups of designers have recognised the power of design for bad and also for good. Launched in 1964, a few years after Packard’s text, the ‘First things First’ Manifesto (<http://www.designishistory.com/1960/first-things-first/>) pinpointed the need for graphic designers to use their talents for less consumerist purposes. A re-issue of the manifesto by a range of publications in 1999 (Adbusters, AIGA, Blueprint, Émigré, Eye, Items) made this point clearly, stating

In 1964, 22 visual communicators signed the original call for our skills to be put to worthwhile use. With the explosive growth of global commercial culture, their message has only grown more urgent. Today, we renew their manifesto in expectation that no more decades will pass before it is taken to heart. (Garland et al., 1999)

In highlighting the many talents of designers, Papanek (1995) stressed the need for an explicit shift in practices.

Both time and place give designers the confidence that the skills and talents that we bring to our work will continue to be valuable in the futures to come. Yet this must make us extremely careful about what we design and why. The changing environment of our fragile planet is a result of the things that we do and the tools that we use. Now that the changes that we have brought about are so major and so threatening it is imperative that designers and architects play their part in helping to find solutions. (Papanek, 1995, p.8)

Sustainable Design: Policies, Reports, Principles and Practices

This shift had already emerged at a policy level through the Hanover Principles (McDonough & Partners, 1992), principles on design for sustainability developed as guidance for the preparations for the Hannover World’s Fair in 2000. The Principles are based on a clear definition, building on Bruntland, but explicitly taking an ecocentric stance. This is indicated from the outset, stating that the principles

Insist on rights of humanity and nature to co-exist in a healthy, supportive, diverse and sustainable condition. (McDonough & Partners, 1992)

Following from this they address issues such as designing for interdependence between humans and nature, respecting relationships between spirit and matter, focusing on long term solutions, understanding the limitations of design and eliminating the concept of waste. The latter is a theme developed through the concept of ‘cradle to cradle’ designing (McDonough & Braungart, 2002) but also picked up

earlier in McDonough's Centennial Sermon (1993) through his categorisation of consumables as "products that when eaten, used, or thrown away, literally turn back into dirt and therefore are food for other living organisms" (p.5). His view is that we should be designing and making more of these, as opposed to what he categorises as "products of service" such as cars, TV, that are only hired, not sold, and eventually return to the producer for disassembly and re-use. His third categorisation is what he terms "unmarketables" – things that shouldn't be designed and sold in the first place because of the impact they have on the environment.

A more recent set of principles are those that have emerged from the American Institute of Graphic Arts (AIGA) – the Living Principles for Design (www.livingprinciples.org) - that aim to provide clear and action-focused guidance on integrating sustainability into design. Seen as both a toolkit and a roadmap, the principles are structured around culture, environment, people and economy. A further set of guidance comes from the idea of Slow Design Principles (Strauss & Fuad-Luke, 2008). Fuad-Luke characterises slow design as

An approach that encourages a slower, more considered, and reflective process, with positive well-being for individuals, societies, environments, and economies. Slow design positions itself against the "fast design" of the current industrial paradigm, which is governed by unsustainable cycles of fashion and over-consumption, business ethics, and anthropology that defines everyone as customers. (Fuad-Luke, 2008, p. 361)

The six principles have been developed around the terms reveal, expand, reflect, engage, participate and evolve and have resonance with ecocentric views of sustainability and whole systems thinking that is promoted by environmental activists such as Arne Naess.

Many design practitioners and theorists have contributed to the development of deep understandings of the role design and designers can play in creating more sustainable futures and through their work have opened up useful concepts and insights that can be drawn on in education. Manzini (2004), for example, has pioneered understandings in everyday, social practices and scenarios and the concept of enduring design. Chapman (date) has built on this to open up the area of emotional durability, how we design to maintain relationships with the products we own – a theme that has also been well developed in the context of sustainable fashion, for example by Fletcher (2008), Fletcher & Tham, (2014). Walker (2008) takes a critical approach, highlighting the potential of creative activity to challenge current notions of function in design and re-conceptualise these by setting up "an alternative to the novelty-based, vogueish approaches to design that ... spur consumerism" (Walker, 2008, p.7).

Critiquing what he describes as the 'sacrificial value' and seeming threat to the freedom of the designer that designing to address sustainability issues presents, Tonkinwise (2011) proposes an approach in which designers take a stance that shifts the reasons for action from negative to positive. In an intriguing re-positioning

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of needs and wants – in which wants become the desirable position, he suggests focusing not on why we *need* to change the way we are living, but why we *want* to.

Imagine declaring – I would like to live a life without fossil fuels; not because these cosmically rare sources of stable energy intensity are depleting, not because accessing energy from fossil fuels changes climatic systems of the earth, not because mass species extinctions are likely to result, nor even because mass displacements of the world's poor are already happening; but rather ... because I find pieces of coal dirty; because I don't like the people and profit from the oil industry; or because it would be fun to see how else society might be structured. (Tonkinwise, 2011, p.74)

Sustainable approaches within design practice are also opening up new methodologies such as co-design (Fuad-Luke, 2009) and metadesign (Wood, 2010; Tham & Jones, 2008). Both of these approaches recognise the value and importance of more democratic and collaborative approaches to designing, in which designers bring their expertise to interdisciplinary teams. This demonstrates an increasing shift away from the notion of the 'hero designers' to a recognition that creating sustainable futures is a team based, not a solo, activity.

In addition to designers pioneering approaches and understandings of a more ecocentric approach to design, higher education design educators are also providing insights. Rob Fleming (2013), writing in the context of architecture education, also highlights the importance of a co-creative approach. He highlights the danger of sustainable design in education being seen as a superficial veneer that is added to the constraints of a project, rather than a fundamental, ecological approach. In what he describes as the 'razor's edge' he contrasts 'green design that "expresses the societal goal of "wants" to "save the planet" and to "tread more lightly on the earth" – while at the same time consuming vast amounts of resources, inflicting significant damage to the planet through deforestation, desertification, erosion, pollution and climate change" with what he terms sustainable design – "a profound movement towards a neutral, if not regenerative relationship to the Earth and its resources, as in need to "do no harm," as the minimum condition" (Fleming, 2013, p. 59). The challenge in maintaining the latter position cannot be denied, but Fleming argues for an embedded approach that has core values of inclusion and cooperation at the centre of processes of designing. He argues that 'form follows worldview' and provides insights into how, through carefully structured design briefs and co-creative processes, a shift can be supported.

The design brief expresses the consciousness of the project, develops the necessary diverse stakeholders, determines the rules for the co-creative design process, sets the schedule of interactions and clearly illuminates the integrative goals of the project. (Fleming, 2013, p. 6)

The approach Fleming advocates places demands on teachers, but equally it places demands on learners, not least because there are expectations that they will develop, through their practice, a greater understanding and empathy for socio-cultural issues

and the skills of collaboration. In doing this he is addressing a ‘design problem’ seen by David Orr to be at the core of ecological design

The problem is not how to produce ecologically benign products for the consumer economy, but how to make decent communities in which people grow to be responsible citizens and whole people. (Orr, 2004, p.11)

ENVIRONMENT AND DESIGN AND TECHNOLOGY EDUCATION

In considering the above quote from David Orr in the context of D&T education, a transformative learning perspective might suggest that D&T education should focus first on developing young people as responsible citizens and second as design and technologists. Following such thinking through raises questions about how learning in D&T has been, is and could be prioritised. This chapter has raised a number of important issues that need to be explored in the context of Design and Technology education – and the chapters that follow in Sections two and three make excellent contributions to this endeavour. There are also important insights from existing literature that support the growth of understanding and practice. However, it is clear from the literature that research and practices in Design and Technology education is sparse. In a meta-analysis of critical discourse in research in Technology Education as represented in the *Journal of Technology Education*, Petrina (1998) noted that, across the first eight volumes of the journal, insubstantial focus had been placed on ecological issues, whereas substantial emphasis had been placed on economic drivers. He makes the point that “that a bit of critical discourse goes a long way in this Profession” (Petrina, 1998, p. 46) but the reality is that since 1998 this aspect of research has continued to be almost a ‘niche’ focus.

A Wholistic Approach

Some fourteen years further on, Pavlova (2013a) in a historical analysis of research into teaching and learning for sustainable development in Technology Education, also highlights the lack of research and practice in this area, seeing a major justification for Technology Education in schools continuing to be linked to economic competitiveness. While she notes a shift towards considering social, ethical and environmental impacts identified in research by Ritz (2009), she concludes that research into learning and teaching for ESD in Design and Technology is both fragmented and limited. The limitations frequently relate to there being a focus on environmental issues alone. Insights from earlier parts of this chapter suggest that an environmental lens is useful, but that a more wholistic, integrated approach is important. From Pavlova’s analysis it is evident that this is not just because of the space for transformative learning that is created by a more integrated view, but also in the potential for motivating D&T teachers towards ESD when a social dimension is included in project work, as was found by Pitt and Luben (2009).

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The value of an integrated view of sustainability is echoed by Elshof (2009) when making a case for environmental citizenship. He believes this to be of fundamental importance in creating a more rounded ‘sustainable citizenship’ that allows for learners to develop a broader, integrated critique and practice encouraging “mindfulness concerning our use of materials and be[ing] complemented by an understanding of how inequitable the gap that exists between the rich and the poor is, in terms of the global consumption of many materials” (Elshof, 2009 p.140).

World View

In earlier discussions of different viewpoints within ESD, a distinction was made between what has been identified as differing ‘world views’ as contrasted by an anthropocentric or an ecocentric stance. The former places a major emphasis on environmental stewardship first and foremost for the well-being of humans and this emphasis can be seen in many of the practices that prevail in D&T curricula and classrooms. Taking the English National Curriculum as an example, great emphasis had been placed through the five iterations of the curriculum that have guided practice over the last twenty five years on learners considering the needs of the people they are designing for. While much of this has been well intentioned and has allowed for relevance to be embedded into D&T projects, actively addressing more ecocentric projects is rare. Even when considering good classroom resources that introduce and support ideas of sustainability, the knowledge and understanding that is drawn on tends to more explicitly focus on looking after the environment for the sake of the human race. In exploring contrasting positions in the context of Technology Education, Pavlova draws on Huckle’s critique. Huckle argues that “ecocentrism can be criticised in that it romanticises a nature outside society and fails to recognise that only humans can value things. Strong anthropocentrism/technocentrism can also be criticised in that it sanctions the exploitation and oppression of nature by treating it instrumentally or merely as a means to human ends” (Huckle, 2006, p.19). Pavlova (2009) sees value in both positions and suggests a balance between the two of “weak anthropocentrism” (Vardy & Grosch, 1999), drawing on Bonnett’s (2002) concept of ‘frame of mind’, discussed earlier and Vernadsky’s (1945) concept of *nöosphere* that aims at “harmonising the interrelationships between the environment and the world community” (Pavlova, 2009, p. 112).

The Product Paradigm Revisited

In an analysis of problem solving in Technology Education, Flowers (1998) takes an explicitly eco-centric stance in considering a Taoist perspective. Highlighting the increasing emphasis on product design and problem solving he notes a number of “definitions of technology center on ‘control’ over the ‘human-made and natural environment’ to better meet ‘human needs and wants’” (Flowers, 1998, p.20). His view is that these perspectives lead to learning about materialism and draw on a

western approach. He counters this by drawing on Taoist philosophy and suggesting that learners should not concentrate on “whimsical or fanciful products” (p. 23) but should apply the risk-taking and independent thinking of problem solving to “what is best, not necessarily only what the clients want or think they want. They must practice the skills involved in deciding when the best path may not be a new technological product” (p.24). To most Design and Technology educators, the making of products is a central activity. To consider a course of action that doesn’t involve the creation of a new product is to challenge their ‘raison d’etre’. This issue was raised earlier in this chapter in relation to designers, where the ‘product paradigm’ was highlighted as being both central to practice and environmentally damaging. Elshof (2006) draws attention to the way this paradigm has dominated technological education, seeing “productivism as an encompassing belief system [that] offers an uncritical valorization of industry, economic growth, and the consumption of technological products and is a theme within many parts of technological education” (p.23). He suggests that four factors need to be challenged to enable teachers to move forward: that technologies only have instrumental purposes; that the production-consumption relationship is unrelated to ecological damage; that practices of repair, reduce, reuse and remanufacture should not be marginalised; and that there should be recognition that products not only expand human possibilities, they also restrict them. Drawing on Layton’s (1993) “critic competence” and Petrina’s (1998) “‘interdiscipline’ of technological criticism”, he proposes that the product paradigm can be reconceptualised through enabling learners to become critical “connoisseurs’ of products that ecologically responsible.

Embedding (Environmental?) Sustainability into the D&T Curriculum

Elshof recognises that shifting the paradigm is a challenge for teachers and it involves confronting worldviews and value systems that prevent approaches that are “tinkering at the edges” (Elshof 2009, p.135). Rose (2010) through the Enviro-tech Project also found teachers more likely to focus on sustainability issues that impacted on economy than on environment but highlighted a shift through the inclusion in the Standards for Technological Literacy (ITEA, 2000) of two statements that bring environmental concerns into the Technology Education curriculum by highlighting the need to understand the effects of technology on the environment and the ability to assess impact. However, she voices concern over the lack of preparation teachers have received to help them develop understandings that go beyond a narrowness of view. Despite some focus on the Standards, Elshof’s analysis of the Tech Tally report (Garmire & Pearson, 2006) indicated a failure “to mention any specific knowledge, critical thinking capacities for capabilities with respect to environmental and sustainability dimensions of technological thinking, design and capability that ‘technologically literate’ young people will need in the upcoming decades” (Elshof, 2009, p.135) and makes the case that the survival and thriving of Technology Education required ESD to integral in order to maintain relevance within the subject.

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Like Rose, he points to the need for teachers to be supported through initial and continuing professional development to avoid a “benign neglect” of developing young people’s criticality in relation to ecological issues. He makes the case that transformative education is needed for the teachers as well as the learners to enable a critical approach to be embedded in practices. - need for teacher professional development to be transformatory in order for this to be embedded in the experiences, understandings etc they bring into their own practices as teachers (Elshof, 2005).

A more recent Delphi study by Rossouw et al (2010) presents a level of optimism. The study, drawing on the responses of thirty two international experts from the fields of philosophy/history of technology, engineering education and technology education to a list of transferable concepts and contexts that could be taught in engineering and technology education, created a set of priorities of key concepts that ranked sustainability as ninth out of thirty four and, for contexts, ranked energy in society, biotechnology and sustainable technology as first, second and third out of thirty five contexts. Whilst the views of a group of international experts may differ from practices on the ground, it is still encouraging to see the level of agreement and priority presented.

This chapter has opened up the territory and issues that particularly relate to environment in the context of the possibilities and challenges for Design and Technology Education if it is to make a critical impact on young people’s ability to contribute to sustainable futures in their communities, in society and at a global level. By necessity the chapter has provided a broad scoping. Fortunately greater depth and grounding is provided through the chapters that follow in sections two and three. I trust that collectively the important role of the environment is communicated at a level that allows for its increasing and sustainable inclusion in the learning activities provided in design and technology classrooms.

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3. GLOBAL ETHICS, SUSTAINABILITY, AND DESIGN AND TECHNOLOGY EDUCATION

INTRODUCTION

Evocative of both family and humankind-to-come, ‘generations’ is a common reference for sustainability. We look back and we look forward across generations and an implicit blend of emotion speaks to concerns for ‘future generations’ or ‘inter-generational justice’. Five witnesses who share these concerns step forward from the past half-century, a period spanning almost three generations. Their motivations are the same motivations as this book’s authors: the achievement of desirable global futures. The witnesses (and there is no shortage of others) all recognise that to achieve such futures what is needed is deep public engagement and an appropriately educated global citizenry. Each presents a radical yet articulate case; values participatory democracy while critiquing Western capitalist democracies; draws on history yet is futures-activist; is motivated by deep values-based concerns; and, recognises the enormity of the challenges they describe. They have said that:

(T)he environment for a satisfying style of life is being undermined by all the emphasis on ever-greater productivity and consumption. As a result, the nation faces the hazard of developing a healthy economy within the confines of a psychologically sick and psychologically impoverished society. (Packard, 1960/1963, p. 293)

The Greatest Resource - Education (Schumacher, 1974, p. 64). The problems of education are merely reflections of the deepest problems of our age... We are suffering from a metaphysical disease, and the cure must therefore be metaphysical. Education which fails to clarify our central convictions is mere training or indulgence. (Schumacher, 1974, p. 83)

Human beings are the only species with a history. Whether they also have a future is not so obvious. The answer will lie in the prospects for popular human movements, with firm roots among all sectors of the population, dedicated to values that are suppressed or driven to the margins within the existing social and political order: community, solidarity, concern for a fragile environment that will have to sustain future generations, creative work under voluntary control, independent thought, and true democratic participation in varied aspects of life. (Chomsky, 1989/2003, p. 136)

(Environmental Education) is a very broad area of educational activity from primary school to postgraduate. It is an amazingly mixed bag, spanning the worst of fuzzy thinking about “nature” to the best and most insightful methods of engaging how humanity currently dwells in the world and needs to do so in other ways. It is extremely important for it to transcend its original naturalistic terms of reference to embrace the “naturalised artificial.” (Fry, 2009, p. 243)

If there is to be a search by the international community for a common ground, there must be a space for an intercultural dialogue on ethics. The international community must make an active effort to begin this process of dialogue and understanding, and to provide a space within which inter-civilizational exchange can occur. (UNESCO, 2001, p. 1)

Thus, twenty-five years ago, Chomsky signalled the development, in so-called democracies, of the use of media for subtle ideological manipulation and control by governments themselves. (Similar critiques have been applied to education: see e.g. Apple, [2001]). Over fifty years ago Packard eloquently foregrounded issues not just about ‘ardent materialism’ and ‘planned obsolescence’ but also about the strategies of persuasion used by business to promote consumerism and consumption (Packard, 1957/1962; 1960/1963). In 2009 Fry, in advancing his notion of sustainment (the overcoming of the unsustainable) rails against greenwashing and argues for a re-imagined and revitalised approach to our design thinking and practices. Schumacher’s 1974 classic advocated ‘economics as if people mattered’, ‘technology with a human face’ and ‘intermediate technology’. At the turn of the Century, UNESCO anticipated the multiple ethical challenges facing humanity (and others) on the planet.

So why does it seem that despite over half a century of raised awareness, that the evidence, opinion and the literature continue to expand but real sustainable change seems as elusive as ever? If our knowledge about the issues is growing why are the problems not being resolved? Perhaps greenwash and scaremongering are working in favour of the vested interests that refuse to change. Perhaps we are led to think that positive change is happening or is just around the corner when, in reality, the only change is superficial or peripheral. Perhaps public global awareness is actually growing but has yet to reach the necessary critical mass for change. Assuming (which optimism suggests) that positive change is taking hold how will such change itself be sustainable?

This chapter argues that necessary, deep and lasting change needs to be considered as a matter of a global ethics that addresses multiple issues – amongst them, sustainability. It is not enough to claim to ‘know’ that sustainability is something we should all care about and act upon. The need is to see sustainability for its rich and problematic nature. Sustainability issues are matters of values contestation which, if they are to be properly understood, debated and resolved, need to engage with other fields of human collaboration and enterprise as well as across cultures. Especially, sustainability shares much with democracy and education. Because all three are

to be cherished and have common ethical concerns, ethics offers a meta-discourse across the triad. Further, all three need to be able to ‘speak’ to each other as well as to any futures that might be shaped by them. To deepen this approach, each must be of, and for, the other. That is: education for democracy and sustainability; democracy for education and sustainability; and, sustainability for democracy and education.

Whatever ‘democracy’ means to different users of the term, for the purposes of this chapter I take it to be: government by the most ethically defensible means. I am not claiming here that this is a right answer or that I am right. I frame it this way to signal the need that it be continuously tested and con-tested both as a concept and as a means of co-existing. Democracy must remain under continuous ethical scrutiny and debate in order to remain democratic. When it ceases to be ethical, it ceases to be democratic – and when a system of government or co-existence ceases to be democratic, it is not ethical. Further, if this sense of democracy is viable, then the principles involved could, and should, extend globally.

In turn, if democracy is ethically determined then so must the education systems on which it is based and for which it exists. As White (1973) cogently argues, “There is at least *one* policy which *must* be in the public interest in a democracy. This is an appropriate education for a democracy” (White, 1973, p. 237. Original emphases). Thus education is key to the wellbeing of democracy and for the wellbeing of its participants. White also argues that the determination of what might constitute that ‘appropriate education’ cannot be left to ‘experts’ but that moral judgements are central to the determination of education in, and for, democracy. In short, we should all have a say in these matters.

Although not foregrounded in this chapter, Design and Technology Education is ever in the background. In parallel to the focus a global ethics and sustainability, all of technologies, designs and the acts of designing, creating and using technologies are themselves understood to be matters of ethical contestation. Design and Technology Education itself warrants an ethical-democratic curriculum role (Keirl, 2006a).

Finally, this chapter has considerable limitations and these are signalled at the end. In particular, there is a Western proclivity that cannot be denied. In part, this is because of the need for deeper study and research by the author. It is also because the general question under scrutiny is of Western making. It is largely the case that the origins of both problems and discourses around sustainability are Western. Arguably, then, Western discourses may or may not be appropriate tools for answering the question or meeting the problems. Thus, in arguing a case for looking at sustainability issues through ethical lenses it matters that some of the West’s key understandings and constructs be critiqued.

Who Do We Think We Are? (i)

The idea of ‘self’ begs some consideration as it turns up often enough across ethics-democracy-education-sustainability literature. ‘Self’ can denote any of: person, identity, individual, agent, actor (after Latour, 2007), being, choice-maker, moral

entity, human, and more. In the Western world we can talk of the psychological self, the sociological self, the philosophical self. There are negations too – self as not ‘the other’, not an object, or not common.

Otherwise, as UNESCO (2001) alerts us, “For the Buddhist tradition...the beginning of ethics consists of a detachment of the ‘self’, of a ‘no self’...(and that) a ‘self’ in the Western sense may not be taken as a reference point for ethical theory. But one can translate the ‘self’ and ‘self-relationship’ to the term ‘autonomy’”(UNESCO, 2001 pp. 12-13). Meanwhile, in the Confucian tradition there is no equivalent to the modern Western notion of self and the individual. Rather, the Confucian self is “...a relational self, defined through social institutions and relationships, characterized by interrelatedness among family, friends, communities, countries and the universe, and is marked by a sense of mutuality, responsibility and obligation” (UNESCO, 2001, p. 15).

Within the Western frame a particular ethical concern is the notion of self-interest. At one extreme there is the absolute selfishness that can be manifested in ruthlessness, winning, surviving, maximisation of personal assets, and so on. This selfishness holds the interests of particular persons above those of other persons, other species and the world at large. A contrasting position, long-established and gaining renewed currency is the recognition that our best ‘self’-interests are actually served by looking after the ‘common good’ through cooperation and collaboration. In its deepest form, such a position affords equal rights to all species and environments.

Singer (1995) discusses the “age of self interest” suggesting that “...human nature may have evolved to be capable of more than narrow self-interest” (Singer, 1995, p. 24). He offers his broader conception of “enlightened self-interest” arguing that we are better served by working rationally and collaboratively than by working selfishly. In a subsequent work (Singer, 2004) advancing the case for a global ethical community, he discusses national self-interest and how ethical discourse is now looking beyond the idea of inter-national with its implicit assemblage of so many sovereign states with their own identities and borders, towards the goal of a one-world global community.

Wood (2007) talks of eco-solipsism – of the narcissistic self trying to ‘be’ in what he describes as ‘the cult of celebrity, vanity, and self-presentation’ and the development of “...a new ethics of the individual in which the environmental responsibilities of citizens became eclipsed by their implicit rights as consumers. Clearly, from an ecological perspective we can see that few individuals could adopt this mode of living without causing enormous environmental damage” (Wood, 2007, p. 35). More recently, Bennett (2010) takes self-interest in a different direction arguing that it could embrace her notion of the vibrant materiality that runs through all things, animate and inanimate (in the Latourian sense of attributing them with agency). As with Singer, Wood and many others, she will not dissolve the very relationships we inevitably hold with all matter and species. Thus, by acknowledging such interdependence we can adopt another kind of enlightened self-interest. Bennett argues that environmentalism, ‘...invented in the 1970s...’, was, in the

2000s, making a comeback with a whole range of concerns and practical problems stirring an American public from their ‘fatalistic passivity’ (after Guattari). “This comeback was motivated in large part by self-interest, by a fear of the environmental ‘blowback’ of human actions” (Bennett, 2010, p. 110).

A key challenge to sustainability is that of anthropocentrism – a different sense of self-interest. To contemplate, analyse, speculate or critique from a solely human-centred position is to take either an academically selfish or an impoverished approach – or both. As with enlightened self-interest, we are collectively the poorer when we deliberately fail to see or acknowledge the ‘other’ which, alongside us, constitutes the global whole. To critique our anthropocentrism raises questions of our existence when we recognise that we, as persons, are not sole existences or beings but that our existence is actually a matter of multiple co-existences. Thus, we can consider ourselves as being-with or co-existing in four different realms: with other humans; with other species; with the planet; and, with technologies. This framing is not intended to be reductionist or anti-ecological in nature. It was offered (Keirl, 2010) to help educators engage with Technology’s complexity and seeming invisibility in our everyday lives. Here, it is offered as the background against which sustainability can be contextualised.

A further concept to introduce in relation to ‘self’ is *Bildung* which has a rich history in German culture and is valid for the concerns of this chapter. *Bildung* offers a special sense of education - one that qualitatively exceeds the kinds of instrumentalist schooling being advanced in many contemporary societies. In his 1975 magnum opus critiquing Enlightenment reason, Gadamer (1975/2004) writes that *Bildung* is not a matter of “...a technical construction, but grows out of an inner process of formation and cultivation, and therefore constantly remains in a state of continual *Bildung*” (Gadamer, 1975/2004, p. 10). *Bildung* as such cannot be a goal – it is a continuous becoming with no goals outside of itself. It is not about the cultivation of particular talents (witness current instrumental educational agendas to ‘train’ and ‘prepare’ students for jobs and markets). It is at once both sustainable and sustaining.

Bildung as (self-)formation is holistic and lifelong with strong dimensions of self-reflection, self-critique and transformation. Rather than adopting a passive acceptance of some kind of ‘natural consciousness’, the aim is the development of “...working consciousness (which) contains all the elements that make up practical *Bildung*: the distancing from the immediacy of desire, of personal need and private interest, and the exacting demand of a universal” (Gadamer 1975/2004, p. 12). He also advances the need for receptivity to “...’otherness’...keeping oneself open to what is other – to other, more universal points of view...To distance oneself from oneself and from one’s private purposes means to look at these in the way that others see them” (Gadamer 1975/2004, p. 15). In turn, what is sought is a “cultivated consciousness” which has “...more the character of a sense...It is a universal sense” (Gadamer 1975/2004, p. 16).

Bildung not only works holistically to develop a critical-ethical self but it also works to develop society and is ever self-questioning to ‘build better’. The concept

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strongly epitomises the sustainable-self, the self who, through reflection and action, seeks to build for the greater good. In this light, growth is not of the kind the capitalist project promulgates. Rather, it is all of inward-, outward-, and future-focused growth. It models a very enlightened self-interest that contributes to the common good.

Who Do We Think We Are? (ii)

Something must be said about the term ‘human’ and such derivatives as humanity, humankind, human being, humanism and human nature. We use human and humankind to refer to our own species and we describe ourselves as human beings which usefully keeps a hint of the existential present – our be-ing human. But we also talk ethically of human behaviour, our shared humanity, inhumanity, humane treatment and so on. Some brief commentary on human nature and some exploration of post/humanism is needed.

In discussing sustainability, the concept of human nature (or any use of ‘nature’) is a shaky one. For one thing, it can be culturally specific in how it is applied. Indeed, for some cultures, the concept could be puzzling. To talk of a human nature as opposed to other natures or in the light of a unifying singular Nature begs contention. The need is that we are mindful of multiple, contextualised uses of ‘human nature’. Warnock (1998, p. 21) reminds us that “natural” is a “slippery and evanescent” concept. Nature, for some, is just stuff, a thing, or so many materials. In educating for sustainability, we know now that we should think otherly, as Wood (2007, p. 188) does when he invites us to see Nature as “emergence and flow”.

Philosophically, humanism celebrates humanity for its own sake and its own perceived qualities resisting not only any supernatural or divine orientation but also scientific descriptions that position humans simply as part of (or at the top of) a ‘natural order of things’. Humanism emerged from a reaction against religion or a God as the centre of all things (thus a humanist-agnostic/atheist tendency) toward a new centring around a reasoning humankind. In turn, humanism offered an ethics that was reason-based, that is, reason over emotions and prejudice rather than, say, a pure scientific rationalism (Lacey, 1995). As with any socially concerned group, positions amongst humanists vary according to values, philosophy or politics. Recently, UNESCO reports that: “Changes in the world call for the development of a new humanism that is not only theoretical but practical, that is not only focused on the search for values – which it must also be – but oriented towards the implementation of concrete programmes that have tangible results” (Bokova, 2010).

Emergent critiques show that the concept human, or its derivatives, cannot be taken as a ‘given’. For a start, any centring of worldviews or actions based on the idea of human is itself inherently anthropocentric. Just as emergent humanism facilitated new ways of knowing and of conceptualising ourselves in a special ‘human’ way, so, as new understandings emerge, might the conceptualisation itself become redundant. “As the archaeology of our thought easily shows, man (sic) is an invention of recent date. And one perhaps nearing it’s end” (Foucault, 1989/2000,

p.29). Here, post-humanism presents itself and we should briefly consider its two broad strands that speak to matters of ethics, education and democracy in relation to sustainability.

First, there is a humanities or social sciences postmodern sense of overcoming and reconceptualizing the human both inwardly and outwardly – looking inwardly to a reconceptualisation of the person and outwardly to all the relations (our co-existences) that we hold and which reciprocally shape us (Badmington, 2000; Fukuyama, 2003; Habermas, 2003; Bostrom, 2009; Wolfe, 2010). In this sense, Verbeek (2009, p. 251) discusses posthumanism as “...development beyond humanism as a predominant way of understanding what it means to be human.” In this arena, we might say that constructs such as human and its relations are no longer sustainable.

Second, there is a more technological perspective of our human-technology coexistence which suggests, acknowledges or advances our transhumanism - as Verbeek (2009, p. 251) puts it: “...the ‘transhumanist’ development towards an enhanced version of Homo Sapiens...” Again, positions vary but one focal idea is that our merging technologies – across existences - are reaching a point described as Singularity (Vinge, 1993; Broderick, 2001; Kurzweil, 2005; Bostrom, 2009) and/or convergence (Schmidt, 2008) whereby we no longer talk of co-existence as existing ‘with’ or ‘alongside’ but, rather, as a fully integrated one. For Kurzweil (2005), posthumanism is the term for the period that will follow the Singularity in (views vary) three to five decades time. In this arena, we might say that constructs such as human and its relations are sustainable – at least through the Kurzweilian (1999, p. 14) take that technology is “evolution by other means”.

Of course, there is also the view of the future where human-caused planetary crises will lead to our own self-destruction - the doomsday scenario – pessimistic but plausible. In this post-extinction arena the question of human sustainability becomes null and Gaia (Lovelock, 1979) may be left to look after the planet. Bostrom (2009) offers four possible “families of scenarios for humanity’s future” (Bostrom, 2009, p. 194) one of which is extinction. The others are recurrent collapse: “in which human civilization oscillates indefinitely within a range of technological development characteristic of a human condition” (Bostrom, 2009, p. 199) that is, peaking and troughing somewhere between our pre-human and the post-thuman states; plateau (of either technological increase reaching a plateau pre-posthumanism or of technological stasis close to the current level; and posthumanity (for which he offers several criteria and possible manifestations one of which is the “singularity hypothesis” (Bostrom, 2009, p. 204).

Whatever is happening in terms of humanity’s evolution, we should note that: i) parallel discourses are developing which draw us into rethinking our understandings of being human; ii) those discourses should be taken into account in our thinking about sustainability – both as a concept and as action in, and on the world; iii) all the possible scenarios are fundamentally technological; iv) whatever the case, there are challenging ethical issues at play; and that, v) we need to rethink what an appropriate education might be for whichever circumstance we contemplate.

Considering Ethics...

With any consideration of being human comes recognition that ethics is particularly and necessarily a human construct concerning our behaviour. “Moral value is something which springs into being only when there is an actual human agent deciding what to do, and doing it” (Warnock, 1970, p. 4). So long as people have interacted, ethics has been evidenced in mythology, in collaborative (rather than competitive) efforts towards coexistence, and in religion. All cultures and communities have developed moral codes and a rich interplay of emotion, spirituality, aesthetics, imagination, and more contribute to ethical coexistence. Sooner or later the classic ethical questions: How should I live? How should we live? What is right? What is good? and so on, are engaged by individuals and communities alike. Such questions beg discourses around values and the moderation of value differences is what can facilitate reasonable coexistence. That is, we act in ways that seek to understand, and to consider, values that we may not ourselves hold.

Midgley (1993, p. 3) reminds us that the origins of ethics can be considered in two particular ways: “...one about historical fact and the other about authority” and the distribution of both authority and agency are central to ethical values discourse and to the question of who gets to participate in ethical determinations. This is a highly significant issue when considering the extent, or otherwise, of participation in democratic decision-making around preferred and sustainable futures. The history of ethics also shows variations in its perceived practical value. Largely constrained to the Academy in the 1960s, “...(r)real subjects...” subsequently became “...the proper concern of moral philosophers,” says Warnock (1998, pp. 12–13). Fortunately, that trend has continued, greatly stimulated by the very real ethical issues presented by technologies.

Despite growth in the recognition of the need to see ethics-as-practice, whether for daily life or for technological assessment, pitfalls remain. There are challenges such as relativism (“It’s all a matter of opinion”) and those of religious and political dogma (“This is right/that is wrong”). As Blackburn has it: “There must be a course between the soggy sands of relativism and the cold rocks of dogmatism” (Blackburn, 2001, p.26). He also observes that “...one peculiarity of our present climate is that we care much more about our rights than about our ‘good’” (Blackburn, 2001, p. 4). Differently, we can have concerns about pervasive capitalism’s capacity to colonise language to its own ends when it talks of ‘ethical business’ or ‘ethical consumerism’ as though such terms are ‘innocent’ (after Galbraith, 2004) when they might actually be greenwash, even oxymoronic. Solomon (1993) points to Aristotle’s distinction between (acceptable) household trading “...essential to the working of any even modestly complex society...” and “...unsavoury and unproductive...” trade for profit (Solomon, 1993, p.355).

Today, most Western societies are being led and shaped by globalised capitalism that valorises egoistic or selfish self-interest over enlightened self-interest. However, we have alternative ethical models to draw upon. To take just two: first, there are

the deeply holistic perspectives and practices of Aboriginal peoples whose intimate relationship with land is generally beyond Western understanding but which is a paragon in the history of sustainability. Second, there is the principled assessment of technologies weighed against the communal good as practised by the Amish (Sclove, 1995; Kraybill, 1989/2001; Nye, 2007). Common criticisms applied by advocates of the dominant Western model to Aboriginal or Amish ways, are at worst a form of derision and at best a technical critique – one constrained to criteria of efficiency, profit, production and ‘progress’ (a now largely debunked bedfellow of capitalism). However, when an ethical perspective and analysis is applied to the varying models of ways-of-being-in-the-world, capitalist criteria alone are inadequate, impotent or, perhaps, are no longer sustainable.

Any pursuit of ethical criteria or for ‘ways-to-be’ ethically soon leads us to see why ethics (like Technology) is a contested field. Sometimes the breadth of contestation (as with Technology) leads people to indifference or apathy: “It’s all too hard; what’s the difference?; just get on with it”. So it can help to know something of the options and issues at play. Somerville (2000) describes the ‘schools of ethics’ thus:

Among the diverse schools are principle-based or deontological ethics; situational ethics; utilitarian ethics; consequentialist ethics; casuist or case-based ethics (...similar to the legal doctrine of precedent); narrative ethics; feminist ethics; hermeneutical ethics (...based on interpretation of a context or text); and virtues or character ethics. (Somerville, 2000, p. 289)

She points out that, if all of such ‘schools’ were to respond in unison to an ethical issue, there would be no ethical dilemma. However, it is more often the case that there is disagreement. Because ethics is about values and values difference, like design, it demands a weighing up of possibilities around matters that are controversial. Each of us has a value system or a set of values over which we have choices and it is for each of us not only to defend our values but also to modify them in the light of new experiences or better alternatives. Many associated concepts inform ethical or values discourse and help it have a presence in our daily thinking and behaviours. We debate terms such as good and right (and their counterparts); we discuss the respective merits of cooperation, collaboration and competition; we assess risk; we trust; we care; and, we develop empathy as both value and skill (Rogers, 2006). All such values have something about them which Warnock (1998) offers as ‘timeless values’: they turn up across the ages in all cultures and societies.

For each of us, tensions and contradictions arise when it comes to deciding how to act ethically, that is, to be a moral agent. Here, the question of the self returns. We might seek to educate to create the autonomous or self-determining individual - but such an education would need to help the individual balance any claim to their ‘rights’ with an equal accommodation of their duties and responsibilities too. The concept of consciousness must also play a role. We can talk of levels of consciousness within the person (as with self-awareness) but there is also the degree of consciousness we hold towards the world beyond ourselves. In this realm it is possible to hold a false

consciousness that masks one's awareness of the true state of the world at large. The term is drawn from Marxist theory to describe "...the masking effect of ideology, which cloaks the true conditions of things, thus inhibiting the mobilization of political activism" (Buchanan, 2010, p. 161). We have already witnessed Gadamer's (1975/2004) promotion of Bildung being grounded in understandings of working consciousness and cultivated consciousness while Keirl & McLaren (2013) have written of altered consciousness with regard to choice and children's designing and technological thinking. All these configurations of consciousness must hold a place in shaping education for sustainability.

Ethical Being and the Common Good

From a strongly argued a romanticist perspective, Beiser (2003) affirms Bildung as an on-going, holistic maximisation of self engaged in many fields of accomplishment whilst concurrently contributing to the maximised and holistic common good of multiple selves. To this we can add the Ancient Greek concept of eudaimonia, not readily translated but which can refer to happiness (though not in the purely subjective or selfish sense). This might be better expressed as welfare, human flourishing, or the pursuit of the highest human good. So, in considering ideas of what it means for people to be fulfilled, flourishing or achieving self-realisation, we consider the good – not only for persons but for all people, that is, as a common good.

The idea of the common good is a worthy one but it has tended to be thought of as applying to and within particular communities or societies. As the witnesses attest, the common good must now be global and future-focussed. Are there particular ethical approaches that might contribute usefully to such an outlook? How might a practical ethics meet our aims? Certainly a deontological approach, (Greek deontos: duty) might inform our actions through prior-formulated rules or principles such as 'Do no harm' a virtue ethics might inform our sense of how we should aspire to what is right and good; a narrative ethics might see ourselves in ethical stories; or a hermeneutic approach might invite ethical discourse as a matter of context-based interpretation. For the challenge of sustainability, all schools or dispositions of ethical thought have something to contribute but aspects of utilitarianism offer some particular possibilities.

Utilitarianism takes a consequentialist approach to ethics in that it is concerned with the weighing of the consequences of actions. In fact, Blackburn (2001) reminds us that utilitarian principles can be used to weigh other ethical approaches themselves. Often too simply described as 'the greatest happiness for the greatest number', our understanding can be deepened if we think instead of 'wellbeing' or 'interests' rather than the perhaps egoistic and subjective-sounding 'happiness'. As Griffin (1995) points out, we might think less in terms of 'number' (the quantitative) and more towards 'the optimum' (the qualitative). Thus, this is perhaps an ethics of optimising wellbeing or: "utility as welfare maximisation" (Goodin, 1993, p. 244). Utilitarianism

is also an approach capable of considering multiple consequences and accommodating multiple agents including those beyond humans, on which, more below.

It is precisely because utilitarianism is forward-looking that it is of value to our concerns for all of: education, democracy and sustainability. While it may be informed by other ethical approaches or principles it is not bound by them. As Blackburn says:

It deals with value – with things being good or bad, or better or worse... Deontological notions of justice, rights, duties, fit into a moralistic climate, where things just are right or wrong, permissible or punishable. These are the words of law, as much as words of ethics. Utilitarianism by contrast gives us the language of social goods... (And, appropriately for this book's readership – SK) The cast of mind is that of the engineer, not the judge. (Blackburn, 2001, p. 75-76)

Also via utilitarianism, Midgley's (1993) 'authority' dimension of ethics can be a more distributed one. It is arguably better for more people to contribute to a forward-looking ethic than is possible when 'authority' lies in the hands of a few or is ascribed to a dogma. To paraphrase Goodin (1993, p. 248): 'What should we do, collectively?' is much more the utilitarian question than 'How should I live, personally?' This, of course, does not sit well with those few who would claim to hold moral authority and it is here that feminist ethical critiques have taken on matters of enculturation and gendered power distribution (see e.g. Tong & Williams, 2011). Given some of the alternatives, there is a case to argue that utilitarianism offers a democratic means for ethical determination through debate and action pursued across time, place and cultures: that is, to effect a global ethical conversation. (Singer, 1993; Somerville, 2000; Blackburn, 2001; UNESCO, 2001, Berman, 2009).

Ethics as Practical Action

Ethics as it is embraced for this chapter is considered as practical philosophy for practical action for the sustainable good. Not only should the field be properly theorised but it should also be seen as a way forward, indeed, as a way of life or a way of being. To lay any claim as to how the future should be is surely to call forth an ethical position. Such is the case if we are to talk of sustainable futures.

While we might work from some prior established principles, shaping the future in an activist way brings some interesting considerations. In the literature it is not uncommon to come across Aldo Leopold's dictum: 'A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise' (see, e.g. Orr, 2005, p. 93, Haupt, 2011, p. 8). But is a 65 year-old rule sufficient to guide today's or future considerations? Perhaps. Its eloquence certainly exceeds the limiting and conditioning language of many current claims of what constitutes 'good' or 'right'. While the deontological approach has its merits

it can be seen that Leopold's words beg much discussion if they are to inform 'right action' towards the future.

What emerges here are the different kinds of values under discussion. For example, Frankena (1973) distinguishes between moral and non-moral values, while we can also look to instrumental and intrinsic, or non-instrumental, values. One attempt at building on such distinctions sought to develop the idea of visioning values to serve future-focussed ethical-design curriculum (Keirl, 2006b). Being aware of these qualitative differences matters because the emergent debates become both personal and public in nature. For example, when it comes to the assessment of the designing and bringing into being of technologies, qualitative, moral and non-instrumental values must be engaged to appreciate the full picture. Many technologies (i.e. products) are produced simply for profit. Differently, for too long technological assessment has been little more than an increasingly subtle, coded language game around the lowest common denominator: "Does it work?" When Feenberg (2010) distinguishes between the cultural roles of technology and craft he notes the differentiation of technical activity and social activity: "Specifically, technical knowledge is separated out from the prevailing aesthetic and ethical values". Technical know-how is one thing but, in craft, the spectrum of values "... form a single complex" (Feenberg, 2010, p. 183).

The Temporal and Ethics

A few considerations should also be given to some temporal aspects of ethics in practice. For example, Somerville argues for 'ethics time' to conduct technological assessments – particularly with regard to major emergent technologies like xenotransplantation or nanotechnology. This resonates with 'slow' movement thinking configured as 'slow design activism' by Fuad-Luke (2010).

Design is a powerful vehicle by which to encourage people to aspire and achieve new ways of living, working and recreating. Design should spend less time on envisioning utopias and focus more on what American architect Bruce Goff called "the continuous present"... Design can reconnect us to a wider world where the ambition could be to encourage...eudaimonia, or human flourishing. Slow design offers that potent 'reconnection' to discover more eudaimonia. (Fuad-Luke, 2010, p. 150)

Wood (2007) also looks to a future of eudaimonia that contributes to the good of others: 'Maintaining a quest for personal happiness is important, but it will also be vital to develop an active ethics of eudemonia (sic) that enshrines self-actualisation within situated altruism' (Wood, 2007, p. 200).

While sustainability is forever concerned with the future, and design itself is about acting with intention on the future, history and hindsight both inform such perspectives. However a charge against some approaches to history is that of 'presentism': the judging or interpreting of past events using criteria of present-day

moral views, that is: we ought not to judge the past by current ethical standards. Just as an extreme anthropocentrism can amount to speciesism (“...considered morally on par with sexism and racism” [Gruen, 1993, p. 350]) so we might think about our current moral perspectives and any risk of presentism. In anticipating ‘preferred futures’ we might acknowledge not only that we must hold our strongest and best-thought-through ethical case for acting towards the future, but also that we should be ready to adapt and reconsider that position as realities manifest themselves. Thus our ethically-grounded sustainability aspirations may simply need to be sustainably aspirational, that is, under continuous scrutiny for whatever would be (ethically) better.

The ethics literature (see eg Singer, 1993) highlights the problematics around intention and foresight and technology researchers have begun to signal caution towards any claim to certainty of outcome regarding designed futures. Tenner (1997) reported on the unintended consequences and ‘revenge effects’ of designed technologies and, building on earlier work around the intentional fallacy (from literary criticism), Ihde (2006) has offered the designer fallacy as a caution against congruence between any designer intention and a technology’s use.

With foresight in mind there has been much expression over the last three decades of the precautionary principle which suggests that unless there is consensus or evidence that harm will not occur, or that consequences are fully understood, then a new technology should not be developed. As Sunstein’s (2005) critique of the principle shows, there is a plethora of issues at play in the assessment of risk, for example: fear; precaution versus paralysis; compromise of civil liberties; expertise vs ignorance; short-termism of people and governments alike; people being “unrealistically optimistic” or their tending “...to reduce cognitive dissonance, sometimes by treating risks as though they are tiny, even worth ignoring” (Sunstein, 2005, pp. 52-53). Sunstein’s work cautions us ethically, socially and politically about the limits and potential of the precautionary principle. Once more, for all a seemingly valid and well-intentioned ethical ‘principle’ can inform considerations about sustainability, it must be maintained under critique for its limitations. Whether looking to the future; trying to act ethically towards the future; trying to design, or to ‘engineer’ the future; it would seem appropriate to move with a nuanced blend of ethics of intention and an ethics of caution.

Moral Considerability and Those Others with Whom (and with Which) We Coexist

Moral philosophy also debates an important concept regarding our several coexistences. Moral considerability emerges from the question of how we treat others. Writing on world poverty, Dower (1993) argues that people, as moral agents with choices, should consider the effects of their choices on the wellbeing of others. It doesn’t matter whether the ‘others’ are part of the same moral community as those with choices. What is significant is that moral consideration is extended to others. In turn, under a life-centred ethics, anything living is eligible for moral consideration:

“...even the whole biosphere itself...A life-centred ethic counts all living things as morally considerable although not necessarily of moral significance” (Elliot, 1993, p. 287).

But should matters rest there? With the Singularity comes the blurring of the natural and the artificial, and the interface of the bitsphere and the biosphere (Franklin, 1990/2004). As Bennett (2010) speculates: “Perhaps the ethical responsibility of an individual human now resides in one’s response to the assemblages in which one finds oneself participating...” (Bennett, 2010, p. 37). Verbeek (2006) has argued for moral considerability towards ‘things’ – all those technologies that mediate our lives, with which we also coexist.

...(T)he argument that things do not possess intentionality and cannot be held responsible for their “actions” does not justify the conclusion that things cannot be part of the moral community...

When the actions of human beings are not only determined by their own intentions but also by the material environment in which they live, the central place of the autonomous subject in ethical theory needs to be put in perspective. Once we do that, it becomes clear that it might indeed be necessary to move the source of ethics, which had already been moved from God to humans, one place further. (Verbeek, 2006, p. 121)

Verbeek doesn’t declare the concept of human to be obsolete but, rather, he advocates a posthumanist ethics that need not abandon humanist values, giving “...a central place to the idea that the human can only exist in its relations... to the non-human... (and)...In order to cultivate humanity, we need to take seriously how technologies also help to cultivate us” (Verbeek, 2009, p. 261).

Established and Emergent Technologies

Apart from all that we are gradually learning to critique about existing technologies, we have a spectrum of emergent technologies that are both accelerating the re-shaping of our (co)existences and forming the foundations for the Singularity and Bostrom’s (2009) scenarios. Major candidates include: nanotechnologies; xenotransplantation; artificial intelligence; and, genetic engineering (of any species). Most recent is ‘big data’ which brings its own capacities for reshaping existences in ethically problematic ways. The well-established issue of data quality (garbage in/garbage out) becomes hugely magnified: “We are more susceptible than we many think to the ‘dictatorship of data’ – that is, to letting the data govern us in ways that may do as much harm as good” (Mayer-Schönberger & Cukier, 2013, p. 166). Issues of privacy, still not fully understood, are now compounded by issues of probability: “...the risk that we may judge people not just for their actual behaviour but for propensities the data suggests they have” (Mayer-Schönberger & Cukier, 2013, p. 192, my italics). When policymakers or businesses have access to, and control over, mass data, all

of democracy, education and sustainability become ethically challenged. The fact remains that, established or emergent, every technology is an ethically complicated navigation of values.

This very fact is a pointer to the challenge of trying to ‘see’ technologies for what they are. Whether a canal, a washing-up brush or a form of government, the mistake is in trying to understand any technology as an ‘it’ rather than the holism it represents. Technologies can be critiqued holistically, democratically, ethically and sustainably by interrogating their circumstances across five interdependent phases: intention; design; realisation; use; and, consequences (Keirl, 2009). Conducting such interrogations opens up the ethics of coexistences, futures and our very sense of being human. Further, issues of our democratic engagement in, or marginalisation from, technological enactments also raise questions around choice as moral agency or choice as illusion. If choices are only presented to us at the realisation stage (once a technology has come into being) then our capacity for effective, democratic choice-making is greatly reduced. In such a situation, it is already too late to discuss sustainability concerns which begged critique at the very intention stage - even before any designing is undertaken.

It has been the absence of democratic participation at these early phases of a technology’s development that has disempowered citizens and publics from helping shape sustainable futures. For too long our ethical perspectives have been reactive rather than proactive: witnessed by the cycle of technological creation - negative consequence - remedial legislation. Street talk still echoes Enlightenment/capitalist faith in ‘progress’ and simplistic technological determinism (see e.g. Smith & Marx, 1994) both of which position citizens as mute and powerless in technological decision-making.

Developing the Necessary Conversations

It can be argued that we are somewhat ‘caught’ at present in that, not being used to collective determination of possible and preferred futures, we are conditioned to accept that “that’s the way things are going” as our (determined) lot in life. There are two ways we might think about the future. First, there is the Future (big ‘F’) - a whole, not just something ahead of now but a way of being, living, relating, feeling and knowing. The Future in this holistic, amorphous sense is not only unknown but is imagined by each of us in differing ways. Nonetheless, the Future is something towards which we can offer moral considerability and we can do this through multiple conversations. Thus, while we can talk reflectively and imaginatively about the Future, we can also talk pragmatically about, and act on, a range of futures (small ‘f’) – multiple and coincident because of our coexistences. Our personal futures are considered not only alongside those of other people but also alongside those of other species, technologies, and the planet.

While education is key to developing citizen engagements in ethically defensible global futures, any such education needs to work across communities, societies,

cultures and boundaries (whether physical, political or otherwise). It needs to be multi-located: in homes; through responsible media; in the street; through policy; and, in formal educational settings. In turn, multiple conversations are needed, both deliberative and activist, around a range of futures-orientated concepts that can inform an ethics of sustainability. From what has been said, these could include:

- The problematics of self, of human, of other;
- The interests of whoever and whatever constitutes the moral community – including both knowledge interests (Habermas, 1971) and ‘self’ interests;
- Bostrom’s (2009) scenarios for humanity’s future;
- Maintaining ideal visions as practical, futures-focussing devices (candidates include: democracy, Bildung, eudaimonia, the common good);
- Moral imagination and creativity (Warnock, 1998; Mackay, 2004; Somerville, 2006);
- Empathy and multiple forms of consciousness;
- Choice and all its manifestations from Singer’s (1995) ultimate choices to our daily choices and the moral context of choice-making;
- Rights and responsibilities as ethics of democracy and ethics of duty;
- Moral considerability across all four realms of co-existence;
- Design, utilitarianism and consequentialism as futures-orientated;
- Ethics time and timeless values;
- Care: “Caring is primarily forward-looking in orientation” (Dower, 1993, p. 275); and,
- Ethics as engineering (or design) rather than judgement

This is not an ethical checklist and the concepts exemplify how ethics (as with sustainability itself) is a process rather than a destination. To build and to maintain conversations around these concepts is to build a discourse of, and for, sustainability. Both Warren (1995) and Blackburn (2001) report Habermas’s case for a discourse ethics that is dialogical in nature and seeks to facilitate conversations between concerned parties. Fuad-Luke’s design activism advances “...participatory democratic spaces for co-design decision-making in the form of a MootSpace, building on historic examples (the Anglo-Saxon moot) and contemporary practices (the Maori marae)” (Fuad-Luke, 2010, p. 151). Meanwhile, to return to the fifth witness, UNESCO cautions that:

All of us involved in the dialogue on ethics must be aware of our own cultural references and roots, and must not claim universality, nor blindly pretend to cultural ‘neutrality’. Our hope is to raise awareness of the deep world heritage of ethical wisdom, and to promote mutual learning and understanding for an ‘authentic’ dialogue on the values that are to guide the evolution of the 21st Century. (UNESCO, 2001, Annex II, p. 5)

In the Western world, we have been conditioned to measure life instrumentally and competitively within and across national borders. But there is significant

difference between ‘standard of living’ and ‘quality of life’ and it is the latter which is the concern of the witnesses. To advance sustainability in ways that qualitatively enhance the wellbeing of all that exists on the planet can only be done by a comprehensive and ongoing engagement with a global ethics. In advancing a case for the consideration of ethics for sustainability I have also argued the ethical interdependence of sustainability, democracy and education (and, thus, Design and Technology education) – that they speak to, for, and of, each other ethically. To advance the quality of one is to advance the quality of them all.

As Blackburn says: “Ethics is disturbing” (Blackburn, 2001, p. 7) but then so is the enormity of our global concerns. Ethics today is developing as a versatile, practical, philosophical tool but skills in using and maintaining the tool are needed by everyone. Hence the role of education and the global village in helping students become skilful ethical practitioners and activists. Education and, thus, Design and Technology education, now faces a major set of choices around whether it will be maintainer of the status quo or agency of change for heightened global ethical consciousness and practice.

Coda

This chapter has offered only a selective overview of some key fields of enquiry – not least, ethics itself. Several ‘isms’ warrant expansion, notably: determinism, humanism, existentialism, idealism, and anthropocentrism. A similar case stands for a range of ‘posts-’, notably: posthumanism (Wolfe, 2010); postmaterialism (Bennett, 2010); and, regarding technologies, postphenomenology (Ihde, 1993; Selinger, 2006). Any use of the term ‘nature’ must be carefully critiqued (Singer, 1993; Habermas, 2003). As already noted, a major limitation is the Western orientation of the chapter. An obvious candidate for expanded discussion would be the ethics of craft practices (see e.g. Fry, 1992; Berger, 2003; Sennett, 2008; Gauntlett, 2011). Finally, and perhaps most telling, has been the avoidance of any settlement on a particular ‘working definition’ of sustainability itself. The conversations continue...

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4. CULTURE IN DESIGN, TECHNOLOGY, AND ENVIRONMENT

Reflecting on Field Experiences

INTRODUCTION

Culture is a fuzzy kind of idea. We all point to it when we see it among others, but when asked to place a universal boundary around it to define it as framing much of what we do ourselves, we run into trouble. When we design and develop made worlds with, and for, other cultures, or when we think how we engage in the worlds made by others, the opportunity manifests itself to see how culture can be embedded not only in the choices made to create the artifacts, systems, or symbols but significantly in the socio-cultural and even natural resources that must have been evident to produce, maintain, and evolve them. In this sense, the made worlds we design and come to accommodate or curse, required both a community and an ecology a priori. Conversely, the designed world gives evidence of culture and community, and the presence of an ecology that offered up something to transform and consume: ipso facto an education in design and technology is an education in the dependencies that necessarily exist between humanity, the designed world, and the ecology. This is a big responsibility, as with such universal dependences that underpin all design choices and judgments, moral dilemmas abound. When we add the question of teaching to accommodate values and beliefs in the classroom, including the culture of shared values and ideologies of the State, multi-cultural diversity among pupils, staff, and parents, and values driving curriculum economics, it does not take much to concede that any simple web definition of culture in the design and technology education setting will prove inadequate, and that a more sophisticated respect for culture in design and technology studies is necessary. Culture in design and technology education and research, deserves much more serious attention than any handbook dictionary, web, or even an anthropological position could offer.

The array of sources that offer definitions of culture across the literature and web search engines range from the scholarly to the over simplified. Despite access to a plethora of helpful sources, there are times when it is more informing to use any number of contextually useful metaphors to describe culture than a definition. This chapter will offer some broad background ideas and unresolved questions about culture in design and technology studies and practice. I will be referring a deal to my own thirty-five years of working in cross-cultural design and technology education

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and development settings. When working cross-culturally, especially across high-contrasting cultural and ecological domains, much is revealed about our own values assumptions as well as that of those one works with and for.

CULTURE AS BELIEFS AND VALUES THAT ALTER DESIGN AND TECHNOLOGY CHOICES

Being asked to write this chapter presented a genuine challenge. To write a broad-brush scene setter about culture for an audience of design and technology educators at first would not seem to be a complex task. After all, all undergraduate teacher education degrees would surely have included the study of culture, including the diversity of human beliefs and values in the classroom, the staffroom, and the hidden curriculum: the latter tapping into the political agenda of education regulators and providers. Culture presents as being obvious in its importance to pedagogy and pupil development, yet can also be seen as a background passive theme rather than playing an active part in a design brief, or a technical operational skill lesson. The sleeper in this challenge was to explore how culture did not just have optional links to how we go about our daily tasks as educators, but also whether culture held deep mutual transformation ties to our made and natural worlds that the idea of ignoring those ties would suggest a flaw in pedagogy.

Further we have the background issue of culture as an add-on content burden, or as something that must be necessarily embedded in the curriculum and assessment of all design and technology education. Is culture yet another layer that the busy teacher just has no time to weave into the DNA of all their design and technology strategies and assessments?

One metaphor. Culture can be envisaged like a real but edgeless mist transcending a forest forming shapes here and there; thick and obvious shapes at times, and at other times, thin and ethereal ones. We see it, it exists across the forest, and the forest draws important value from it that in turn makes the forest what it is. Without the regular mist, the forest would be very different, not just as being void of any mist, but that without the fine moisture and nutrients provided by it, the life ecology of that part of the woods would surely develop quite differently. The objects and ecology of the forest transform with the presence of the mist, and the mist transforms in density and shapes because of the form of the forest. Altering significantly either the form of the forest, or the presence of the mist, is all that is required for both to change. Imagining culture as an object with clear edges – here is culture, here is not culture – is a view that would surely be difficult to defend.

To consider the task of sketching out some universal and significant ideas on culture that both acted as a scene-setter, as well as connecting to design and technology educators dealing with the ambit of culture in the classroom, the staffroom, making things, engineering devices, using tools, its links to ecology, and visualizing ideas, all amounted to a challenge that seemed too wicked (for background information about wicked problems see (Balint et al. n.d.; Brown, Harris, & Russell, 2010; Ferlie, 2013;

Ritchey, 2010; Schultz, 2011)). But like the mist, culture is real, it changes things and it forms itself in response to the natural, social, and designed environments on which it depends. As both teachers and designers we hold in our strategies of action, the ability to form a culture in the design and technology staffroom, classroom, as well as around the topic and actions through which we scaffold our pupil's learning; whether or not we task those actions strategically to effect a planned transformation as a learning outcome.

DISCOVERING THE CULTURE OF YOUR OWN MAKING

All designers are socially and culturally situated. *Ipsa facto* so are design and technology teachers, learners, and evaluators. While this proposition may be true, it's another thing altogether to figure out what one does with that insight as a teacher of design and technology. Moreover, how might it's importance be perceived in the minds of one's pupils and their readiness to accommodate beliefs and values in the task of investigating the basis of a successful design and its defence?

One fundamental motivation for designers to take seriously the task of understanding the shared beliefs and social bonding values of the initial end users of designed outcomes is that these represent deep broad behavioral patterns - patterns that may not reflect those held by the designer! If one of the criteria for producing designs for others is that others take it up and use it well, then the idea of ignoring a cultural dimension to the end user is rather wasted, and would be highlighted in a rigorous evaluation of a design defence. Fostering empathy for the end-users of an intended technology and design can offer a critical underpinning of good design, and so, good design education. The only note of caution here is the scenario where the designer believes that they are already at one with the end-user, that if the end-user of designs and technologies was either themselves or groups they believe they know intimately, or assume they do. In such settings, can design empathy for accommodating culture be too easily passed over?

From a pedagogy viewpoint, there is the question of maturity; a question linked also to prior life experiences and developmental expectations implied in the depth and complexity of a design and technology project set for pupils of different ages and circumstance. To the extent that developing a community sense of belonging with shared beliefs and values is something that one is acculturated into, usually from birth, life experiences play a powerful role in the ability of a pupil (and teacher), to infer and comprehend the subtle details that a design ought accommodate for its end-users. When we design for our first clients, for ourselves as the end-user, we have the opportunity to learn a little about how seeing our ideas manifest before us reflects the making of our values and beliefs.

When we design for others with whom we feel a good sense of empathy, two things are apparent: we might not feel the need to step out of, nor the need to highlight, our cultural frames to have some success with members of our fellowship community valuing our creations; and, the evaluation of those creations can appear

to get by rather well with not critiquing the cultural dimensions to our design and technology choices: after all, the designed objects and outcomes are products from, and evaluated by, those who identify as belonging to the same cultural fellowship. Assessment in such contexts can too easily turn more of its attention to the non-cultural concerns such as the technical and functional merits of the design. However, such domestication of design and technology education, production and assessment may also tend to avoid disruptive and necessary, culture-changing, innovation opportunities. Designing for the greater common good of a more just, tolerant, and sustainable shared future is one example where design ought not be caught short-sighted in its attention to culture change.

To guide teaching with sensitivity to culture, four key areas of material evidence can be used as key to design research, development, and production. These four areas are the systems, services, symbols and artifacts that human groups commonly build about them to manage their lives. Generically across these four areas, designers sensitive to culture and beliefs are interested in the way different human groups organize, solve problems, form relationships, develop beliefs about, and both make and respond to, the social and material world around them.

The evidence of what defines and drives us as social creatures is well embodied in the items, and the structures, we design and make. Archeology, considered in the North American tradition as a branch of anthropology, is entirely framed on the premise that how human groups developed responses to their world can be reconstructed from the material evidence in the systems, services, symbols and artifacts left behind. Designing that is active in considering the cultural dimension to the end-user context of their creations uses insights drawn from material culture from historically positioned ethnographic studies and field techniques, and applying that knowledge and set of adapted techniques to inform the process of designing and working technologically; in particular, to inform how different human groups respond to, and can co-develop ideas towards, new designs. Systems, symbols and all forms of artifacts are very common types of human material and digital 'products'. Many design educators who have already used or heard of methods such as co-design, or participatory design, have drawn upon long established ethnographic techniques.

MAKING IN SERVICE OF THE CULTURE OF OTHERS

Designing for others leads to a better chance of user acceptance if the designer understood well how their end-users are socially and culturally organized. We can learn a whole new way of growing design and technology knowledge by comparing what other cultures do, why they do it, how they socially sustain what they do, and what goes wrong when situations change.

Informed by social scientific enquiry, design has the ability to engage with the visions of technologists to create ambient assisted living schemes that are not merely technically feasible, but also culturally desirable. (Roberts, 2011, p. 223)

What has made culture studies in design come to light in more recent years is a heightened appreciation of the emerging role that social dynamics plays in guiding the development of innovative new technologies, service, communication, and spatial and product designs. There are a few common ideas underpinning culture-based design research that very well overlap with design and technology subject matter. One method used to understand culture in design is where the designer collects tangible comparisons between groups of people. A key area that such methods examine is the way different groups of people create, use and are in turn socially influenced by the world that they 'made' in the situational context they live, work and socialize. Educationally and technically, the deliberate accommodation of culture in design and technology studies opens a rich opportunity to engage in a mutual transformation of both people and the physical (including digital) world. Harris (2007) and Nafus (2008) argue that when we engage with others that have a different way of knowing and doing in the process of transforming resources to achieve a goal, we cannot avoid experiencing a transformation, if not also an affirmation, of the knowledge and world views we hold. There is new insight that comes with working and learning across cultural domains.

Working with difference, be it from within knowledge traditions of anthropology and design, or between the designer and user, also necessitates developing skills of engagement. Central to engaging with others is finding ways of imagining oneself into another person's world. This however does not mean individuals participating want to be the other. Rather they want to learn from each other's practices in order to build a closer relation between practices. We would argue that in building closer relations between using and producing, designing and using, people and things, a move is required away from a problem-orientated approach towards designing. (Gunn & Donovan, 2012, p. 1)

In 1983 I was asked to assist in redesigning a device called a pelton cup used in a micro-hydro electric power supply system being developed for the small and remote island village of Iriri in the Far North Western Province of the Solomon Islands (Seemann, 1986). It was also my role to undertake an analysis of the skills of villagers nearby to guide local capability strategies for maintaining and adapting the micro-hydro system years after our project team installed it. What I found is that technical skills were insufficient indicators for associating the project's functional success. While most of the 'technicality' of the technology design (such as its components as specified by engineers) added key functional requirements, this knowledge by no means was adequate for assuring that the overall technology choice and system design would lead to a good 'fit' for the end-users socio-cultural and ecological circumstances. Moreover, if the project ignored local social organisation (including shared values), and local technical knowledge, key design innovations that later were included to help assure the technical value of the project would not have been identified. To choose technologies and design the system so the project's overall purpose met the end-user's

local context was a key technological empowerment objective. Culturally, the Irii people had a significant asset, they had already a well established and sophisticated shared belief in craftsmanship, and work structure organisation. Ecologically, they understood the tropical jungle resource and constraints. Indeed their deep knowledge of how to use and bind split vines to hold and suspend the penstock pipe tracing down the mountain from the small creek dam to the pelton turbine was instrumental in the design's technical and socially sustainable maintenance success. The knowledge and design behind the technology system and choices made was only able to be validated when assessed against the context in which the end-users and maintainers required it to function, including the key requirement that it 'worked' socially, technically, and ecologically and was locally maintainable. The technology design was successful, and validated for the engineers and end-users the many ideas developed. The design defence was robust, and as a result, new technical, social, and ecological context knowledge was produced transforming the lives and knowledge gained by engineers and end users alike.

The necessary ties between all that makes the people, the ecology, and the design and choice of the technologies used, was an inescapable system of dependencies that made the technology work in its context. This interlinked pattern appears to repeat itself: people, ecology and the context in which the purpose of design has to succeed cannot be extracted from the study and practice of design and technology.

In 1986, I was invited to up the scale of my previous project experiences in the Solomon Islands, and undertake a national research effort to examine the requirements for establishing the first national vocational qualification that would best fit the local circumstances of hundreds of small and remote Australian Aboriginal Communities located on their traditional desert lands across central and northern Australia. The goal was to enable these communities with a 'technical training qualification' that would help them maintain the plethora of transferred technologies into their lives.

The field projects noted above presented an insight about the ubiquitous social transformation power of technologies and design choices on people's lives. It was apparent that our educational and technology service institutions (known as the donors of aid) not only never questioned, first, if the technologies transferred were the best-fit for the socio-cultural and ecological circumstance of the end-users but also, second, that the transfer of them was both a conscious and compliant process to re-socialise people into an archetypal Western lifestyle. The choice and design of technologies and systems were part of a deliberate cultural assimilation strategy of government (Australia. Parliament. House of Representatives. Standing Committee on Aboriginal Affairs, 1987). The object was to use the power of structuring the material world of how people were to live so it would bring the world's oldest continuing culture into the economy and values of mainstream governance. 'Houses' were provided with layouts that assumed people formed a nuclear family structure (two parents, 1-3 children) despite the fact their 'family' was based around a more complex set of relationships extending often to 20 or 30 people seeking to live together. Houses and technologies such as public telephones and water-borne flush

toilets were also not designed with features and materials that offered any comfort or functional reliability in the extreme temperature conditions of the Australian desert: wind and bull-dust that affected both the technologies, and the health and wellbeing of the very young and old. The mismatch between the cultural and ecological lives of people and the assumed lifestyle represented by the design and technologies transferred into people's lives proved disastrous. Consequently, the Australian Government began investing in research, design, development and new education in Appropriate Technology and Environmental Health-hardware ideas since the late 1970s (Mayne, 2014). Underpinning much of this research was the concern for how the design and technology choices that were transferred into communities affected the fundamental social and cultural foundations of people, foundations critical to social cohesion and stability.

The systemic impact of poor technology choices did not stop with the house, but extended to the greater technological and design impact upon culture of the settlement system itself. Settlements were created that required a move away from a social organisation and values systems based on subsistence and an actively mobile lifestyle. Settlements represented a new set of value to accommodate where the mobile life was shifted in a 'boxed up' sedentary one that had to reconceptualise prior beliefs of shared ownership of made objects, and caretakers of open lands, to a new culture with notions of privatised property, fences, repair and maintenance tools and purchases using "cash technology", and the new governance structures that were also required to manage and fund the upkeep of this new made world called the settlement. Every layer of transferred technologies moved people closer to the cultural norm and technical education standards that those technologies required. With a settlement, came the new cash economy to manage technologies that did not exist before. A people that had control over the detail, choice, and designed of tools and shelters, were now 'rounded up' so that over time, they took on the life of a householder (Australian Race Discrimination Commissioner, 1994). In effect, the strategy may be summarized as a view that it was better to change the people into the ways of their new material worlds, and so alter their governance, than to enable people to continue their path and transfer technologies that have been chosen and developed to best fit with local values and social organisation. This was an awakening to the political and cultural face of design and technology.

Social, political and cultural dimensions to technology transfer projects have been well documented in case studies of community development and Appropriate Technology philosophy (for an insight into the philosophy of Appropriate Technology in community development see (Mayne, 2014; Schumacher, 1999; Walker & Seemann, 1988; Willoughby, 1990)). However, what these projects demonstrated was how the donors and end-users of technologies were both largely uninformed if not dismissive of the role culture and values played in the success of a design and technology build. When they were aware, there was a chasm with no theory or methods available to deliberately and assuredly guide design and technology development that could guide a 'best fit' for the end users needs and circumstances.

In contemporary Western government departments of education and curriculum, the lack of serious understandings about the design of our technological world remains at best problematic and at worse void of attention. It is part of the reason why our education systems can be described as sleepwalking society through the design and technology education they experience (Seemann, 2007). We are comfortable with a set-aside module of learning or objective about the social and ecological impact of technology. We can accommodate the idea that culture has some indirect, vague role in how these ideas shape our worlds. We can at times be almost dismissive of the idea that the made world acts upon our minds and behaviours where we largely capitulate to its rule as the easier path to take, and accept that our made world, over time and repetition, alters the values and ideas we come to accommodate as normal and so no longer at the forefront of any conscious design and technology deliberations. That is, much of our perceived will to make design and technology choices has already been conditioned at least in part, by the learned and shared values we have come to accommodate living over generations in the world we have created around us.

Our understanding of the dependent links between culture and technology in education are all still to mature. If we asked even the most experienced technology educators to articulate how, exactly, does one design and create things, systems, and services to best fit a cultural context, and how do we know if this fit is indeed 'best', we find our draw upon assured methods, theory, and research is rather thin. There is a lot of work to do in this space of educational research and practice.

What I have coined as the study of cross-cultural technology and design transfer and development has its success heavily grounded in a critical understanding of the culture that has made a technology possible. Culture was also essential in maintaining and innovating technology and design as circumstantial (contextual) changes emerged in communities over time. We sometimes see this idea written as humans adapting to change. We also see evidence where the common held and shared values and worldviews of people are so embedded and invested in the very world they have created that for the created world to change, people have to accept a change in the cultural world views they have so heavily and systemically accepted over time. Culture drives the acceptable uptake of design and technologies. However, the technology designs and choices placed in our worlds can only induce cultural change to the extent that the change required to successfully accommodate the introduced technologies do not require an excessive shift in existing shared world views, capabilities, and beliefs by those engaging with it. It is one reason why the appearance of disruptive technologies can, for some, be associated with a degree of anxiety or apprehension.

What has always struck me as conceptually significant in my efforts above, both as someone educated as a secondary teacher, as well as in the scholarship and practice of design and technology, is that the more I sought to help the communities learn and manage 'our' technologies, the more I found myself discovering the loaded values and worldview assumptions we have blindly embedded in the technologies we were donating. Indeed, it becomes more important to know what our "Western"

beliefs and social organisation assumptions were if I was to have any success in explaining to people the new technologies before them. The trade-offs such systems will introduce in their lives. The warning on the packet, along side the tangible benefits. Yet, still today, such a critical approach to the teaching and learning of design and technologies, at the tangible level of researching and making, remains largely silent if not disassociated in many mainstream school activities.

Over the 1990s and more so the last 14 years, these fundamental dependencies extended from what was initially a view of ‘best engineering fit’, to ‘best socio-technical fit’. The move to a conceptual frame that acknowledges the necessary requirement of design and technology to fit in the intended end-users socio-technical circumstance, appears to take highest priority as indicators of longevity of the end-users capacity to benefit, control and alter the new technology in their lives. However, all the while, there have always been two more fundamental dimensions that design, technology, and education projects could not ignore. These were the end-users’ natural and human made environmental circumstance, and the role that different belief systems played in the social management of all technologies, whether indigenous to the users, introduced, or ‘hybridly’ adapted: the latter often a basis for innovation.

So ubiquitous are the socio-cultural and environmental necessities of designs and technologies to the successful uptake of them with end users, that it may be postulated that unless a school curriculum necessarily studies the cultural and ecological dimensions of all and each design and technology project, the transaction of learning taken place in the school may be rightly contested as mis-educative. So essential is the need to always examine the socio-cultural and environmental co-dependencies of all human creations that to omit or under-represent their role in directing design and technology choices is to foster a flaw in the learner’s intellectual frame for material and digital judgment. It is difficult to defend design and technology judgments – the choices and decisions we take about the material and digital artifacts that litter, aide, and shape our daily lives – if we teach this area of knowledge without connecting those choices to understanding the social and ecological trade-offs that are inevitably implied.

There is perhaps no other subject field in the school curriculum that so deliberately demands a tight synthesis of learning of people, their innovations, and their ecologies than the study of human design and technology. If we add to this the meta-level of teaching in addition to doing and learning design and technology in and across any culture, we find ourselves standing before an immensely uncharted and exciting field of scholarship and educational practice.

CONCLUSIONS

When it comes to culture in design and technology, we have a lot of work to do. Throughout the field of design and technology studies, scholars will continue to link overtly, and by inference, matters of design and technology to human beliefs, values,

and culture. Where they do, we, in education, ought give their propositions serious attention and follow-up, knowing that such associations are not by accident but due to the inseparable nature of how our subject matter is ontologically embedded in culture and ecology as a characteristic of its epistemic foundation. What we cannot do is play the role of culture down, or over-simplify its position in the design and technology curriculum of pupils, teachers and all branches of designing from the craftsperson, the product designer, the food technologists, the textiles technologists, to the engineer, builder and architect and the software and service designers and developers. All these areas are branches off the common discipline stem of designing and working technologically. Our subject offers the curriculum a foundational proposition that humanity, the worlds we design and engage with every day, and the ecology that makes both possible, when integrated towards accommodating at least an initial purpose and context criteria of use, together form the empirical stem of the discipline. It is why culture and ecology, as well as tool design, systems, symbols, and ethics, all form necessary and legitimate ontological dimensions to the field. If a good education in design and technology is to mature, we have the foundations for how the discipline builds its body of knowledge, and defends and validates its outcomes; this includes the test of best fit optimization that is contextually validated. We have a subject, indeed we may assert a discipline, that has developed a deep and rich stem and branch body of knowledge that will continue to define humanity. We can count culture as axiologically grounded in the proper study of design and technology education and practice.

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SECTION 2

PETER COLE AND PAT O'RILEY

5. IN(DI)GENEITY IN DESIGN AND TECHNOLOGY EDUCATION

Animating an Ecological Cross-Cultural Conversation

Indigenous trickster glyphs and figurations from Canada's westcoast, Coyote and Raven (C&R), are wont to roam and soar freely, rather than be confined to field, fen, glen, thicket, moor, genre, medium, discipline or paradigm. It behooves them to be told to carry and produce a visa or carte du maître at a border, bridge, stile, lock, gate or wicket, so they make do—shapeshifting, makeshifting, circumlocuting and electron tunneling to, by, with, through, across, and around regulations and natural laws.

As agents of goodwill from the natural world, as well as keynotes at an international technology education conference, C&R are concerned that today's Design and Technology Education conversation dismisses the traditional ecological knowledges (TEK) of Indigenous Peoples and other "ecological ethnicities" (Parajuli, 2001) as being naïve, primitive and irrelevant. Leafing through the conference program, they are pleased at the growing realization in academia, civil society and the corporate world that to ignore millennia of TEK is short-sighted and counterproductive. Ancestral eco-technological, eco-pedagogical and eco-literacy knowledges, and the Indigenous languages of which they are part, are disappearing as a direct result of ongoing colonization and post-human economics and C&R feel it is their responsibility and mission to promote technologies that do not rely on massive ecological and ethical footandbodyprints to live one's life. The announced visit of Coyote and Raven to the University of Z, where the business model of academia is in the ascendant has caused unrest in the senior administration. A UoZ spokesperson let it be known that the employer is seeking special constabulary privileges from the government, including immigration detention powers, giving it the power to deny entry onto the campus of any unwanted visitor due to possible financial risk factors such a visit might have on the university's endowment fund and credit rating. With these proposed powers, university officials would have the power to deny entry onto its [our] campus to any and all who actively promote social justice, civil society, animal rights, environmental indigenous and cultural sustainability agendas. When it came to the attention of the university administration and CSIS (Canadian Security Intelligence Service) that C&R were invited to ["converging on"] campus to give a workshop on pre- and post-contact Indigenous sovereignty and self-determination, you'd have thought a global nuclear war was imminent. Every agent provocateur previously posted to surveil and intercept Julian Assange, was re-assigned to feathers and fur duty. Even the dismissed

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and disgraced former officers of the law who had been reconnoitering James Anaya (Radia, 2013), the United Nations Special Rapporteur on the Rights of Indigenous Peoples, were reassigned to cover C&R. The RCMP (Royal Canadian Mounted Police) has been directed by the provisional [university] government to send canid, corvid and Indian control officers to secure and contain the situation. After being whisked into the side doorway of the theatre from an unmarked off-white Volkswagen Golf, C&R had a moment to catch their breath and perform rituals to invoke good spirits, before walking onto the stage to await the curtain raising.

[Lights, camera, curtain]

ama7 sqit wa7lhkelapha ama7 my poikilothermic homeothermic and athermic sisters and brothers of the wing fin chitin chrysalis and paw it is good to be here thank you to the settleric reception committee for sharing the tomatoes and other comestibles indigenous to turtle island a tribute to the spirit of the columbian exchange

[Crossfade to high angle panorama on C&R downstage centre]

I am called raven or corvus corax my human paternal heritage is *st'at'imc* in southwestern british columbia the high snow-capped coastal mountains a five-day canoe journey from our home on kitsilano indian reserve #6 my mother's roots are northeastern scotland and southern wales coyote and I acknowledge the tens of millions of years prior residency of our elder sisters and brothers on these territories and the indigenous human nations on whose traditional unceded territories we are guests we acknowledge the territories where we now stand and those where our message travels *kalan7wi samas* my great grandmother used to say to no-one in particular but to settlers in general aho!

sek:on I am coyote dubbed *canis latrans* by zoologists but my human ancestry is irish mohawk and french born on a dairy and sugarbush farm in the eastern townships of québec in canada I thank you relations all for inviting us to share our thoughts on design and technology education

[raven says sotto voce]

I think they were expecting mike holmes or someone with a toolbelt and coveralls or a poststructural guru like noel gough

(voice of raven)

I'm wearing my toolbelt on the inside says coyote *clunk clunk* hear that yes coyote heavy metals or loose marbles my friend you must endeavour to eat lower or higher (depending on the source of heavy metals) on the food chain

getting back to the conference I feel confined by reason as a roadmap for a good and useful life

[haff kaff intermittent coughing and shuffling in the audience]

some audience members fear we might address them directly as trickster glyphs or figurations acknowledging the coercive relationship between audience and performer in western theatre tradition meanwhile their disbelief (and belief in it) remains suspended in the umbrella bank at the front of house fulfilling constructed binaries—us them fictional real true false yes no

their suspension of disbelief is a concentric propagation of reason as the epicentre of their lives if all become indoctrinated into believing the disinformation manufactured by industry-wedded universities the unbelievers will be deemed mad without merit or terrorists

the tyranny of the majority coyote

we must show diplomacy and compassion with the minions of academia government and industry though circumstances might dictate we stab as occasion warrants

stab with what my beak? my wit? we can learn much from doing what goes against our grain we might in fact be sustained by those very things we try to escape or destroy

speaking of which how sustainable is a university that clearcuts its endowment lands to build malls and condos and endless settler dreams *in excelsis ceo?* how many parking lots fountains and ‘sustainable’ buildings have been erected *in [ad] hoc nomine* as part of the university’s sustainability drive how many forests have been transformed into sawdust woodchips toothpicks and toilet paper? how much longer before everything green and alive is plowed under using sustainable electric chainsaws and bulldozers?

coyote for the unethical university sustainability always and only refers to fiscal sustainability what would make the director of campus landscape architecture clearcut healthy sliving trees to fulfill a sick settler dream of green lawns from flagpole to flagpole and damn any living thing that gets in the way oceans of concrete are poured to contain and control ‘nature’

what compels a university to destroy forest nations and call it sustainable? sustained warfare with nature yes trees are deemed to be obstacles to settler dreams of financial nirvana when did universities become authorized to do *ipo's* (initial public offerings)?

coyote imagine if settler society ‘invested’ in the natural world as it invests in destroying it speculation is the central core of the settler collective unconscious an ineradicable life destroying prion

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but unlike bse (*bovine spongiform encephalopathy*) the human variant can manifest as severe memory impairment

coyote you look awful you haven't been eating dairy products have you or gmo's you areslashbecome what you eat

I'm getting stressed trying to create a financial plan with a small ecological footprint I need a good pension plan that does not create massive killing fields for fifty thousand other species every year

if you're thinking about counterfeiting my furry friend remember what happened last time anyway you shouldn't be talking about those things while we're up here as keynotes

'do re mi mi re do' yes in the past I did on occasion take creative shortcuts when I had been short of funds and behind in my taxes

coyote if you weren't always taking the hypotenuse you wouldn't get into so much swamp water and russian thistle geometry does not work well in the bush just as ideal gases don't work well in the real world and gmo in the digestive tract

but they work on smooth white one dimensionalized paper (disappeared forests) and in essentialized western conceptual spaces the sum of the squares works fine in numberland with numberrules but on the ground it doesn't take into account the fact that geography the weather otherthanhuman agency and other people's plans conflict with your own

the laws of physics meet the biological imperative but not in my backyard sings the b minor diminished chorus in chemistry class we were taught about ideal gases and I know from experience a few gases that are far from ideal a few hypotheses that need laundering and airing it's the part of the curriculum school doesn't teach

[raven addresses the listener/viewer/reader/dreamer]

one day coyote is sitting at a beachside café relaxing cool umbrella cool shades tail switching slowly back and forth iced tea and finger food I knew she was up to more than just taking it easy you could see the flywheel turning the clutch and power takeoff engaging and springs were sticking out of her ideas as they hung above her head in perforated rainbow balloons

raven I have constant buzzing in my head gridlocked bio-neuro-chemical-synaptic pathways everybody knows that engineering and architectural models don't work in the real world and math functions only in the controlled conditions of self-reflective positivist philosophy and self-referential number theory depending on how you define your terms a proof is a proof is a proof

so says jean chrétien calculus has nothing on my grandmother's grand unified laws of everything she knew there were infinite variables and probably no constants except change

raven you have always been troubled of the vortex between theory and practice and the fact that you can't control the world with your imagination make it do your bidding you're not a demiurge

ach a fi besonders my head is filled with seemingly random data information connected only to other information I need to improve my memory as I overly rely too much on paper and don't want to benefit unnecessarily from the deceased pulped bleached pressed flat bodies of my friends the tree nations

use sand or etch-a-sketch chalk and slate writing on paper can be sustainable if the paper is 100% recycled do you have to write?

I keep getting ideas for making the world a better place but a thousand voices in my head ask what 'better' means and for whom who pays when things go wrong with poorly tested technologies? I don't want universities or industry government or ngos to control ethics I don't trust any of them and the context of seven generations—about 200 years—complicates taking even one step without taking into account repercussions exponentially recalibrated for each step

raven the violence within and between nations reminds me that war is a direct product and producer of economic change from the boom of war to the boom of peace elites are ethically removed from ethics from the genocides of which they are the producers and deniers

maybe I've been watching too much international news or the history channel I need to relax

I was going to suggest for your frown lines I could give you homemade injections obtained by fracking the post-vivo victims of *botulinum* toxin one of the most acutely toxic substances in the world people inject into themselves to look younger obversely I could iron your face with a flat rock from the hot springs uphome to get rid of crow's feet raven tracks *wrrakk klok klok*

I don't want sausage poison injected into my face thank you very much even if it does block neuromuscular transmission by slowing acetylcholine release give me wrinkles and crinkles any day I prefer to look my age than to play dorian gray another day biochemical technology means you take what in wartime immobilized tortured or burned alive 'the enemy' (human beings and vegetation) and in peacetime inject it into the centre of the wealthy and the vain the egotized lookatme face making a tidy profit for the producers of weapons of mass destruction and weapons of mass deception

you're paddling too hard (in your dreams) you get that sarcastic misanthropist turn when you've been alone too long or hanging around with like-minded

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cynics why not turn around for a change and go the other way find the positives in electronic technologies

trillions of dollars are spent by industry to sell of the positives of consumerist technologies surely one tiny voice of critique need not join the rah rah *te deum laudamus* am I overly harsh to speak of the causally-related growth of ecocide and post industrial revolution minus the evolution leaving an 'r' which isn't much of a dividend?

sounds like you're trying to design something to reduce your carbon somatoprint that's nice you're moving forward

not really but I appreciate you looking at it that way like you said about hypotenususes you go through swamps over cliffs and quicksand in the geometry of the real world which becomes geography geology

so it's not misplaced altruism I was hoping your were turning over new leaves mostly needles pine spruce fir cedar yew my ecoliterate friends in the high amazon say the condition of leaves can indicate the presence of micro-organisms that help with the creation of *terra preta de indio* amazonian dark earth. (Apffel-Marglin, 2011)

now you're talking bush smart

coyote I need to simplify my life but that does not include living in the jungle with creatures like yourself if it were any simpler you'd have no vital signs pigeons would land on you

I need complexities to inspire me narratives to relax my mind stories that come from nowhere and just sort of fizzle out no more 'progress' narratives progress gets in the way of living life in the real world (Heinberg, 2011) the ethical world the world of reciprocity

what's this really about raven are you going through midlife crisis again? I don't know how many times you've been through it over the millennia maybe you should just be happy with your muddy mixed up thinking patterns and not aim for clarity after all clear thinking might not be accurate thinking many crooks and tyrants have very clear thinking 'in precisely 3 minutes we send off 68 cruise missiles and 400 armed drones to shock and awe (and kill)'

it's the planning that is getting me into trouble the organizing takes over like its alive the patterns behind the cycles behind the.

clichés? that your life has turned into how exactly is your communication strategy bothering you? scheduling conflicts?

that's just it I don't have a schedule but I do have conflicts my challenge is just cranking up the process of communicating with the aim of getting

something for myself and getting somewhere in terms of putting a little something away

like what some shiny marbles? a few sticks for your nest? myself I like to keep a few bones around as cultural artifacts something to help me remember where I'm coming from present progressive rather than past retrogressive and where I'm going from your narrative it sounds to me like you are thinking mostly about marketing and not so much just pure communication

it's all the same we communicate to get something we don't just communicate with the void though I do like taoism I also appreciate non cryptic conversations too

what do you want to get car? house? retirement package? you have to work to get those things are you trying to shortcut work? hypotenuse it?

work? it gets in the way and is overrated especially its capitalist design you were talking about clichés work is a cliché get up go to work get up go to work or stay home be at work or don't work don't eat no home

like I said work and the idea of work get in the way

of your relaxation but you work so hard at finding shortcuts to doing nothing that that becomes your work you can't relax because you're aiming at the moon even though you were not even looking at the pointing finger or its referent

finger shminger philosophy also gets in the way I need to go straight for the rewards

take a step back

what and fall into a hole? by the way where is the audience?

it's intermission so you want to eliminate the middle person which in this case is not just gaining qualifications or applying for jobs but gainsaying work itself even to acquire a lottery ticket to fuel your dreams you need to find the means to buy one though you could go around picking up discarded ones or push grocery carts up the alleys you could get discarded beverage containers that themselves are part of the outofcontrol footprint of the consumerist society

but dreaming up ideas *is* doing something it's called consulting

so you need to have somebody pay you for doing this is that it?

I'm not sure I even want money or wealth I just want the things that they buy I don't want to have to bother with actually having to buy them to physically go out and hand somebody cash or a credit card or paypal though I do like the image of a big wad of cash it's impractical plastic is easier to carry around and you don't have to carry the receipts or even have them printed out it can all be online

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so you want to have things things that don't clash things that fit in with your lifestyle do you want them to magically appear like a genie brought them or perhaps a *leprechaun*?

yes anyway you know how some of our *gunditjmara* and *yorta yorta* friends in australia richard franklin rochelle patten go on about the dreaming dreamtime well I need dreamspace that just gives me the end product without having to go through the whole process the ragman roll call. (Cole, 2006)

of working

but the dreaming is the working it's hard work to dream up ways of having a life of luxury and ease

aren't you misrepresenting how the *koori* understand and visualize dreamtime?

no I'm analogizing using their dreamtime technologies to make quantum leaps to other kinds of knowing that work for me calling their dreaming a technology is a way of honouring it as a cultural way of being and doing just as the potlatch is

what are some of your strategies to reach this place?

I need to improve my presentation portfolio my public persona people will want to flock to me and give me things the name doesn't matter I have a calling and I need to have others help me to fulfill it

what steps have you taken so far to improve your communications?

thinking scratching my head walking up and down biting my nails biting my lip listening to relaxing music watching the yoga channel burning candles

sounds like you're on a roll do you have a yoga block and a bell for your technologies of lassitude?

be serious I need technical support not critical reasoning it just gets in the way remember this conference is about technological thinking and design and part of our job is to move it from the conservative centre to the margins where most indigenous peoples and other-than-humans are located or have been moved to

you want to use technologies to improve your lifestyle when you get the things that you want will you eventually want to do something proactive to engage with the world or will you just be reactionary because if your lifestyle is just about perpetuating personal wealth through designing your dreamspace? then you aren't really following your or anyone else's original instructions

they get in the way I need [ab]original instructions post/original instructions I need stuff things gadgets tools technical stuff computers ipods ipads

you want to be a consumer without contributing to the world in a positive way
you can't just revise original instructions to suit you and call it evolution or
ethical renewal

I contribute my ideas to the cosmos my carbon dioxide it nourishes plants
algae phytoplankton I need to use the multiplier effect to increase my wealth
to counter the bioaccumulation effect if I become wealthy the multiplier
trickledown effect will help to increase the gdp everywhere

but if you don't have anything to multiply if you multiply anything by 0 you
won't be getting much in return the product itself might be meaningless in
terms of both numbers and what the numbers are representing and if you
multiply anything by an imaginary number or negative number you won't be
any further ahead what is it that you really want raven notoriety?

I want to create personal wealth I don't care so much about meaning or process I
need tech gadgets and post containment strategies that help me to reach out with
ideas especially in cyberspace and have others reach back with gifts although I
don't mind other people working I find it gets in the way of creative imagining
and of my lifestyle I want to be a philanthropist not sharing things but ideas

but your lifestyle dream is simply about creating personal wealth and avoiding
creating anything of value your goal is to have these techno-devices to help
you achieve your dream have you thought about the context of your wealth it's
effect on the environment?

yes plug 'n play drag 'n drop

will these gadgets be your communications strategy to achieve your dreams of
not really creating anything of social value or contributing to moving society
forward? will they be the means of marketing your dreams of creating personal
wealth?

everybody needs the latest of everything because they're the social norm it
doesn't really matter if you really need them they're part of a bigger cycle if
you don't fit in you won't get the rewards including tenure on the other hand
the creator gives everyone and everything tenure and promotes them

but there are billions of people who don't have or need or want any of these
technologies

raven everybody needs a minimum number of tech devices read the economist
or wired magazine any of a million flyers apps rule!

the ecological and ethical footprint of one page of one flyer is massive even
before it gets to the print stage all the people working for the advertiser their cars
their clothes their homes all directed at creating Jacques Lacan's (1991) *désir*
people protopeople prepeople and propriopeople waybackwhen had nothing

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but pointed sticks and shaped stones antlers horns and bones for a million years but they survived and thrived using these unintrusive technologies maybe that is the kind of technology we should be thinking of more using less needing less having less how much do we need? how much is 'enough'?

that was the old days raven people were satisfied with ecofriendly tech because it was all they knew if they were alive today they'd want a different toolkit rough stones give way to refined stones antler horn bone sticks give way to metals plastics some call it progress

[*Baritone voiceover*]

be careful what you say the capitalism hit squad is everywhere pre-emptive strikes with everyone and everything especially the environment and justice

coyote rejoinders canada is dead last in the latest oecd rating (Waldie, 2013) our government has been eroding the environmental regulations to pave the way for an extractive economy mining forestry oil and gas

how many people today could live a full life with a few sharpened shaped bones stones and a pointed stick? not just for weekend paleopretend early humans lived with these technologies for a million years even the neanderthals lived with them for hundreds of thousands of years in eurasia stones sticks and bones are we truly more evolved than they are? more connected? if so connected to what? simulacra? cyber entities? certainly not nature many outdoors people are addicted to adrenalin rather than to nature

why discuss ancient technologies no-one needs to use anymore? we *need* the modern ones of course they're part of us

I'm not suggesting we only use stone tools in place of an iphone or computer but when will we realize that technological production itself is problematic for the environment that poisons and other toxins are the major products of technological progress with techno-gadgets themselves merely by-products that toxic effluents impact all that is alive the whole web of being my ancestors taught me that we are responsible for looking after the earth why are so many human beings carnivores including fish and chicken crustaceans milk butter cheese? how efficient is that? how ethical? to raise billions of animals in tiny cages justifying it by calling them *food* they too have spirits valuable lives feelings they too matter and not just as nourishment or investments they were born to live full lives

raven up to this point the environment has been able to look after itself give it a chance to see what it can do it is more positive to talk about affluence rather than effluence it's all about prefixes roots and the root of roots the foundation of foundation

now is not the time to play devil's advocate with evidence pointing to climate change being caused by a throw away consumerist society shouldn't we at least try to not be part of the link to worsening environmental conditions? tens of thousands of species are being destroyed by this 250 year old biocidal industrial revolution how is this deemed possibly be termed 'progress'? what kind of balance sheet are they using? what kind of holocaustic arithmetic statistical ball of wax are they giving us? where does personal responsibility fit in government and industry responsibility and transparency and cleanup with no cost to the taxpayer? let the millionaire billionaire stockbroker pay let the shareholder pay according to their investment they're the ones wanting to take a risk to make a fortune by gambling with the future of the earth

if extinction can happen to megafauna out of the blue it can happen to us we have to make the most of our time on earth

coyote are you saying we should consume as much as we can before the big one hits is that the strategy?

we have to fuel our dreams

sounds like an ad for the alberta tar sands have you considered that consuming is its own tsunami we are our own comet

don't split hairs raven or feathers how can you argue against fitting in to your own time? consuming is how the world works today play with your stones and sticks I did as a child now I want other things as a responsible person I'm trying to fit in to the time in which I live

with marketing the communication tool that vets your responsibility what about your responsibility to the rest of creation?

in the old days there was telegraph pony express newspapers smoke signals you have to get your message out whether you want to save the world share a story or just sell your product marketing needs technologies to share the message creation will look after itself

so we shouldn't take any personal responsibility or accountability for any of our individual or collective actions? you sound like an oil company

raven oil gives us plastics for all kinds of products so what if the water needs filtering drink wine or beer or whiskey

qu'ils mangent de la brioche! what are the responsibilities of the producers of those technologies especially if carcinogens are the primary products? it might seem we are purchasing a computer or iphone but we are actually buying a series of toxins adding it to our ecological footprint when we buy something in a shop we add the toxins from their computer production their debit and credit machines the byproducts are the computers and iphones

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the manufacturer has a responsibility to make a profit if it is a private company for the shareholders if they are publically traded it's a social and corporate responsibility a legal responsibility

and not producing poisons and putting them into the earth the air the water is not such a responsibility?

[voice over narrator]

on and on it goes - this back and forth banter coyote and raven take a break from the word battle take a sip of coffee tea nibble a biscuit or two

ugh coyote I'm getting a bit tired of all this speculation and argumentation I want to live the way I live and not force others to conform to my ideas but

aha I knew there were a few more buts left in you so how's the coffee?

good good shade grown fair trade

decaf cappuccino raven made from a pressurized technology add the burr grinder technology the technology of the transportation mechanisms and systems that brought the beans from south america africa or asia to your cup and the filtering of the water the pumps that pump the water the making of the cups the roasting machines the building of the coffee shop the footprints of footprints of footprints pawprints bodyprints every transnational footprint is massive no matter how small the individual process or product the philosophy is non-local ownership and lack of responsibility or accountability to environmental degradation

it is a challenge to critique the methods and manipulations of capitalism and its technologies while enjoying their fruits and vegetables and non gluten grains

however?

as a society we must consider how to govern our actions individually and as citizens the rights and freedoms we cherish are themselves impinging on the rights and freedoms and integrity of the rest of the natural world giving corporations personhood is like giving cyborgs the key to the red button in fact it's the same many corporate protocols and constitutions are anti-democratic whoever has the most money and power has the biggest say

we're privileged raven to have the freedom to choose whether when how and where to use technocreations most consumer technologies come from research and developments created by the military including space programs

I'm aware that thousands of electronic civilian technologies come from the development of military weapons and space technology—computers internet

radio-isotopes and lasers and the power that runs my technogadgets comes from hydroprojects that have displaced or killed poor people indigenous peoples animals birds fish insects bugs beetles and forests or from fossil fuels

many of us use electricity or radio-isotope technologies that come from atomic bomb experimentation and research that killed hundreds of thousands of Japanese civilians I know that mining creates great wealth and power for the few and jobs together with silicosis emphysema cancer for the many if I boycott everything that is bad for the environment I will have few options for food shelter or clothing I would be paralyzed not just my unethical footprint but my power to do good to use the gadgets for good as someone who loves the six leggeds and the crawlers do I dare go abroad knowing I will tread upon them? how do I measure my own ethical footstep? do I dare to eat a peach imported from ten thousand kilometres away? how often?

coyote knowing that its transportation from argentina via motocar truck boat truck train truck as facilitated the emission of large amounts of greenhouse gases and airborne toxins but you know people will drive to a grocery store or market in their suv's burning fossil fuels in air conditioned comfort one can make an informed decision which is not *just* a decision it is a *just* decision it is each of us all of the I's acting as citizens of the world or not

if my health and wellness are on track do I need to worry about others? if my financial circumstances are good why do I need to concern myself with the plight of others? wouldn't I be getting into an enabling relationship with them? how is one to know?

by caring I would hope that compassion would be more than assigning quantitative value and employing statistical analysis

but aren't foodbanks enabling isn't looking after the needs of the people the government's responsibility paid for by our taxes yet this is downloaded into the private sector which pays the taxes (Kimmitt, 2012) and what of about these naïve young fresh-faced kids on the street asking for donations to charities including hospitals what is the government doing with our tax dollars if not supporting hospitals and charities?

I am saying that technologies of caring can be or can become technologies of enablement that allow governments to use tax monies rather than for the health and welfare of the people and individuals giving money on the street think 'oh I have to give these people money in order to be seen to be a good citizen'

and compassion how far will you go in your use of technogadgets to get what you want? do you have an ecological profit and loss statement in mind or is your profit just someone else's loss? my iphone means that somebody in vietnam has a modest income

coyote how you achieve balance and how I achieve it depends on what we feel we need and what our values are and whether or not we live by and act on them

look at the clothes we wear apparel technologies offgassing we're wearing chemical clothing and it's killing us it might not be sulfur dioxide but it's a first cousin our choice in clothing is causing untold damage to the environment whether it's silk cotton bamboo hemp nanofibre tencel the dyes the screen printing look at the poisons produced by gortex by wash 'n wear permapress what about pesticides like methyl bromide used to kill rodents insects fungi nematodes used in shipping organic cottons (Cardinal Professional Products, 2012)

would you prefer we go around with yesteryear's artificial fabrics I wear a solar powered negative ionizer necklace and hang my clothes outside to dry to get rid of the positive ions (static electricity)

a lot of people want to know where technologies come from who made them what are their effects on living beings it's interesting that when children in school hear the word 'technology' their first thought is electronic gadgetry video games there is little talk of the technologies that human beings have been using for millions of years that *homo erectus* *homo sapiens* used not just worked stones and sticks for hunting cutting digging up roots and grubs nets for catching birds and fish *atlatl* for launching projectiles bows and arrows but the early technologies of medicine and dentistry preventive technologies such as medicines from the land how to communicate with plants with animals spirits stones rivers sky

do students learn about language as technology? about technologies of urban survival of peace of spirituality? they are taught about the technological gadgets that are part of the capitalist consumerist toolkit buy this but don't think about the history and politics of where it came from just buy it to fulfill our dreams desires emptiness our lack. (Lacan, 2007)

'high' tech is seen to be the only tech 'high' meaning Western and consumerist 'low' meaning Indigenous and other/ed technologies that are treated as second class or even useless today educational technology is about computers not about pencils or caring or ethics

coyote I remember the first bifacial stones manufactured ten thousand generations ago people were happy to have these new techs but they didn't abandon their earlier ones that were all made locally within the family within the community people valued what they had and their lives for millions of years made almost no ecological footprint pawprint clawprint on the land the waters in the sky our ancestors would be amazed at us but ashamed one of my relatives born in 1835 in *sachteen* before the whiteman came died in 1942 when technology was all about war greed stealing indigenous

everything she saw it all her technologies were the baskets she wove from cedar the berries she gathered from the forest the paddle as it dipped into the rapids at chehalis

remember when the first eyed needles were used to sew? the technologies of weaving clothes weaving baskets weaving walls for houses weaving sleeping mats people were engaged and busy

don't forget the earlier technologies like catching fish by hand being patient watching and waiting

today we don't have to make anything by hand or repair it it's done by someone else somewhere else we throw everything away recycling today is a token gesture who repairs anything anymore?

back in the old days everyone was handy you had to be it was how you lived you made things and you fixed them if they broke or got worn out today everything is discarded especially thinking skills are these worked into the cost of technology cost to the environment? does anyone besides environmentalists traditionalists really care saying they are too busy with their lives?

with built-in obsolescence as one of the central pillars of global corporate capitalism how can technological production ever be sustainable if it means that you always take more from the natural world than you give back? overwhelmingly modern technology is about devaluing and degrading the environment

coyote your values determine what you give back how and where 'reciprocity' is central to in (di)genuity reciprocity as enacted by our communities means giving back more than you take look at our potlatches as economic technologies imagine reciprocity being a central and critical component of the design and technology curriculum students learning to live with less learning about their anthropogenic ecological footprint and how it affects other peoples all living things in the world the air they breathe the water they drink

that sounds good students learning how to walk "lightly, carefully, and gracefully" (McKibben, 2010) on the earth little by little there is a growing call for rethinking the 'progress narrative' slow-growth low-growth no-growth de-growth (Heinberg, 2011; Victor, 2008) imagine design and technology education focusing on "economics of enough" (Coyle, 2011) and "economics of localization" (Norberg-Hodge, 2011; 2009) a paradigm shift toward human economics of scale and local community sustainability

are you suggesting ecotechnologies ecopedagogies ecoliteracies as part of design and technology education? how is this possible with western education grounded in hegemony ethnocentrism depoliticization salvationism uncomplicated solutions and paternalism. (Andreotti, 2012)

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raven perhaps “in (di)genuity” (Cole & O’Riley, 2012) has the potential to animate design and technology as spaces of equity social justice cultural inclusivity and environmental responsibility

this would mean abandoning the arrogance of the superiority of the western scientific paradigm the military-educational-industrial complex replacing a short history of knowledge with the long-standing TEK of indigenous peoples who have lived on this planet since time immemorial with little ecological footprint. (Wright, 2004)

but coyote today’s students are connected like never before through digital technologies

connected to what? although I am not optimistic about the quality of the connectivity it is still a tiny minority doing all the work in social justice civil society circles students do not learn their relationships and responsibilities in the real world ecotechnological literacies of “interdependence” (Cullis & Suzuki, 2010) this would require an ongoing commitment to caring for the land and creating and nurturing just and equitable cross-cultural relationships (Apffel-Marglin, 1998) using reciprocity and equivalency as measures of success Kevin Kelly (2010) writes of the drift toward mutualism in the “technium” where individual human autonomy and the power of people work in symbiotic interrelationship

coyote are you suggesting that teaching/learning reciprocity and interdependence in design and technology education might encourage cross-cultural spaces where “equivalency of epistemologies” (Cole & O’Riley, 2010; Grillo, 1998) might become the norm?

De Souza (2012) refers to this as “epistemological pluralism” that pushes against “abyssal thinking” that cannot see other/ed knowledge systems through the prevalent “thinking-as-knowing” paradigm

hmm this would mean taking into consideration the TEK of indigenous peoples TEK that connects mind body heart and epistemologies of spirit and ritual with place (Apffel-Marglin, 2011) Wade Davis (2009) writes about the critical importance of the wisdom of long-standing sustainable communities for the modern world equivalency is not about transplanting indigenous and other/ed knowledge systems into western systems but generating more complex and culturally-inclusive possibilities for the diversity of humans and non-humans living together on a shared planet

raven just imagine education where “everyone (be it man, tree, stone) is a person, complete and indispensable, with its own inalienable way of being ... with its specific responsibility in the keeping of the harmony of the world. It is

in such condition of equivalence that this living world relates with each one and the other.” (Grillo, 1998, p. 224)

now that’s my idea of in (di)genuity this would profoundly change how technology discourses are enacted within and beyond education

an example of this is the work of Australian scholars Kurt Seemann and Dora Marinova (2010) with remote desert communities their research demonstrates the benefits of “mutuality of influence” and “scale-free networks” engaging both Indigenous and non-Indigenous technological knowledge systems across communities ecologies and built systems exploring synergies between Indigenous technological ecoliteracies and digital technologies to support Aboriginal communities in their cultural renewal and educational economic and ecological initiatives

in peru we learned about research with *kichwa-lamista* communities and schools in the high amazon to create pre-columbian anthropogenic bio-char soil drawing on millennia of traditional ecotechnological literacies and pedagogies. (Apffel-Marglin, 2011)

what is so amazing about this project is that it supports food security by replacing slash and burn agriculture in an area of intense deforestation and because the technology is adaptable to many ecosystems it has global significance and consequences

we learned too that ritual and spirituality play a central role in the *kichwa-lamista* technological ecoliteracies and ecopedagogies just as they do in *st’at’imc* territory ceremonies and festivals are enacted as a collectivity of humans and other-than-humans working toward a liveable common world that must be constantly reiterated through “intra-actions.” (Apffel-Marglin, 2011)

raven can you imagine a remapping of design and technology education that nurtures equity social justice cultural inclusivity and ecological responsibility?

that nurtures the community not just the ‘skilled individual’?

was there anything more you wanted to say about technology and in (di)genuity?

that depends

oh?

on whether it’s your in (di)genuity or mine

ah yes musn’t essentialize

the essence

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did we miss anything

oh yes we've hardly started but our time's up

not by my watch

I'm reading the faces of the listeners they need a break and time to digest
are there any questions comments well folks moving right along we're off to
the spa the hot springs up home in *st'at'imc* country where all the pre-contact
technologies are natural local and nonintrusive if you do have any questions
or comments just send them into the cosmos and someone or something
somewhere will respond sometime somehow

nia:wen

kukwstum'c

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MARGARITA PAVLOVA

6. DESIGN AND TECHNOLOGY EDUCATION FOR SUSTAINABLE FUTURES

In Preparation for Global Citizenship

INTRODUCTION

The processes of globalisation with their positive and negative influences on almost every aspect of modern life have not ignored education. One aspect of these processes is visible through the formulation of international educational agendas by such organisations as United Nations Educational, Scientific, and Cultural Organisation (UNESCO), United Nations Environmental Program (UNEP), United Nations (e.g. Millennium development goals) and the Organisation for Economic Co-operation and Development (OECD) that are shaping significant shifts in the educational debate about the purpose and nature of education. Over recent years an emphasis on the role of education and educators in enabling sustainable futures (e.g. UNESCO, 2009a, 2009b) provides additional opportunities and challenges for Design and Technology (D&T) education. Education for sustainable futures could increasingly engage students in transformative learning, helping them to face socio-ecological crises caused by modern ideas of progress.

This chapter examines current and possible roles that D&T could play in students' preparation for global citizenship shaped by what is defined in this chapter as a 'noösphere vision of the future'. This chapter argues that a social emancipatory view on transformative education through D&T is a most appropriate way for evaluating and developing teaching and learning for global citizenship, and that development, activation and utilisation of these capabilities are required to achieve change in students' attitudes and behaviours.

CHALLENGES OF THE MODERN WORLD AND EDUCATION

With the challenge of sustainable development as considerable as ever, recognition is growing that technological advances, legislation and policy frameworks are not enough. These need to be accompanied by changes in mind-sets, values and lifestyles, and the strengthening of people's capacities to bring about change. (UNESCO, 2012, p.5)

Global challenges of the modern world affect the ways education is conceptualised and organised. More and more issues of global citizenship are on the agenda for

policy makers. However, the notion of this term is interpreted in a variety of ways. They include ideas of being a citizen of the globe, being responsible for each other, understanding the need to tackle injustice and inequality, valuing the Earth as a common home, having the desire and ability to safeguard the future, willing to act to make the world a more sustainable place. Not all interpretations of global citizenship are positive. Bhikhu Parekh (2003) argued that global citizenship might dislocate one from the immediate community, that a worldwide government system that might be required for global community could be bureaucratic, oppressive and culturally insensitive. This type of world can be dominated by some countries that have a particular interpretation of a just world order. These countries have a prominent position in the World Trade Organisation (WTO), the World Bank, the International Monetary Fund (IMF) and have a particular perspective on the current global issues.

Globally oriented citizenship thus calls for a delicate balance between several complementary but also potentially conflicting virtues, such as appreciation of our common humanity and of our deep differences, courage of conviction as well as humility, a firm sense of our moral identity and a willingness to revise it, internationalism as well as patriotism, rootedness in our community as well as openness to others. How to cultivate and institutionalise these and related virtues is one of the most important challenges of our age. (Bhikhu Parekh, 2003, p.17)

These challenges of global citizenship lead to a variety of ways the notion of global citizenship is applied to education. Some global studies have been undertaken to that effect to establish consensus among experts across different regions, concerning a framework for curriculum development that is “multinational in origin, perspective, and aim and that. [is] responsive to a crisis-laden, interconnected world” (Parker et al., 1999, p. 120). These studies examined undesirable trends and forecasted social realities, and the competencies that help citizens to deal with these trends and the pedagogical means that could help teachers to develop particular qualities in students. Among the major findings of these studies is a proposal to consider ethical development as a core business of education. In the research by Parker et al. (1999), 182 scholars, practitioners and policy leaders from four geopolitical regions were involved. On the basis of their responses the authors proposed to develop a curriculum framed by six ethical questions that should be considered as the core subject matter: equity and fairness, privacy and access to information, environmental stewardship and human prosperity, population growth and child care, universalism and particularism and power relations. Together with related concepts, skills and attitudes, they constitute the main components of the proposed curriculum. Ethical questions “support the teaching of subject matter in a manner that encourages children to think critically” (p. 131). This and other studies emphasise the need for establishing ‘universal’ approaches towards the development of education.

UNESCO traditionally has played a significant role in the educational debate on the purpose and nature of education, and from the 1990s, by emphasising the role of education and educators in enabling sustainable futures. ESD has been promoted globally through the DESD (The Decade on Education for Sustainable Development) (2003-2014). “The DESD is intended to have broad scope and far reaching effects. It offers national governments the chance to reorient education, training and even governance to enable everyone to view the world through a lens of concern for sustainability” (UNESCO, 2012, p.10). The UNESCO’s preferred conception of the content of ESD was developed in detail in the Framework for the DESD International Implementation Scheme (UNESCO, 2006). The following 15 strategic perspectives, and the connections between them, were identified as framing the foci of education and learning for SD, namely: Human rights, Peace and human security, Gender equality, Cultural diversity and intercultural understanding, Health, HIV/AIDS, Governance, Natural resources (water, energy, agriculture, biodiversity, etc.), Climate change, Rural development, Sustainable urbanization, Disaster prevention and mitigation, Poverty reduction, Corporate responsibility and accountability and Market economy (UNESCO, 2006, 18–20). These perspectives highlight the critical role of education in enabling communities to create sustainable solutions to problems that are of importance on local and global scales. The nature of learning that supports ESD goes beyond the gaining of knowledge, values and theories related to sustainable development; it focuses on the transformative role of education.

Analysis of the processes and learning in the context of ESD concludes that learning in ESD refers to:

- learning to ask critical questions;
- learning to clarify one’s own values;
- learning to envision more positive and sustainable futures;
- learning to think systemically;
- learning to respond through applied learning; and
- learning to explore the dialectic between tradition and innovation. (Tilbury, 2011, p.8)

This list is based on Tilbury’s (2011) review of approximately 200 articles to understand trends, innovations, and growth in ESD. Key processes that underpin ESD frameworks and practices revealed by the same research include:

- processes of collaboration and dialogue (including multi-stakeholder and intercultural dialogue);
- processes which engage the ‘whole system’
- processes which innovate curriculum as well as teaching and learning experiences;
- processes of active and participatory learning. (Tilbury, 2011, p.7)

These learnings and processes are closely related to the social emancipatory view of transformative education argued by Pavlova (2012) as a most appropriate way

for evaluating and developing teaching and learning for sustainability. The social emancipatory view of transformative education accommodates both social change and individual transformation (Taylor, 2008). Thus the goal of transformation is both personal (self-actualization) and social (aimed at social transformation). It is as much about social change as personal development. This social emancipatory view is primarily rooted in the work of Freire (1970) who believed that people are agents of change and should be constantly reflecting on the transformation of their worlds and acting upon these reflections. Emancipatory transformation is based on planetary consciousness and recognises the interconnectedness between natural and social environments and personal worlds, and therefore requires a vision of preferred futures and pathways towards sustainable development.

To foster emancipatory transformative learning three teaching approaches are of central importance: critical reflection (to identify the ways students' agency could transform society and their own reality); a liberational approach to teaching (facilitating cognition, problem posing and discussions); and an equal, horizontal student–teacher relationship (Freire and Macedo, 1995).

The International Civic and Citizenship Education Study (ICCCS, 2009, see Schulz et al., 2010) conducted across 38 countries and focused on citizenship education at school, was aimed at identifying common teaching and learning topics in citizenship education. Twelve topics were revealed including: 'human rights, legal systems and courts, different cultural and ethnic groups, understanding parliamentary voting and elections, the economy and economics, voluntary groups resolving conflict, communication studies (e.g. the media), the global community and international organisations, regional institutions organisations and the environment' (Schulz et al., 2010). These topics are delivered through different forms including a separate school subject, a theme integrated in other subjects, cross-curricula and extra-curricular activities and some of them are closely related to 15 strategic perspectives identified by UNESCO (2006).

Oxfam (1997) argued that Global Citizenship in schools is based on the following principles.

- The importance of reaffirming or developing a sense of identity and self-esteem.
- Valuing all pupils and addressing inequality within and outside school.
- Acknowledging the importance of relevant values, attitudes, and personal and social education.
- Willingness to learn from the experiences of others around the world.
- Relevance to young people's interests and needs.
- Supporting and increasing young peoples' motivation to effect change.
- A holistic approach to Global Citizenship - that it should be an ethos permeating all areas of school life (Oxfam, 1997).

Many common features of education for global citizenship (at the level of theory and practice) can be summed up in the mission of education: to prepare young people for national citizenship in a globalised society that develops sustainably.

DESIGN AND TECHNOLOGY EDUCATION FOR SUSTAINABLE FUTURES

Education that supports this development should be based on an ethical imperative and social emancipatory view on transformative education. This framework seems appropriate for conceptualising learning for global citizenship. In addition, a number of specific questions caused by the process of globalisation that education needs to answer were formulated in a recent OECD report (2013). This report examined key economic, social, demographic and technological trends and their potential to impact on education. The report used robust international sources of data, including the OECD, the World Bank and the United Nations. This analysis was focused on five areas of globalisation, well-being and life-style, skills and the labour market, modern families, and new technologies. Trend identified in this report provides inputs to formulating concern to be addressed through education.

Trends associated with globalisation led to such questions as: how to provide students with necessary outlook and skills for successful international cooperation; how to nurture the kind of transferable skills to cope and adapt to economic uncertainty and change; how to foster and value the creativity necessary to be innovative; how to develop greater cultural sensitivity; what is the role of formal education in raising awareness and creating responsible citizens with civic values, critical thinking skills and sustainable consumption habits; how to foster the necessary attributes and knowledge for the international cooperation required to address environmental issues?

These questions and existing practices related to global citizenship and ESD could help Design and Technology to formulate educational responses to the challenges of globalisation. The next section focuses on the ways Design and Technology responds to these challenges.

DESIGN AND TECHNOLOGY EDUCATION - ORIENTATIONS

Responses by Design and Technology to a global citizenship agenda are reflected in curriculum and teaching/learning approaches adopted by various countries. In this section I refer to the new Australian Curriculum: Technologies (ACARA, 2013) that is under development. The nature of this new curriculum is directly related to the issues discussed above by emphasising students' engagement in 'creating preferred futures' by applying systems thinking "to develop the technologies knowledge, understanding and skills to provide a method for identifying and moving towards ethical, socially responsible and sustainable patterns of living" (ACARA, 2013, p.4).

Students will develop increasingly global perspectives that help them to understand the "complex interdependencies involved in the development of technologies and between the developer and user in their technologies solutions, and how these can contribute to preferred futures" (ibid, p.9).

Among seven general capabilities that need to be addressed across all learning areas, including Design and Technology, critical and creative thinking; personal and social capability; ethical understanding; and intercultural understanding are directly related to global citizenship. The extract below outlines the ways sustainability is

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linked to Design and Technology in the new curriculum. Sustainability is included as a cross-curriculum priority:

In the *Australian Curriculum: Technologies* the priority of sustainability provides authentic contexts for creating preferred futures. When identifying and critiquing a need or opportunity, generating ideas and concepts, and producing solutions, students give prime consideration to sustainability by anticipating and balancing economic, environmental and social impacts.

The *Australian Curriculum: Technologies* prepares students to take action to create more sustainable patterns of living. The curriculum focuses on the knowledge, understanding and skills necessary to design for effective sustainability action. It reflects on human need and equity of access to limited resources. The curriculum recognises that actions are both individual and collective endeavours shared across local and global communities.

The curriculum provides a basis for students to explore their own and competing viewpoints, values and interests. Students work with complexity, uncertainty and risk; make connections between disparate ideas and concepts; self-critique; and propose creative and sustainable solutions.

In this learning area, students focus on the knowledge, understanding and skills necessary to choose technologies and systems with regard to costs and benefits. They evaluate the extent to which the process and designed solutions embrace sustainability. Students reflect on past and current practices, and assess new and emerging technologies from a sustainability perspective. (ACARA, 2013, p.17)

This curriculum has an explicit focus on understanding and addressing sustainability issues locally and globally and is based on ethical considerations. Students' achievements by the end of year 10 are described as students' ability to

explain the complex interdependencies involved in the global environment in the development of technologies, products, services and environments for preferred futures. They investigate how knowledge of properties and characteristics of technologies, materials and systems can be used to make judgments about their appropriateness for use for designed solutions to problems of individuals and the global preferred futures for a range of technologies contexts. (ACARA, 2013, p.58)

The importance of students' involvement in global perspectives, in stimulating their reflections on preferred futures, on appropriate use of technology and appropriateness of technology highlights important new developments that are visible in this version of the National Curriculum. Critical reflections and problem-based learning can serve as a basis for transformative education:

Students specifically focus on preferred futures, taking into account ethics, legal issues, social values, economic, environmental and social sustainability factors and using strategies such as life cycle thinking. (ibid, p.54)

Development of global perspectives and understanding of ways ‘the global preferred future’ might look, requires students to perform as global citizens.

ETHICS

Concern over the need to develop a planetary vision that enables people to see the interconnectivities of the world and the need to address issues holistically is not new. This understanding goes back to the very beginning of the 20th century, when Vladimir Vernadsky developed a theory of the *nöosphere* that presented a philosophically rethought image of our desirable future, one that in current terminology is called a sustainable future. Vernadsky’s concept of *nöosphere* or the “sphere of wisdom” (*tsarstvo razuma*) is grounded in his research in the physical sciences and stages in the evolution of the planet (Vernadsky, 1926, 1945, 1998) from a geological perspective. Although our species represents an insignificant mass of the planet’s matter, humankind has emerged as the increasingly dominant “geological force” in the biosphere:

Its strength is derived not from its matter, but from its brain [*italics added*]. If man understands this, and does not use his brain and his work for self-destruction, an immense future is open before him in the geological history of the biosphere. (Vernadsky, 1945, p. 5)

That force is defined not simply by the biological metabolism of the human population (such as its nutrition, excretion, and muscular effort) but by the much larger flows of matter and energy, which are connected with the physical-economic activity of human society:

Mankind taken as a whole is becoming a mighty geological force. There arises the problem of the reconstruction of the biosphere in the interests of freely thinking humanity as a single totality. This new state of the biosphere, which we approach without our noticing, is the *nöosphere*. (Vernadsky, 1945, p. 5)

Vernadsky believed that *nöosphere* is the last stage in the evolution of the biosphere in geological history. The concept of *nöosphere* provides a useful contribution to the formation of a new global and holistic worldview, which envisages a world where human consciousness, cognitive power and wisdom help to harmonize a co-existence of humanity and nature. Vernadsky argued that all components of human nature such as our mind (through appropriate information and knowledge), heart (through feelings and emotions), and spirit (through the highest human aspirations and morals) should be reached and moved in the process of *nöosphere*.

The argument that human consciousness is the way to solve problems that our planet faces has now gained more support (e.g., Beck, 1994, 1997; Giddens, 1990, 1994a, 1994b – reflexivity; Gardner, 2001 – conscious agents; Bonnett, 2002 – frame of mind; Sterling, 2007 – a positive planetary vision; Hart, 2008 – consciousness as a viable concept). Bonnett, for example, directly locates the essence of sustainability in the nature of human consciousness -- emphasizing the special position that human consciousness has in “the greater scheme of things” and suggests that sustainability seeks and requires openness to nature:

The issue of sustainability as a *frame of mind* [italics added] is not simply the issue of our attitude towards the environment, but represents a perspective on that set of the most fundamental ethical, epistemological and metaphysical considerations which describe human being; a perspective which is both theoretical and practical in that it is essentially concerned with human practices and the conceptions and values that are embedded in them. (Bonnett, 2002, p. 14)

This planetary vision is an essential attribute of global citizen that emphasise peoples' responsibility in saving our planet. The large flow of matter and energy led by design and technologies could provide appropriate solutions for sustainable development if shaped by nōosphere ethics and understandings.

DESIGN AND TECHNOLOGY EDUCATION – PLANNING OF IMPLEMENTATIONS

New developments in Design and Technology curricula, as exemplified by the proposed Australian curriculum, pose considerable challenges for implementation. If previously students were asked to apply life cycle analysis or undertake research on material selection (to ensure less damage to the environment) or apply waste minimisation strategies, now they need to shape all learning by the framework of sustainability and by the vision of preferred futures. Implementation of a Design and Technology curriculum that enables learners to develop the capabilities of a global citizen needs to be shaped by learning targets and expected outcomes suitable for ESD. Learning targets to support ESD (including skills, attitudes and values) proposed by the UNECE (2009) and an additional target proposed by UNESCO (2010a) provide guidelines on how ESD, including global citizenship, can be addressed in the curriculum. These learning targets and outcomes are presented in [Table 1](#).

These learning targets and outcomes need to be translated into learning activities and teaching strategies. Although many examples are already available (see, <http://www.sda-uk.org/>; <http://stepin.org/>, Pavlova, 2009), the main concern is that students are not often exposed to ethics that are at the core of transformative education that enables students to become global citizens. Understanding ethics and the ways issues can be addressed through projects (e.g. appropriate technology; eco-design; low-cost product design; technological systems to solve community problems, see

Table 1. Learning targets and expected outcomes

<i>Competence/ Does education enhance learners' capacity for:</i>	<i>Expected outcomes</i>
Learning to learn	Posing analytical questions/critical thinking Understanding complexity/ systemic thinking Overcoming obstacles/problem-solving Managing change/problem-setting Creative thinking/future oriented thinking Understanding interrelationships across disciplines/ holistic approach
Learning to do	Applying learning in a variety of life-wide contexts Decision making also in situations of uncertainty Dealing with crises and risks Acting with responsibility Acting with self-respect Acting with determination
Learning to be	Self-confidence Self-expression and communication Coping under stress Ability to identify and clarify values
Learning to live and work together	Acting with responsibility (locally and globally) Acting with respect for others Identifying stakeholders and their interests Collaboration/team working Participation in democratic decision making Negotiation and consensus building Distributing responsibilities UNECE, 2009
Learning to transform oneself and society	ESD builds civil capacity for community-based decision-making, social tolerance, environmental stewardship, adaptable workforce and quality of life; ESD is facilitated through participatory and reflective approaches. UNESCO, 2010a, Tool 6.

Pavlova, 2011) should play a central role in pedagogical approaches to ESD. These approaches need to address at least three areas: how to develop, activate and utilise capabilities that relate to global citizenship.

It is critical that at the stage of development the assumed norms (the shared values and principles underpinning sustainable development) are made explicit so that they can be examined, debated, tested and applied to problem identification and solution development. Also a variety of pedagogies that help teachers and learners work together to acquire knowledge and play a role in shaping the environment of their

educational classroom, should be applied. Participatory decision-making, critical thinking and problem solving strategies used in classrooms lead to confidence in addressing the dilemmas and challenges of sustainable development.

At the stage of activation students should have an opportunity to use their understanding and capabilities through design tasks/learning activities that are oriented towards sustainable development and global issues. At the stage of utilisation the learning experiences offered are integrated in day to day personal life and extra curricula activities, including projects with communities. One appropriate example, although not specifically related to Design and Technology, is a community practice for university students in Indonesia. All university students in their final year of study need to spend a period of time in the community applying their knowledge and skills to solving community issues. Students from different knowledge backgrounds can work in one team. They collaborate with members of the community on identification of an issue and on developing a solution.

The first two stages of development and activation are related to attitude development and utilisation - to behaviour. Important psychological research on relationships between attitudes and behaviour revealed that although attitude change is frequently the target of ESD programs, some characteristics of attitudes and intentions that strongly influence behaviour, such as concreteness and specificity, are often not addressed in ESD programs (Arbuthnott, 2009). For example, attitudes to recycling predict recycling behaviour much more effectively than do attitudes to environmentalism (Vining and Ebreo, 1992). This and other research demonstrates that educational effort designed to target specific pro-environment behaviours is more effective than campaigns to increase knowledge about environmental degradation. As summarised by Arbuthnott (2009) there are three types of factors that influence whether intentions are translated into action: the nature of intentions themselves (e.g. specificity and perceived control), contextual barriers and supports (e.g. task difficulty, regulations, incentives), and individual characteristics such as habitual behaviours and self-regulation depletion (p.158). Arbuthnott (2009) argues that ESD can influence all factors (Table 2).

Therefore, in addition to efforts aimed at developing specific values and attitudes, knowledge, skills and competencies, ESD programs should include strategies aimed at helping students translate their intentions into actions. For example, activities could include a review of case studies of specific behaviour change in areas such as energy conservation, recycling and water management. Instructors should provide feedback to students about the effectiveness of change undertaken to influence students' beliefs about the efficacy of personal changes. Students should also be aware of the reality of self-regulation depletion and discuss alternative plans for times when they are unlikely to be successful in self-control (Arbuthnott, 2009).

These pedagogical approaches applied in a Design and Technology context should help students to develop and activate their capabilities as global citizens. Extra-curricular activities and community projects could help students to utilise

Table 2. Relationships between attitudes and ESD strategies in support of behaviour change

Theme	Factor	Sample ESD strategy
Attitudes	Intention specificity	Focus on specific behaviour change Provide specific examples, case studies Teach implementation intentions
	Perceived control	Present feedback on targeted behaviour Highlight information about effects of change
Context	Task difficulty	Suggest ways to make sustainable behaviour more convenient & less costly than wasteful behaviour
	Regulations/ incentives	Mandate sustainable behaviour Increase financial and social rewards for sustainability
Individual attributes	Habit	Develop habit change support program Introduce efficient technologies
	Self-regulation depletion	Plan alternative behaviours for depleted times Arbuthnott (2009, p.159)

their capabilities and to reinforce qualities and experiences required to deal with real issues in the context of global preferred futures.

FINAL REMARKS

This chapter argues that education for sustainable development framed by the ethics of *nöosphere* is an effective way to develop capabilities for global citizenship. This implies that a number of strategic perspectives framed by learning targets and outcomes should be addressed in learning and teaching of Design and Technology through the stages of development, activation and utilisation of students' capabilities. It is also suggested that specific learning and processes should apply including specific strategies aimed at helping students to translate their intentions into actions.

Curriculum development that uses sustainability as a framework for Design and Technology (an example of the new Australian curriculum was presented) is a required step in developing students as global citizens. However, additional effort needs to be spent on supporting implementation through developing teaching and learning activities that are framed by broad understandings, but focused on specific actions.

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7. DESIGNING FOR CULTURAL GROUPS AND HUMANIZATION

Two Ideas from Design Anthropology

INTRODUCTION

Understanding, using and teaching the link between culture, ecology, and design and technology education can offer a rich and effective strategy for fostering whole student development. This chapter will appeal to educators interested in exploring what a more advanced perspective of design and technology can offer to their students as well as to their own professional enrichment. Where an educational interest lies in how to effectively embrace culture and ecology in design education, the broad field of anthropology presents the most authentic discipline of choice, especially through its sub-discipline of design anthropology. From a hands-on perspective, design anthropologists have been instrumental in many contemporary product, service and system designs that exist around us today¹. From an educational development perspective the ideas behind design anthropology provide solid foundations for guiding human development that is informed by the way people response to, and embed their values within, their built, social and transformed natural environments. The mutual value-add of combining the goals and frames of education with those of relevant branches in anthropology, offers fresh and exciting learning opportunities for teachers and students alike.

Two ideas have been selected from the field of design anthropology to help demonstrate how culture presents a critical educational experience in the practical act of what I will refer to as designing and working technologically. In the first part of this chapter I explore how understanding culture can scaffold the act of designing. In the second part of this chapter, I explore the formidable role that design and technology plays in human development itself. In this second idea the chapter combines anthropological and related philosophy of technology propositions to present insights into how, as a species, we define what it means to be human through the making of the world around us, and in so doing, literally also produce ourselves as a product of our own making. From an educational perspective, this making of ourselves to be human, is an extraordinary proposition that sits at the heart of design and technology education and the core curriculum role it plays in transforming humanity itself. It is arguably one of the most sophisticated ideas underpinning the potency of the subject and as such ought be nurtured carefully and deliberately by the subject's custodians: government, educational institutions and teachers.

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PART ONE: USING ETHNOGRAPHY TO INFORM AND ENHANCE THE
PROCESSES AND PRODUCTS OF DESIGN AND TECHNOLOGY

Design anthropology offers ideas for how to enhance and creatively inform the teaching of design and technology where the goal is to design for, and with people, and the social networks with which they feel they have a peer affinity. Ethnographic theories position the individual as a member, as well as a product, of a socio-cultural context. For the design student and teacher alike, the social dimension of design raises rich educational as well as technical choice information that can guide both the learning experience for students, as well the material output objective of the design and technology project in which they are engaged.

While exceptions remain, a conventional representation of design and technology projects in schools has favoured a focus on the technicality of designing and making. This can be portrayed in some schools in the form of a specific product to be made in accordance with a set brief. These briefs typically assume an individual-archetype as the end-user of that product. One result of this convention is that the human factor can be very easily discounted reducing the end user to a benign and essentially passive client persona. The effect of this may cause the designer (the student) to focus most of their efforts on the 2D (sketching) and 3D (making) of their design. The product becomes the object rather than the living end user and the context within which the product is meant to succeed. If we now extend this line of thinking to the end user as a social member of a group, and the values and beliefs they are a part of, we then have a whole new range of 'market' impact to accommodate. When designing for people who identify with larger human groups and communities, culture becomes the main game to factor and value for the designer. The person undertaking design, and the client's belonging to their groups, raise opportunities to embed not only new intellectual frames for guiding practice in design, but also for revealing rich educational opportunities for the student who is given the task to reflect on the roles they play when designing and working technologically for, and with, other people.

DESIGNING AND WORKING TECHNOLOGICALLY ALWAYS OCCURS IN A
SOCIO-ECOLOGICAL, AND SOCIO-TECHNICAL CONTEXT

If there is one pattern that many teachers and consumers may have noted over the last decade it is the rise of social technologies. Social technologies include Facebook, smart phones, and products designed to target specific human group communication and identity. The move to design for groups, rather than for individuals, demands a new range of conceptual frames for how we understand technology and the relationships groups form with their designed world. New group-based methods are required to check, challenge or redefine the given design briefs. The very processes of design can also require redress. These shifts in how design is approached when it is for small, moderate or large groups of people, such as workplace groups, communities of practice, or age segments in society, has given rise to new techniques. These

include co-design/collaborative design and participatory design methods. They may also include design techniques for products targeting other human groups such as families, clans, tribal groups, or even human settlement systems. The latter would be the case for international aid projects where cross-cultural technology transfer investments are designed and deployed (Button, 2000). Anthropological theories about how humans identify with tribal groups for example, may be appropriate when designing phone apps or product ecosystems for growing and maintaining sporting club team membership numbers. All these techniques are founded on design anthropology theory and methods, and target how groups form, maintain and evolve common values and beliefs that bond them to the cultural norms of the human groups to which they feel they belong. One obvious advantage for using such group based design strategies is that groups generally sustain a bigger and longer lasting market.

Products, services and systems that co-designed and framed from their beginning a process to work with groups of people offer strong opportunity for more socially sustainable commitment from the participants to new innovative designs as a direct result of using such participative design research techniques. The application of anthropological frames to guide design has been applied to contexts as diverse as housing standards in remote Aboriginal Australia (Fisher, 2002; Karanja et al., 2010; Seemann, 1986; P. K. Singh & Hiremath, 2010; R. K. Singh et al., 2009; Smillie, 1991; Tao & Wall, 2009), through to the way transnationals design their web sites to accommodate regional cultural preferences. In his on line article summarising key business ideas Christian Arno noted,

The anthropologist Edward T. Hall theorised that “high-context cultures” (such as many African and Asian ones) tend to use symbols more, and expect people to interpret meaning from fewer words. ...“Low-context” cultures, such as America and Europe, tend to use more text, and spell out their messages explicitly. While these aren’t hard and fast rules, they are often reflected in website preferences. ... Chinese, Japanese and Korean users often expect to see a greater use of images, videos and sidebars, compared to more text-heavy Scandinavian or German designs. (Arno, 2012)

To include culture as a key factor for enriching design, it is desirable to develop an awareness of how thinking, feeling and acting on the *social-material* world around us contributes to the systems of values and perceptions we hold true of the world ‘we perceive’. If we pay attention to the world as it is perceived by clients rather than as we guess it to be as designers, we then can appreciate that designing and working technologically is a scholarship that demands we learn techniques to help us understand what drives human groups, their values and their cultural belief structures. Armed with such knowledge, designers can more effectively develop solutions that fit naturally with their client’s worldview, their culture. The difference of how designers, clients and end-users perceive the world can be minimal; ‘they’ are like me, or substantial, ‘they’ are nothing like me. Designing for other groups thus requires the designer appreciates how the social and material context in which

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their clients are reared, or enabled to be productive at work, defines at least in part, the expectations they hold of the world designed about them.

USING DESIGN ANTHROPOLOGY IDEAS TO DESIGN AND MANUFACTURE A
WASTE MANAGEMENT SYSTEMS: THE SIGNIFICANCE OF CULTURE

The design and technology context for the following example is captured, at least in part, in [Figure 1](#). The design context highlights the way culture plays a key role in helping designers understand the end-user's socio-technical and socio-ecological situation. The ethno-technical context of the end-users of a waste system helps designers better identify the deeper factors that design criteria for new devices and systems must meet. The object is to assure that both the approach to design, in this case, co-design methods, and the final products and systems produced, work sustainably in the cross-cultural technology transfer location of a small and remote desert community². What may work fine in the city, is unlikely to also work fine in the outback for both ecological as well as socio-cultural life skill reasons. While this preference to design for best local fit can vicariously be ignored by adding substantial urban-oriented support systems to the technologies introduced in remote communities, they almost always prove to be collaterally unsustainable, and very often result in communities being worse off than before. A search for scholarly literature detailing cases of failure to develop appropriate technologies, or failed technology transfer in community development aid projects highlights this point (Schumacher, 1999; Smillie, 1991).

The community, as a settlement, had developed an unfortunate reputation of being unsightly with considerable litter evident throughout the small town ([Figure 1](#)). Many adhoc opinions had developed. One of the effects of such widely developed views is that politically, the cause of the problem was assumed to be members of that community, rather than looking at the contextual constraints that the community was face with managing for its situation. Health concerns also were voiced. One consequence of this projected view formed about the members of this community by some service agencies was that it was unable to manage itself. Communities that appeared to not be able to manage themselves did not engender confidence in the Government of the day. A loose view formed where there was reluctance to inject worthy resources into that community for fear that those resources also being ineffectually managed. A highly accomplished civil engineer assessed the litter situation and concluded the solution was rather simple: just line up the 80 or so residents at one end of the small community, including the non-Aboriginal service staff living there, and in one day, pick up all the litter as they walk across. Problem solved. This technical view of the design problem was not uncommon by accomplish designers and engineers at the time. We will return to this engineer's view of the solution later to highlight the significance of why designing for people requires techniques to understand and identify cultural factors so that more effective and socio-ecologically sustainable product, system and service designs could be implemented.

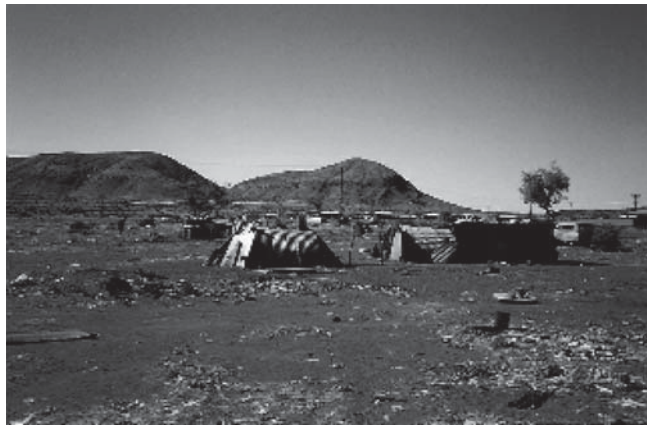


Figure 1. Litter context of a remote small Aboriginal Australian community at time of project. This plate shows a remote desert community (a human settlement). The foreground textures and objects on the ground represent considerable physical litter that is of such concern that the leaders of the community sought assistance to help remove it and avoid it building up again. The issue this plate raises is that neither a technical nor a socio-cultural solution was sufficient. Instead, a socio-technical and environmentally informed systemic solution offered the more sustainable design outcome.

The team noted the engineer's thoughts, and decided to investigate communities in similar situations elsewhere to compare what other remote communities did that worked for them. The report presented below is an extract from that comparative evaluation of another remote desert community and their litter management situation. Comparing human groups for how they address common situations is a typical investigative technique in design anthropology.

A SOCIO-ECOLOGICAL AND SOCIO-TECHNICAL LITTER EVALUATION: A COMPARATIVE REPORT

Imagine a small and remote community located in an Australian desert climate. The range of waste seen to accumulate in the community includes plastic bags, discarded fuel drums, building and packaging materials, and abandoned or temporarily vacated shelters. Adding to the challenge of controlling this waste is the limited availability of reticulated water, extreme weather conditions, and energy losses due to inefficient shelter designs. The community also produces a lifestyle dependent on external specialists to maintain public and private hardware. It is almost entirely dependent on government funding and capital resources that have to be brought in from hundreds of kilometres away. This significantly increases the relative cost of hardware used in the community,

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and if spare parts, or particular tools are not available, major delays can occur to the repair of waste management technologies. As a result, some hardware may undergo unorthodox makeshift repair work.

The community also serves as a resource provider for a number of its smaller outstations that lack reliable water and power. Septic systems in the community tend to fail and alternative means are often used. The attitude of the community towards the waste their lifestyle producers is a general desire to remove, reduce or reuse as much waste as possible. However, community members also find it difficult to realize their desires, gain access to, or operate the technology options provided to deal with the waste, or, they have come to expect that the waste, and any broken down waste management hardware, will eventually be removed by someone else, or replaced by government. This lifestyle and environment of the remote community has created a perception of time, and responsibility towards reducing cost, that does not compare with mainstream urban services. (Seemann & Walker, 1991, pp. 5-6)

The waste management situation described in the above community comparative evaluation could easily be mistaken for a remote Aboriginal community in Central Australia, but it is not. This compared community, describes the waste management problems of one of Australia's Antarctic Stations. What we can learn from this example is that the social and material context within which groups of people live plays a key role in how people adapt to live in that context, and the expectations they develop about ordinary material services and technologies. We can also learn that if the designers involved in the initial set up of technology choices and services had learned to use ethnographic methods to help inform a better fit for the end user's socio-ecological and sociotechnical context, the quality of life could have been substantially improved.

Key to designing sustainable futures in the remote Aboriginal waste management example was to factor into the design process local ethnographic and ecological information using co-design methods. These methods revealed both values and cultural structures within which new technology systems needed to work, and also access local shared insights to help ensure that key design requirements were accommodated. Since culture is not something that comes and goes randomly but moves and evolves like a deep current among human groups, learning to translate culture and values into tangible design briefs is a key to designing solutions that are well placed to ensure a better uptake upon their installation, deployment or diffusion.

One of the co-design methods used involved design researchers working with local Aboriginal leaders and families to build up storyboards of local group perceptions for the cradle to grave lifecycle of litter found commonly around the community grounds: Plate 2 presents the combined narrative that was produced by the various groups.

The lifecycle pathways of litter as depicted in [Figure 2](#) was in fact a merged set of two story boards, where two community groups were working on their drawing

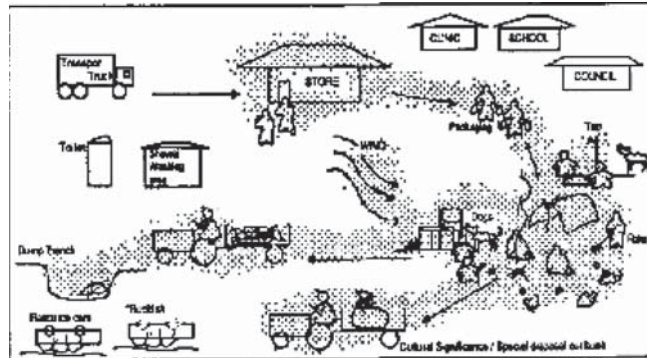


Figure 2. Local story board depicting local awareness of the lifecycle of waste. The grey stippled area represents the sources of waste perceived by community members. The non-stippled areas, such as the transport truck bringing supplies into the community store, the Health Clinic, School, Local Council Office, detached shower and toilet facilities all represented sources of waste that local members of the community did not perceive, even though they were the source of the majority of the litter distributed through the community grounds. The storyboard also revealed some clothing found laying about in the community grounds had cultural significance and required special handling.

separately then brought together to compare notes. There was a clear revelation among most community people when their storyboards were brought together. Seeing the two drawings together was noted by participants as helping them better understand the nature of the waste lifecycles and so how they might then organize to more effectively address the problem. They could see the bigger picture and began co-developing ideas with the design researchers to reduce different types of litter 'escaping' from the dominant sources around their community: paper from their community school and council office, nappies and sharps from their clinic, and recyclable packaging material from their community store.

Importantly, the research included how groups were currently trying to collect and dispose of domestic waste using existing devices, service routines and systems. They found among other things, that the technologies were severely hampered by the extreme heat of the desert and the handling difficulty of emptying 44 Gallon (200L) drums into trenches. This collaborative research process helped the designer identify key cultural, ecological and technological parameters for a better 'fitting' waste management system. New devices were developed and generated local employment in the regions for their manufacture and repairs, while new service routines were designed that helped deliver relatively smooth social-organizational processes for their local situation. Some years later, the local situation and resource conditions had shifted, partly in response to the first innovations in place, causing new waste management service designs and equipment to be developed. As long as the design

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evolves drawing on the methods and ideas presented thus far, the community's waste service would be well placed to sustain its waste management functions in cultural and ecologically appropriate ways.

We now return to the expert engineer's solution first proposed. The solution was a technical one mainly because the engineer did not, nor could not, imagine how a litter pick up run could be so dismissed: it was so technically feasible and simple to organize.

A key to accommodating cultural insight for developing more effective and sustainable design solutions is that as a designer, one has to accept there is almost always more socio-cultural factors to glean out of the intended applied context for a design than what logical reasoning and assumptions reveal. In the waste project example, the storyboard activity revealed that some items of waste found laying around the grounds of the community held a sacred status when that item belonged to a person that passed away. To touch such items required specific family members who held the appropriate cultural permission to discard the items. These items were forbidden for most people to touch. The engineer's solution to line all people up including non-Aboriginal members of the community to pick up all waste would not have been well received.

The waste project presented above for the remote Aboriginal community resulted in a range of product, system and service design outcomes. A service designed about local values was developed that facilitated a culturally appropriate work organisation structure to accommodate local family clan arrangements. The products included new hardware designs for bins, and social organization, that was a better cultural and socio-technical 'fit' to deal with the range of anonymous, as well as socially sensitive waste materials.

Design Anthropology offers knowledge and methods to design and technology teachers and students that help identify a range of ethnographic factors involved in designing and working technologically. Its goal is to deeply inform design choices, processes and design research methods for (and with) *groups* of people. This field predicts basic social requirements and drivers for how different human groups may sustain an interest in new products, structures, spaces, systems, services, or communication designs. Indeed, all *genres* of human technology are of great interest to design anthropologists³.

PART 2: DESIGN ANTHROPOLOGY AND HUMANIZING DESIGN AND TECHNOLOGY EDUCATION.

Teaching and anthropology share an interest in how people develop, innovate and express their identity. This common interest in human development is already a good fit for including anthropological methods and theory into aspects of education. When we refine this association to the common ground between design anthropology, and design and technology education, the mutual advantage is compelling. Design anthropology is forward looking, and seeks to significantly enhance the knowledge,

skills and processes involved in designing and working technologically. Design and technology education seeks to foster similar sets of qualities in its students.

In this second part of the chapter, I outline how the design and technology curriculum contributes to humanization and how humanization is also of interest to the field of design anthropology. The common area of interest pertains to how humans socially and culturally ‘make themselves’ when they engage in deliberate, and contextually validating, social-material praxis. Through the social and technical processes of investigating, and practically integrating knowledge and environmental resources into artifacts (an artifact in this context refers to the production of anything made by humans that transformed natural, digital or processed resources) not only are resources transformed into the ‘*object*’, but also the learner is transformed as the ‘*subject*’, being the agent of the transformation process. Human transformation is more overtly fostered when designing and working technologically requires the student to learn, contextually validate that learning, and critically reflect on the new knowledge, skills and social insight acquired through the act of producing the said artifact. The student comes out ‘changed’, alongside the change that has occurred to the consumed resources used to produce the product. Students have changed in that they have emerged from a deliberate and reflective material activity with new knowledge, new social awareness and new motor practice as a result of seeking to validate their designs for a set context of application. Even if the application was familiar, the change is at least one of affirmation of prior knowledge, skills and social insight being tested.

If the educational experience of designing and working technologically was based on deliberate co-transformation strategies of learning, and if the learner builds new knowledge, social and practical skills, then both an object, and a transformed person, is produced. The transformed products of a humanized education in design and technology may therefore be empirically observed as both the *object* produced and the *subject* that produced it. The transformed object gives evidence of the transformed subject, but equally, the transformed subject must give evidence of the transformed object. When these co-transformations are both given as evidence for meeting the researched requirements of the object to succeed in the applied social and material context in which it was intended to function, we then can assert a basis for validating the humanization of the design and technology curriculum⁴. I will refer to this co-transformation thesis, and the need to validate the object against the applied context for best fit, as the *unique epistemic foundations* of design and technology as a discipline.

Ideas and methods in design anthropology have facilitated both the processes and products of design. These methods provide educators with a unique and powerful insight to how designing and working technologically helps us understand what it means to be human. The transformative effect on the learner, if guided well, is a formidable educational outcome that design and technology offers the curriculum in ways no other subject can – without of course, looking like they are conducting design and technology lessons. The humanizing value of being able to bring together

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in one learning objective the co-transformation of our physical, intellectual and social capabilities into the one contextually validating process of designing and working technologically is a very powerful quality to foster in the classroom. While all other areas of the curriculum certainly can synthesize the students' affective, cognitive and motor development, none offer the necessary range and depth of such content as the body of knowledge that design and technology demands of its students. This centrality of the humanizing value of praxis when it is derived from socially informed transformations of our natural and made world around was also of great interest to scholars such as Marx Wartofsky.

The 'other'⁵ in which human beings come to recognize themselves as human, is no longer simply the 'thou' of religious consciousness, but the natural world itself insofar as it becomes a world-for-us – a world either designed or made to meet the needs of human existence. It is this transformation of the world into a resource for human existence that makes of it a mirror of our needs, and thereby, the representation, in this form, of our species-nature or our essence. It is thus in this humanization of nature that human beings come to be human – the humanized world becomes the 'other' whereby humanity achieves itself. (Wartofsky, 1979, p. 361)

Humanization so far has been presented through the thesis of co-transformation, where contextual validation of 'best fit' is a necessary and so required condition to claiming that change in knowledge and resources have occurred. However, socially and culturally, people are also adapters and adopters of worlds designed by others. We usually move passively through, and accommodate, most of the ordinary spaces, tools and things designed and made by unknown others around us. Over time, we get so socially used to the technologies in our lives, and within our bodies, if not also as extensions to our bodies, that they become quite invisible to our ordinary consciousness. This is the second, and much more socializing, transformative effect of the designed world around us. This 'disappearance' and 'semi-transparent' nature of how humans socially relate to the worlds created for them and by them, aligns with Don Ihde's thesis (1979, p. 19) for the developmental telos of tools and instruments. So normalizing is this relationship with the world we have made, that much of it blends invisibly to our consciousness, and yet forms the basis of a deal of our socially aligned or 'group think' expectations for how to navigate the worlds we have grown up with and passively accommodated (De Tezanos-Pinto, Bratt, & Brown, 2010; Fernandez, 2007; Hamre, 2003; Millar, 1985; Ochara, Asmelash, & Mlay, 2012; Reeve, 2006).

What I will call the domestication of the world we have made, means we have come to share with others common beliefs, behaviours and perceptions around the digital and material worlds that we live in. This cultural *a priori* of consciousness with our made world is starkly contrasted, however, when our designs and technologies are transferred into the worlds of other cultures: when technologies are transferred across the boundaries into new cultural and material contexts. We cannot assume the

end-user will be like us: the designers and makers of the object. We need to validate our design knowledge contextually in the social and material setting of that end user in order to build our body of knowledge. We tend to notice mostly the new, the novel and the failed when it comes to technologies in our lives. Subliminally if not overtly, our concepts of what we value, what we expect in ordinary life, and how we view such ideas as safety and comfort has been conditioned since birth in a culturally normalized manner with the made world about us. Many of the ideas and social patterns humans hold as normal, have already been conditioned, or *primed*, by both the designed and the natural worlds within which people live.

We initially design and make our technological worlds precisely because we seek to influence, or be influenced by, the world we make; if this was not so, the entire premise of designing and making anything, including service design, is moot. We design corridors in buildings and cities to influence how people move through our structures and how they interact. We design fashions to express a desired view of what is powerful, friendly, attractive or protective. In agreement with Feenberg (2010), we can design to influence our world, only because we are a part of it. Our membership in the world we transform brings into play our need to critically anticipate how we, as designers, are going to be affected by our creations, and as ordinary people who share in common with our identity groups, the creations of others placed in our world. The act of designing and working technologically asserts an ethic of reciprocity, the denial of which is at best an illusion, and at worse a global consequence.

Every one of our acts returns to us in some form as feedback from the other. But this means that in acting we become the object of action.... In more formal philosophical language the paradox of action says that human beings can only act on a system to which they themselves belong. Because we belong to the system any change we make in it affects us too. This is the practical significance of our existence as embodied and social beings. Through our body and our social belonging we participate in a world of causal powers and meanings we do not fully control. We are exposed through our body to the laws of nature. And we are born into a cultural world we largely take as given. In short, we are finite beings. Our finitude shows up in the Newtonian reciprocity of action and reaction. (Feenberg, 2010, p. 31)

People are influenced in their thoughts and social actions by the behaviours that designs evoke among their social peers. As social creatures we are influenced by what smartphone our peers choose. We expect others to abide by the behaviour regulating rules of machines we install in our 'technocology' like traffic lights (technocology is a relatively new term used to describe the linked up interdependencies of other technologies that new technologies require in order for them to operate as designed. Examples include functioning electricity grids to power a wide network of mobile phone towers that in turn need to be in place so that mobile phones can operate as they were intended and so on). My point being, in time we learn to accommodate

and automate how we ought change our behaviours around new technologies so that socially, we may live in sync with them. I call this stage of social accommodation as living with technologies that we have domesticated. In an affront to domesticated technologies in our lives, we are also exposed to new devices and systems for which we socially have yet to accommodate (I refer here to the social-psychology interpretation of accommodation, where people adjust, alter, even compensate their behaviours and reasoning as a cost benefit decision in response to a social intrusion or novel encounter. The more people accommodate the more they have developed behavioral pattern that normalize and accept the intrusion). If a design innovation enters the social space of a human group its uptake (its trend to being socially accommodated and domesticated), is more likely if the designer had mastered the necessary ethnographic 'tools' in the development of their designs. While this proposition may seem obvious, the serious and accurate use of techniques and theory to guide the process of gathering, filtering and translating necessary ethnographic information into effective design processes and products remains a weak area in most design and technology education programs.

Whether conscious of it or not, we are usually compliant to the made world around us: we normally choose to accommodate it. We learn to live in the context of our surrounding technocology and after a while of this, find our technocology to be rather invisible and normal to us, that is, until we move across into a new technocology context with many unfamiliar systems and expected behaviours. It is no surprise then how well established high-density urban human groups (city dwellers), view time, fashion and communication often quite differently to long established rural or remote groups (country dwellers). How cultures are different across contrasting social-material contexts is a branch of design anthropology that is rich with opportunity to grow knowledge and techniques for improving, at least the initial value, of new designs for such situations. For our increasingly connected and complex global societies, researching and designing with, and for, cultural and social groups, and forming good group personas, are design anthropology techniques that have become intensively interesting for designers (Bichard & Gheerawo, 2011).

These principles also help us better design ideas if our clients' products are to succeed in cross-cultural technology transfer processes such as from urban east coast Australia to remote desert and predominately Aboriginal communities in central Australia (Seemann, 2009, 2010). Similarly, workplace cultures and the technical systems with which they are meant to be productive, demand a critical method to assure those technical choices are indeed designed to achieve the cultural productivity a workplace seeks. The transformative effect that designing and working technologically plays in *self* and *artifact making*, is the basis to the view that Design Anthropology is concerned with "how the processes and artifacts of design help define what it means to be human" (Tunstall, 2011). The worlds that different human groups make gives clues to who they are, what they value and how they socially organize and innovate given the priming role played already in their own social-material histories.

DESIGNING FOR CULTURAL GROUPS AND HUMANIZATION

SUSTAINABILITY AND CULTURE AS TRUTH CONDITIONS FOR AN EDUCATION IN AND THROUGH DESIGN AND TECHNOLOGY

In the same way that anthropologists seek to learn how the wider resource context within which humans lived altered their social and material ways of life, Design Anthropology takes a deliberate interest in how the world we design and make, and our socialized relationship with it, is defined by the natural resource conditions upon which they are eternally dependent. This absolute constraint, that both humans and our designs must obey the ecological limitations that make our artifacts and us possible, establishes the truth condition that design and technology education is necessarily a study in sustainability. To diminish or exclude the systemic inter-dependencies between people, their ‘making of worlds’, and the ecological foundations that resource them, would give rise to a concern as to whether an education in design and technology has occurred. Understanding how different groups of people socially respond to, and exploit, their created and natural resource environments offers powerful frames for designing and making sustainable futures.

The assertion that sees humans, their innovations, and their natural and designed context as combined into necessary, rather than optional, interrelated systems is a key idea evident in Design Anthropology. The field is concerned often with how these three systems engage in mutual transactions where people, their made things or spaces, and their resource conditionality co-transform towards a co-dependent relationship with each other. In this systemic frame, Design Anthropology presents a rich new branch for educators and designers alike. It offers a way to both review the past, as well as design probable futures that inform the basis for sustainable choices in design and technology.

CONCLUSIONS

Design anthropology has been defined in this chapter as concerned with the interplay of social and material culture, and the role that the designed world plays in transforming human perceptions of the self, as well as of others. The feedback effect on cultural evolution caused by the very act of people socially engaging in the production and reproduction of their surrounding world offers a key point of interest to both educationists as well as design anthropologists. In the classroom, students don’t just make *stuff*, they make *themselves*, and along the way, they validate their newfound situational knowledge in *material* as well as *social* frames. No other area in the curriculum is so well placed to provide such a rich and wholly humanizing process of both the student and the object of knowledge, than a coherent education in design and technology. Design Anthropology is ideally placed as a scholarly and well-respected field to accompany a new and rewarding dimension to designing, learning and working technologically.

Designing, that purposeful effort to transform the perceived world, produces much more than an object or system. At the very least, the act of designing produces

our private subjective world. To the extent that we often design *for* others, or where others *encounter* the world we have transformed, as designers we are also in the thick of altering the subjective world of others. These propositions of transformation, however, are incomplete, for the world we transform in the act of designing necessitates we have something to alter – a natural or made ecology. Indeed, we exist *because* of that ecology, and through drivers of survival if not social norms, we are influenced by it in how we presuppose our next act of design.

From an ethnographic view point then, the act of designing in human societies is a socio-cultural act, that bonds people to others, influences their own sense of self as humans, and necessitates a domestication and transformation of the natural world about them. In short, designing and working technologically as a combined method is a humanization process that is heavily engaged in both creative as well as social production. This necessary social underpinning to the act of designing and working technologically raises many important ethical as well as social and epistemological questions that educationists and learner alike can explore. It is an experiential mode of social-material learning that invites designers to examine the way they *make meaning* and *validate applied contextual knowledge* from the social and material world around them. However, the cultural embeddedness of designing and working technologically for self and others, also invites a new chapter in Design and Technology Education Research: how our socio-technical actions are reciprocally tied to the truth of our ecological dependencies?

In a world where we are interacting with other cultures more, both in the workplace and across political geographies, learning and sharing cross-cultural design and technology knowledge can offer much needed new ideas to help humanity address pressing new design challenges

NOTES

- ¹ Examples of transnational companies that have been drawing on the expertise of design anthropologist to help use culture as a way of improving their products and service designs include Xerox PARC™ (Anthes, 1998, p. 74; Suires & VanDeVenter, 2012, pp. 289-310), Intel™ (Bell, 2014), and even Coke Cola™ and Boeing™ (Kirah, 2012, 2013).
- ² In human settlement research, the expression ‘community’ and ‘human settlement’ take on various meanings depending on the disciplinary origin of the researcher. In this chapter’s scenario remote desert ‘communities’ is interchangeable with remote desert ‘settlements’. In Ekistics theory, (the science of human settlements), a settlement refers to the whole collection of its occupants, its structures, its economies, its technologies, and its natural environment, among other entities. A settlement may include several human communities. However, remote small desert settlements in Australia tend to be of one language and place as an identity and as such may also be of one community.
- ³ For a range of design anthropology focus areas consider (Clarke, 2011 - See diverse range of technology genres addressed in chapters 8 (Automotive), 10 (Furniture), 11 (Textiles), and 14 (Digital); Parnell, 2012, pp. 121-123; Seemann, 2003, 2009, 2012; Turner, 2012)
- ⁴ It is suggested that the co-transformation thesis of object and subject, and the process of epistemic validation having to occur in the context of the objects intended application, presents a key framework to explore post/trans-human development via advances in biotechnology, genetic engineering, and bio-

engineering. In this case, the object transformed is validated *within* the bio context of the transformed subject. Trans-humanisation and related text include (Al-Rodhan & Palgrave Connect (Online service), 2011; Dickenson, 2012; Graham, 2002; Haag, Peterson, Spezio, & Ebooks Corporation, 2012; Hughes, 2004; McNamee, 2008; Petrina & Feng, 2006).

- ⁵ Marx Wartofsky's reference to "other" and 'thou' is referring to the world outside our mind, the natural world that we consume, transform and interact with both socially and materially that exists around us in our general environment.

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KAY STABLES

8. AGENCY AND UNDERSTANDING

The Learner as a Sustainable Designer

INTRODUCTION

This chapter focuses on how learners can be supported to utilise their design capability to take on the challenge of creating a world that has a chance for a more sustainable future. It begins with three premises. The first is that all human beings are born designers; that there is something fundamental about being human and being designerly in the ways that we go about our lives. The second premise is that in order to optimize the designer in all human beings we have to attend to how that capability is nurtured. My hunch is that when designerly capability is nurtured, human beings have a greater sense of well-being than they do if they are frustrated as a result of the lack of development of their design capability. Building from this is a belief that if all human beings feel that the designer in them enables them to make a satisfying contribution to their own and the lives of others, that society in general will benefit: that the well-being of the designer in each human makes for the well-being of society as a whole. The final premise is that, if this is to be achieved, the provision of design education for all children is critical. Moreover, this education needs to focus on the development of design capability in ways and contexts that allow children to grow into people who can take on ambitious and crucial projects that they recognise as having great social and cultural relevance; that they feel they can genuinely make a difference to the quality of people's lives.

The chapter begins by exploring these ideas, first by considering the ways in which human beings benefit both personally and emotionally from engaging in positive activity and how this relates to the designer in all human beings. Democratic notions of the designer are then developed further by linking in the 'made' world; the importance of making in the enterprise. Finally there is an exploration of how this potential can be developed through design and technology education that creates both agency and understanding. In all of this there is a critical link to the relationship between such an education and creating a more sustainable world by developing in the learner the ability to use their design capability to address issues of social and cultural relevance such that the challenges of sustainability become achievable through individual actions.

HUMANS AT THEIR BEST

The environmentalist Thomas Princen places a good deal of emphasis on the value and potential of individuals in making a difference for the future. He focuses, for example, on the benefits of engaging in a localised way with individuals and communities for positive actions that contribute to a future, more sustainable, world. He draws particular attention to the principle that human beings tend to be at their best, and possibly feel best about themselves, when they are proactive in contributing to and taking control of the world around them. In particular he describes humans as being at their best when

1. they are faced with a genuine challenge;
2. they are creative and productive;
3. they find meaning in their own problem solving and in acts larger than themselves;
4. they help themselves and help others;
5. they self-organize and self-govern;
6. they feel they are getting a fair shot at the benefits of their work.

Princen, 2010, p.175

These statements are seemingly simplistic but they have great resonance with how people feel in their daily lives. Princen sees these characteristics as evidence of what he describes as a human being as a “quintessential adaptive creature” – a fundamental aspect of being human that includes “the capacity to adapt to new and changing environments during one’s lifetime” (p.175). In considering our ability to adapt, he is highlighting the impact that employing that ability has on our well-being. The description of humans at their best also has resonance with ideas from quite different sources. In describing what he called ‘flow’, Csikszentmihalyi highlights the happiness people feel when immersed deeply in an activity and links this to the “best moments” that

usually occur when a person’s body or mind is stretched to its limits in involuntary effort to accomplish something difficult and worthwhile.
(Csikszentmihalyi, 1992, p.3)

These ideas also have similarity with those that Daniel Pink identifies as being critical in considering human motivation. Pink (2009) suggests that three elements are particularly important in this respect, these being autonomy, “innate capacity for self-direction” (p.90); mastery, “the desire to get better and better at something that matters” (p.110) and purpose “which provides the context” (p.134).

Others have highlighted our ‘adaptive’ ability as a critical element of being human. Bronowski (1973) refers to a human as the only creature “not locked into his environment” (p.19). He places imagination and reason as core attributes in this, and particularly our “ability to draw conclusions from what we see to what we do not see, to move our minds through space and time” (p.56).

Bronowski links our capacity to be adaptive and creative not just to our ability to imagine future scenarios that are different to our present realities, but also to our ability to create these future realities, including through our physical capabilities as makers. Bruce Archer clarifies this by providing definitions to point to key features here – of technology and of design. He begins with technology, stating that

one fundamental attribute of human beings – that is, one of the attributes that define creatures as being human – is that they devise and make tools, and use these tools to adapt their environments. If Technology is ‘knowing-how’, then Design is ‘envisaging what’. The capacity for envisaging a non-present reality, analysing it externally and modelling it externally, is the third great defining characteristic of humankind. (Archer, 1992, p.8)

Ken Baynes likens the human ability to design to the ability to use language. Building on Chomsky’s idea that babies are born with a Language Acquisition Device that creates a pre-disposition to develop linguistic skills, he suggests that humans also have a Design Acquisition Device – a “wired in pre-disposition to explore and change their environment” (Baynes, 2010, p.7). In highlighting this he is also highlighting the contribution all humans can make to designing our collective futures – that this is not just the territory, or even the ‘right’ of the “hero designers”. He sees designing in an ideal world as being a democratic practice in which “the designer is not a special kind of person: every person is a special kind of designer” (Baynes, 2010, p.25).

Linked with the positive viewpoint of Princen’s characteristics of when humans are ‘at their best’, we are offered a utopian perspective of both design itself and of the potential of designing in enabling the creation of sustainable futures. But while design might have the potential to ‘save the world’ it has also demonstrated its potential to destroy the world through the ways in which designers have paid attention to creating and feeding a consumer society that has resulted in a depletion of resources, a degradation of environments and massive inequalities in the ways that people can live their lives. Baynes reminds us of a more dystopian view of design when he comments that “designerly thinking – is one of the most dangerous of all human characteristics (Baynes, 2009, p.5).

Shannon (1990) also comments on the negative implications of the hero designer, highlighting the way in which the creation of designers as an elite group of experts has disenfranchised the rest of us from our role as active contributors to shaping positive futures. The general public become the passive recipients of the designed world, potentially the victims of the power of design. Keirl enriches the discussion further as he comments wryly

Our capacity to design and make sets us apart from other species although our capacity to head into the future uncritically may, in another sense, not set us so far apart at all!. (Keirl, 1999, p.79)

The need for the designer within us to engage more effectively with shaping a more sustainable future is highlighted by Tony Fry, captured in his statement referring to

how the future might unfold, that “as the necessity of futuring, there are two naked facts that unavoidably confront us: we have no choice, and we have no agency to call upon other than ourselves” (Fry, 2012, p.5). In reflecting on the ubiquitous impact of the designed world, he points out that we humans design things and, in turn, those things then ‘design’ us – we design the mobile phone and the mobile phone then designs the ways in which we operate in the world. Seeing more possibilities, we then re-design the mobile phone. This iterative relationship has largely taken us into a vicious circle of consumption. A better way forward would be replacing the vicious circle with a virtuous one – to design towards a future where, in Thomas Princen’s words, we all learn to live well by living well within our means.

The iterative relationship between the designer and the designed is captured in the concept of ontological designing. The concept is fundamental in considering how the relationship can move forward in a virtuous manner, and also in considering the role that all humans have to play in achieving this. The theory of ontological designing is outlined in the following manner by Anne-Marie Willis.

To begin simply, ontological designing is a way of characterising the relationship between human beings and lifeworlds. As a theory its claims are:

- that design is something far more pervasive and profound than is generally recognised by designers, cultural theorists, philosophers or lay persons;
- that designing is fundamental to being human – we design, that is to say, we deliberate, plan and scheme in ways which prefigure our actions and makings – in turn we are designed by our designing and by that which we have designed (i.e. through our interactions with the structural and material specificities of our environments);
- that this adds up to a double movement – we design our world, while our world acts back on us and designs us. (Willis, 2006, p.80)

CRITICAL CAPABILITY

The word design carries with it an embodied notion of intent, purpose and choice. If something is ‘designed’, then by definition it hasn’t happened ‘by accident’. So the act of designing, as is indicated in the description of ontological designing carries with it an understanding of the potential impact of the designed artefact or system. Dystopian views of design point not just to the negative impact of intended consequences of designing (such as machine guns) but also to unintended consequences – what could literally be seen as ‘thoughtless’ design. This is not to suggest that a designer can control the uses that anything they have designed is put to – as anyone who has ever opened a tin of paint with a screwdriver can testify. The concept of the “designer fallacy” (Ihde, 2006) – that there is “some degree of material neutrality or plasticity in the object, over which the designer has control” (p.121), can be seen in almost every major technological innovation the world has witnessed, as Ihde exemplifies through examples such as the phonograph, the typewriter and the ‘paperless society’.

But what a designer can do, is to do their best to conduct a ‘risk analysis’ in relation to the potential intended *and* unintended uses of the design. To design in this manner, to design thoughtfully, preparing for that ‘Aladdin moment’ that once a genie is out of the bottle – once a designed ‘thing’ is released into the world - it is nigh on impossible to control its use and its impact. Sennett (2008), referring to Pandora rather than Aladdin, makes a similar point when he points to the “fiction that opening the casket is a neutral act” (p.1). Managing this situation requires an understanding of both the designed ‘thing’ itself and the context in which it exists.

In tandem with understanding, and also highlighted in the previous section, is the importance of *agency* – the ability to take action, to consciously intervene to bring about a desired effect. The word agency carries with it a sense of control. Viewed from with the perspective of the Capabilities approach, promoted by Amartya Sen, agency is critical as a liberating force for an individual. He characterises a person with agency as

someone who acts and brings about change, and whose achievements can be judged in terms of her own values and objectives, whether or not we assess them in terms of some external criteria as well. (Sen, 1999, p.19)

The extent to which an individual is their own judge in terms of values is core to the Capabilities approach which, at its simplest, is presented as what a person can be (their values and beliefs) and what they can do (their actions). In qualifying what this means, it is useful to see how Sen sets passivity against action.

Need is a more passive concept than ‘capability’ and it is arguable that the perspective of positive freedom links naturally with capabilities (what a person can do?) rather than with the fulfilment of their needs (what can be done for the person?). (Sen, 1984, p.514)

Whilst Sen’s major area of focus is that of equity, freedom and development in an economics context, the idea of agency translates easily into a design context, for instance as given in the illustrative example provided by Fry.

To lose the ability to design is to lose everything. Here is the distinction between, for instance, the homeless who make a world for themselves from whatever they find on the street and those who totally abandoned their very being to its fate and reach their historical end. (Fry 2012, p.32)

What we can be and what we can do is, in Sen’s view, the basis of functioning as a human being. Fry presents a similar idea, but relates this directly to our human capability as designers.

The nature of our becoming by design... What it actually means is changing, by design, our relation to one another (our socio-political ecology), to object-things (and those loads of exchange upon which our existing economy and technosphere stands), and our perceptual field (how we see, know and feel). (p.37)

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His view is that this is what we need ‘to be’ in order for the world (and humans) to continue ‘to be’ – to exist.

In focusing on exercising individual, or personal, agency, neither Sen or Fry are promoting an egotistical perspective. Both link the power of individual agency when linked to social, cultural and political contexts. Speaking in the context of the economics of development, Sen goes further by saying that, to overcome world problems (such as poverty, deprivation etc) individual freedom needs to be seen as a social commitment (Sen, 1999). So, from the perspective of developing design capability, in which agency is enacted within a framework of social, cultural, environmental and potentially even political relevance.

Attempting to achieve both understanding and agency with learners in a formal educational setting is a challenge that will be discussed later in this chapter. But if the learner is to become a sustainable designer these ambitious goals becomes an imperative.

MAKING AND BEING HUMAN

Bringing the capability focus more directly onto designing allows us to also consider that when exercising *design* capability we are in the special arena of agency and understanding that links with our human ability as a maker – homo faber – and the duality highlighted by Archer of ‘knowing how’ linked to ‘envisaging what’, or what also might be presented as the hand and the brain. Fry highlights the importance of the relationship between the two.

We should understand that, in making a world, we largely made it by hand and, in doing so (from the perspective of ontological design), made ourselves what we are. Certainly, the development of our brain was crucial, but, without the capabilities of the hand, the brain was an agent without an actor. (Fry, 2012, p.47)

Writing nearly a hundred years earlier, A. N. Whitehead, in an essay making a strong case for what was then described as ‘technical education’, also highlights this critical relationship.

The connections between intellectual activity and the body, though diffused in every bodily feeling, are focused in the eyes, the ears, the voice, and the hands. There is a co-ordination of senses and thought, and also a reciprocal influence between brain activity and material creative activity. In this reaction the hands are peculiarly important. It is a moot point whether the human hand created the human brain, or the brain created a hand. Certainly the connection is intimate and reciprocal. (Whitehead, 1929, p.60)

Dating from even earlier that Whitehead, educators had been exploring this important connection through the development, initially in the Nordic countries, of educational Sloyd – an aspect of general education in those countries that still exists in the

present day. Uno Cygneus, seen as a founding father of Sloyd in Finland, spoke not just of the mind but also ‘the hand and the spirit work in concert.’ (Thorbjornsson, 2006, p.12). Kajsa Borg, writing about the early developments of educational Sloyd in Sweden, outlines how

The pupils were asked to make handicraft objects that were needed or could be used in their homes. The work was expected to train the children’s bodies and minds, and to support their cognitive development. The main purpose of the subject was NOT to learn the technical skills, but other aspects that were trained while working by hand, such as respect for manual work, seriousness and carefulness in any task or work.’ (Borg, 2006, p.38)

The holistic development of the individual through engaging in making, in whichever national context the curriculum has been set, has consistently focused on thoughtfulness in relation to the material and made world and it is not surprising that current Sloyd curricula, e.g. Sweden (Borg, 2006) and Iceland (Thorsteinsson & Olafsson, 2013) have a focus on the environment and sustainability. The complex and rich context for learning that making provides is further illustrated in the anthropological case studies Marchand has drawn from his research into apprenticeship in the vastly differing contexts of minaret builders in Yemen, mud masons in Mali and fine-woodworkers in London (Marchand, 2008). Describing the nature of the knowledge of the makers as embodied knowledge – “knowledge beyond language” including in domains such as “emotional, sensorial, spatial and somatic” (p.257) he describes the richness of learning through making as including

technique, worldviews and a set of guiding principles for ethical judgement; and in some cases, training encompasses devotional religious practices, the performance of magic and correct enunciations of powerful benedictions. (Marchand 2008, p 250)

A combination of the above perspectives of the value of making, the unique way in which making manifests in humans, the resonance with both the Capabilities approach and the concept of well-being and the important role it plays in both agency and understanding, it can be seen as a critical aspect of design capability. The intimate relationship between making, materiality our made world and sustainable futures highlights the importance of its inclusion in the educational experience of the learner becoming a sustainable designer.

THE LEARNER AS SUSTAINABLE DESIGNER IN THE CURRENT CURRICULUM CONTEXT

What does all of the above mean for Design and Technology education?

In discussing the publication of his book *B is for Bauhaus: An A-Z of the modern world* (Sudjic, 2014), Deyan Sudjic commented on the increasing importance of design that asks questions as much as design that offers solutions. He was referring

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particularly to what is a critical design approach formalised by the practice of Tony Dunne and Fiona Raby (2005). He also spoke with some concern about what he described as a generation of designers that have missed the experience of making, by which he is referring to physical making. For me, these two points jointly contribute to an important question – what of the next generation of ‘designers’? How should we frame the educational experiences of the next generation? Should we be focusing on the development of the critical designer, the thoughtful maker?

Commenting on the mass design that now populates our material world, Sudjic referred to the ‘Macdonalds of design’ – ubiquitous, palatable but not nutritious. This comment caused me to reflect on much of what is currently practised as Design and Technology in schools. Have we been providing the ‘Macdonalds’ version of a Design and Technology experience? If so, what would a more ‘nutritious’ version be like? In the earlier part of this chapter I have explored the concepts of well-being and designerly well-being; of a capability approach; a critical approach; the value of Design and Technology practice within the context of making; and, especially for sustainable futures, the importance of a Design and Technology education that is framed by social and cultural relevance. Seen through these lenses, how does current practice measure up? How might these lenses be used to inform future developments?

CURRENT CONCERNS WITH DESIGN AND TECHNOLOGY CURRICULA

In an analysis of a set of recent documents critiquing Design and Technology in the English education context (Stables, 2012), I highlighted key aspects of concern that were raised and also illustrations of where practice was seen to be at its best. The issues of concern indicated that all too often the subject was seen as too narrowly focused, too formulaic, spending too much time on tasks with little worth that led to undemanding and often unfinished projects. Too much of what was taught focused on inappropriate assessment, driven by a ‘teach to the test’ mentality. Where the practice was at its best, teachers had high expectations of learners, the subject provided ambitious and engaging projects that enabled learners to deal with major human issues through significant design challenges. The projects fascinated and inspired learners (Ofsted, 2011; Miller, 2011).

At a general level, the subject was seen to be enjoyable, ambitious or not, which could indicate the ‘Macdonalds’ tendency. There was also a tendency to view the curriculum under consideration as overloaded – highlighted in one of the reports being analysed by the comment “There seems to be too much in the DT curriculum to have time to reflect on the broader picture of Big Design.” (Miller, 2011, p.9)

Questions I posed as a result of this analysis included “are we prioritising the right things in D&T education?”, “does the curriculum need de-cluttering?”. While drawing on the English Design and Technology curriculum, there was a suspicion

of resonance in other national and provincial settings. My expressed belief was that the curriculum does need de-cluttering and that this could be achieved by a radical shift in priorities, away from lists of knowledge and skills to be learned and towards a focus on attitudes and engagement – towards a curriculum that first and foremost “sparked enthusiasm, passion, competence, confidence and pride” through engaging learners in challenging tasks that they considered to have social and cultural relevance – what might be seen as Big Design challenges, rather than Big Mac projects that fill a gap but in the end are not intellectually inspiring or satisfying. Such a shift links well to Sudjic’s comments about the value of a focus as much on design that asks questions as on design that offers solutions. If there is one thing that designing for more sustainable futures requires, it is a questioning approach, starting with a fundamental question of which problem of sustainable futures is the creation of yet more products the solution.

This is an area that has been explored by Leo Elshof (2006) in discussing the massive influence of the *product paradigm* on teaching and learning in Design and Technology Education.

The notion of a product paradigm stems from the fact that the conventional manner in which we have considered the role of products in the cultural life of rich, developed nations needs to be reassessed in light of scientific realities and in the paradigms that inform their production (Elshof, 2006, p.19).

With a concern for the lack of criticality that is brought to understandings of impacts of current production and consumption habits, Elshof makes the case for questioning and reassessing “the manner in which we teach young people about product design, development, manufacture, use, and disposal” (p. 19). In discussing problematic elements of the product paradigm, he poses the value of addressing the symbolic nature of products including the cultural perspectives that are embodied in products as “carriers of a worldview” (p.21). In presenting an argument for the development of an eco-product literacy he draws attention to the cultural lag of Western methods of production and consumption, in respect of their negative impact on environmental sustainability. Providing a learning landscape where products are analysed to understand the ways in which they are really addressing needs and wants – and whose needs and wants - he highlights the importance of developing an eco-product literacy that creates understanding of the impact of the production and consumption of products not just on the environment, but also on matters such as social justice and equity.

Throughout the historical development of what is now formulated in many parts of the world as Design and Technology or Technology Education, a core feature is designing and making products. Take away this activity and what does this do to the very identity of the subject? I have made a strong case earlier in this chapter for the importance of making, but questions need to be asked that challenge assumptions within the discipline. What is the value of making for the development of the learner? Is making always concerned with the physicality of materials? Is the result of designing always about the creation of a physical product? Exploring these ideas

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from an explicitly different worldview, that of Taoism, Flowers (1998) presents a more holistic perspective wherein the outcome is driven by the challenge, not the need to engage with a particular material.

the result of product design activities for technology students is that these students learn materialism to an extreme. They are taught that just because something can be invented or produced, it should be. They are taught that creatively designing products is a good thing, regardless of the outcomes. ... Maybe the solution to a problem would be a change in corporate policy, new legislation, a consumer education program, or changes in how a product is marketed. These are each examples of design, but it is a system, not a product, that is designed or redesigned. Maybe the best solution is non-action, and acceptance of the situation without change. (Flowers, 1998. p.21)

He goes further by exploring questions of consumption – when is enough, enough? Quoting from Taoist texts the concept that “[one] who knows that enough is enough will always have enough” (Lao Tsu, 1972, #46) he asks “Is the goal to achieve a sustainable future, or to keep accelerating? Are there enough designs? Is there enough technology?” (Flowers 1998, p.23). He suggests that if learners “know when enough is enough,” they can be liberated to explore outcomes more independently and thoughtfully. His wry comment on this is that

Students who are practiced in considering this wider range of alternatives will be better prepared to face the demands of global citizenry than those who merely make yet another CD rack. (Flowers, 1998, p.25)

MODELS OF LEARNING FOR SUSTAINABLE DESIGNING

Encouraging a critical approach to understanding production and consumption is not new in Design and Technology Education. This approach has been consistently explored and promoted in recent history, for example Petrina in the context of taking a political stance (2000); Layton (1992) and Conway (2000) in exploring ethics and values; Keirl (1999) in the context of citizenship and democracy; McLaren, with a focus on critiquing products (1997, 1999); Walker, with a focus on a spiritual dimension (1999); Pavlova in the context of social change (2005). With each dimension presented there is an implicit or explicit necessity for a shift in approaches to learning and teaching. If we want learners to be empowered to break from a current paradigm of thoughtless production and consumption to one where they are empowered with agency to make more critical approaches towards a sustainable future, then models of learning and teaching need also to shift from a default transmissional pedagogy towards one that is more transformative in approach. Drawing from the work of Freire and Macedo (1995), Pavlova (2013) presents a social emancipatory view of transformative education that promotes three approaches to learning and teaching

critical reflection (to identify the ways students' agency could transform society and their own reality); a liberational approach to teaching (facilitating cognition, problem posing and discussions); and an equal, horizontal student–teacher relationship. (Pavlova, 2013, p.660)

Linking critical reflection of the learner to the development of their sense of agency has resonance with ideas presented earlier in this chapter. The notion of developing agency through Design and Technology education is present in the forceful idea of taking action. Linked to critical reflection, we have the groundings of thoughtful action and critical capability, drawing on ideas of Sen (1999) and Fry (2012), as presented earlier.

Focusing learning and teaching in Design and Technology into contexts and activities that put learners into positions where assumptions are challenged, norms are questioned, their own worldview can be contrasted with that of others, can provide engaging springboards to 'intrigue and fascinate' learners. Balancing the understandings such contexts could create with creating agency to take positive action is vitally important. In exploring this idea with 'eco designers' and student Design and Technology teachers (Stables, 2009) the following comment, forcefully brought home this point.

they know that there's an issue around recycling and energy for example so you have to be really, really transparent about, "Yes. It is complex". ... And that is difficult because they're very young and ... you want them to be enthusiastic but you have to do that and find the right balance of the sort of agency and information – because too much information and too little agency is no good. And the opposite is no good either. (Stables, 2009, p. 214)

GLIMPSES OF POSITIVE SCENARIOS FOR DESIGN AND TECHNOLOGY EDUCATION

Section three of this book provides excellent examples of where a critical capability is being developed through balancing agency and understanding – where learners are encouraged to consider complex and challenging questions about the impact relationship between sustainable futures and design and technology. I would like to finish this chapter with a small case study from my own research – one that focused directly on positioning social and cultural relevance at the centre of a design and technology challenge.

The project formed the core of a very small scale pilot project that set out to explore the consequences and outcomes of putting learners' identification of meaningful design contexts at the centre of project work. The research started with giving 46 fourteen year olds a questionnaire that asked what they wanted to learn about in Design and Technology. The questionnaire contained 30 questions that ranged from designing transportation systems of the future, to designing that helped address issues of climate change, designing ways of addressing health issues and design

that could help create world peace. On the basis of the questionnaire responses, the learners were grouped into teams of four learners who shared common interests. Teachers then planned a one-day Design and Technology ‘enrichment’ day, where they set the teams the challenge designing for a world of the future, considering how lifestyles and technologies might change. Outcomes from the challenge ranged from designing that addressed issues of health and isolation by creating a website to bring communities together for social sporting activities to designing that focused on the tragic impact on bomb disposal experts of the death of bomb disposal dogs by creating comfortable, flexible, protective dog armour, to concept development ideas for using geo-energy to reduce climate change, for example artificial trees that suck carbon from the air and launching millions of tiny mirrors into space to reflect sunlight. Pondering the comment of Flowers cited earlier, all a long way off making yet another CD rack.

Possible more significant outcomes from the day were indicated by the learners through an evaluation questionnaire in which showed, for example, very high level agreement that letting the learners choose the design topics worked well, that they felt proud of what they had done, that the ideas were being driven by the learners, with teachers acting as support. Feedback from the teachers focused on the learning that took place – not of the knowledge learned, but of how to work in teams, how to communicate, how to learn independently and most significantly how the learners had learnt about themselves. They also commented on how the learners had surprised them with their maturity, their seriousness, the level of debate they engaged in.

The project was no more than a taster, but it gave welcome insight into how ready young people are to take on challenging projects where they feel a real commitment and where they feel they can make a difference to their world. One key consideration in engaging learners in challenges of sustainability is the very real impact that unsustainable practices will have in their lifetime. Just as there needs to be a balance between agency and understanding there also needs to be a way of engaging learners with issues without presenting either overly optimistic or nihilistic perspectives. The value of maintaining a balance of perspective is indicated in the much quoted comment of Donella Meadows (2001)

I’ve grown impatient with the kind of debate we used to have about whether optimists or the pessimists are right. Neither are right. There is too much bad news to justify complacency. There is too much good news to justify despair.

In the case of the young learners engaged in the pilot project above, they chose to address challenging, complex topics and they showed their capability in doing so. Their commitment and enthusiasm allowed them to show an unexpected level of maturity in treading a positive path. In doing so they surprised their teachers and possibly themselves. Along with learners presented through the case studies that follow later in this book they also gave clear indications of the readiness of young learners to become sustainable designers.

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9. POLICY FORMULATION AND ENACTMENT

Linked up Thinking?

INTRODUCTION

This chapter explores the challenges, issues and potential of Design and Technology Education as an active contributor in transformational change working towards a sustainable future. The focus is on the process of policy formulation, through translation, into practice and implementation in Design and Technology education in schools. Overall, the aim is to examine what is central to change, the key stakeholders, and what might be considered the inhibitors to enactment of policy and practice change.

Initially, more general consideration is given to what drives changes in policy and what is required in order to translate policy into practice. For changes in ways of thinking and being to manifest, with meaning and purpose, a more holistic interconnected systems-approach is required. Transformational change requires a shift in collective mindsets, a state change, and strategic changes that impact on processes and involve cultural change. By its nature, it is ambitious. Transformational change takes some time to enact and will never be a 'quick fix'. It aims to bring about change that is embedded and deep rooted. Transformational change therefore, requires more than issuing new economic, social, environmental, and educational policies. For transformational change in education, it is not enough to simply alter policy guidelines, or national curriculum guidelines, tinker with curriculum architecture and assessment regimes and offer a few professional development sessions for teachers. The traditional institutional, incremental, evolutionary changes that comprise the more common developmental approaches will not suffice.

Design and Technology Education (internationally known by various nomenclature; here D&T will be used) is commonly included in school curricula with a view to developing attitudes, skills and knowledge related to creativity, problem solving, communication, making (in the variety of fields related to design, engineering and technologies). Aims, and arguments, for the purpose and value for D&T in school curricula tend towards developing life skills and lifelong learning and employability skills, dealing with uncertainty and the pace of change encountered over time, and potential creative contribution of thinking and action-orientated individuals to society and economy.

The purpose and aims of D&T in the curriculum have developed from the original and more traditional skills and employment preparation of Technical Education, and / or the preparation for domestic duties through Home Economics, which tended to be at the root of the subject (s) in the early 20th century. These roots are still prevalent in some 21st century D&T education, while societies, economies and cultures have undergone phenomenal change.

To explore why the learning experiences for young people and the curriculum, as it relates to D&T, need to change the following questions are posed:

- What needs to be in place for D&T to actively contribute to the significant educational goal of attaining sustainable global futures?
- Who is involved in the development of D&T as an agent of critical and practical action for learners as global citizens with an understanding of ethical ways that are respectful of peoples, cultures and environments?
- What needs to be in place to allow D&T to demonstrate what it offers in holistic and integrative cross-curricular ways?

This chapter draws on an overview of the past 20 years of developments in one country, with the intention that the general principles can be transposed to the different states, constitutions and national systems of the readers. It examines the long term planning, linked up thinking, the process and players required for any aspirational, transformational change, in which D&T is situated, in order that policy formulated is indeed enacted.

WHAT DRIVES IMPETUS FOR CHANGE?

This section begins to explore the key drivers for change generally. More specifically, it considers the drivers for change in education systems, curriculum architecture, principles, values and content which manifest as changes in policy.

Generally change is thought to be required in relation to issues arising from cultural, social, economic, environmental and educational challenges, problems, ambitions or aspirations. This may lead to policies written from the perspective of party political ideologies and as a consequence such change is driven through by political mandate. There is a range of stakeholders, with vested interests, that influences core policies either officially or, maybe through less formal civic processes and possibly more subversive and insidious approaches. For example, lobbyists, activists, professional associations and institutes, unions, media, non-governmental organisations may work to encourage an alternative view of progress and aspirations for citizens, national and global. Whichever driver, or collection of drivers, drag or push for change, there tends to be a consensus of some sort and very rarely does change occur if a lone individual announces that change is needed and no one joins the call.

Christensen (1997), in the context of commercial, profit-seeking businesses, noted that many recognise innovations and the associated potential for change e.g.

in technologies, products, systems and methods. Yet, they prefer the status quo, as their current environment or business model does not facilitate or encourage early adoption. Change is disruptive when it has the potential to meet the unknown needs, fits new and emerging demands, perhaps not yet even identified, and is not a neat fit with any existing model. There may be the risk of diversion of resources and/or investment, which may alienate clients, customers and shareholders. This perpetuates incremental evolution and ‘sustaining change’, which maintains the relationships with the existing stakeholders/customer base by maintaining some familiarity and does not disturb the status quo. Christensen broadened the term ‘disruptive technologies’ to ‘disruptive innovation’ in order that it could be understood more usefully and adopted in a wider variety of contexts, specifically in relation to social change. Christensen, Baumann, Ruggles and Sadtler (2006) apply the term ‘catalytic innovation’ when disruptive innovation begins to receive a growing interest that results in an undercurrent of activity adopting the new technologies or systems or models and a sizeable momentum is generated. It is at this point the traditional thinking and ways of doing are then displaced/ disrupted.

At the level of various national governments and non-governmental agencies, the issues that are increasingly becoming apparent in the 21st century are related to social justice, climate justice, climate change, energy and resource access, the divide between rich and poor, digital communication networks, and access to basic human rights such as water, shelter, and education. These are, undoubtedly, big issues. It is becoming apparent that in order to address these, a different way of thinking and being is required. This demands a fundamental rethinking of systems and infrastructures that have hitherto developed incrementally in ways which, all too often, have fragmented, and become politicised. Once determined, policies for educational change may serve as the driver for change, but in order to be disruptive, or for ‘catalytic innovation’, they need to take root.

STAKEHOLDER CONVERGENCE

Central to change are the instigators, the stakeholders and the collaborators. The questions which may exercise the stakeholders with a view to instigating change may be as follows: Why bother? Will it make a difference? Who are we trying to change? What exactly are we trying to change? If we can change things, who will it impact on? Who has greatest influence in order to make this happen? Stakeholders, as prospective collaborators, may not always arrive ‘at the table’ with common goals, but they may, after discussion and debate, arrive at a consensus that change is worthwhile and meaningful. This can be transformed into a common will and the motivation to embark on change.

Aspirational and transformational change for education requires a number of key stakeholders to arrive at some consensus and support the enactment of change for all those directly involved and beyond. In brief, there needs to be (cross party) political will with educational, and community stakeholders’ agreement / ‘buy in’. The key

players of the community stakeholders are the teachers who will enact the change in practice, directly with their learners.

Hargreaves (1994) acknowledges the importance of involving teachers in educational change and recognises not only 'their capacity to change, but their desires for changes' (p11). In order to avoid imposed 'top down' change and ineffectual policies resulting in superficial tweaking of existing practice, or policies that remain in the abstract, inspiring little or no enactment, Hargreaves advises that attention is given to the individual teacher, in the collective of the teaching profession, and their personal *desire* for change. He examines change through the ethic of practicality, which guides teachers in their own context, culture and world view, their desire for improved experience for their learners and ultimately whether they feel change is of value or not.

Rost, Gresele and Martens (2001), in their model of the phases of integrated action, suggest that for the process of initial policy creation to begin, and for that policy to have some impact, a long-standing commitment from different providers and interested parties is fundamental. These stakeholders must all be willing to tackle the same identified issues and aspirations regardless of affiliations. Fundamental to the process of change is the importance placed on consensus of interested parties with motivation for change within and outwith government, be they statutory, non-statutory, voluntary, local or national stakeholders. There tends to be a convergence of various initiatives, from the bottom up, from the top down and, perhaps, a single key player who brings such stakeholders together for a collaborative and consultative phase of change. In summary, the phases of integrated action are as follows:

1. Motivation phase: Integration and information sharing from all players/stakeholders on board. Analysis of threat (perceived or otherwise); identification of the need for change, and motivational drivers for change; and consideration of what may occur if there is no change.
2. Action choice phase: Opportunities are identified & motive (s) are clarified. Where a goal oriented action can be identified (for example, to develop a more sustainable nation and increasingly aware global citizens through education, economy and cultural change) this tends to reaffirm the initial motivation by emphasizing the threat. This, in turn, reaffirms the conditions that might arise if *no* action were to be taken. This phase directs action and creates the set of objectives that will drive the volition and implementation phases. It may be necessary to accept some pragmatic and feasible ways forward and identify the timeframes that will be required for actions to be enacted, reviewed and developed before the goals (s) can be reached. If there is no suitable action identified as being relevant or possible, then the process of change will cease.
3. Volition phase: convergence and / or consensus of the will to take action (s) as agreed in the action choice phase.

4. Action implementation phase: Goal oriented action manifests in national strategic objectives and legislative acts, policy recommendations and targets, changes in practice, especially when opportunities arise and can be exploited.

The integrated action model acknowledges the time required for ongoing further commitment from stakeholders, the time for the change (s) to take root, to be adopted, adapted and to be embedded by an increasing number of participants.

COMMON ISSUES AND INHIBITORS ENCOUNTERED IN TRANSFORMATIONAL CHANGE

The importance of having key drivers for any change has already been mooted. What are the key elements that need to be established to stimulate and facilitate any transformational change and ensure the complexities are interpreted into meaningful, collaborative and authentic action in D&T? What needs to be in place to enable the potential contribution of change in terms of D&T reach our learners and have any impact or influence? What might be common issues and inhibitors encountered in transformational change?

As with all change, there may be ‘inhibitors’ that impact on the pace, direction, ethos and effectiveness of change to the detriment of those driving change. It may be possible to identify the potential obstacles in advance and others may have to be circumnavigated as encountered. Comprehensive and significant change, such as pedagogical and curricular reform, takes multi-agency effort and collaboration. Such reform can easily take a decade or more. In that time, it may be that the rationale for the change is lost, diluted or misconstrued. It is important, therefore, that the long- term benefits, values, and purpose of the change, are kept central and to the agreement of all stakeholders. When critiquing the process of change and examining why it often falls short of what is required with maximum benefit not achieved, Reform Scotland (2013) suggest the potential inhibitors (see [Table 1](#) below) can be addressed, through various carefully planned strategies.

JOURNEY OF CHANGE: AN EXAMPLE IN CONTEXT

An example of the long term nature of the journey of change through policy to enactment in practice, as related to D&T will be described through a broad-brush overview of the process as it is from one country, Scotland. It will focus on the process of change in policy and practice which embeds sustainability, education for sustainable development and global citizenship in governmental policies and practice for education, industry and society and in the school D&T curriculum.

Scotland is a small country with a population of approximately 5 million people. Scotland has remarkably few obligations and prohibitions relating to education contained in statute. The national (central) government has responsibility for the

Table 1. suggestions of potential inhibitors: general and in educational context

Potential inhibitors as they relate more generally to change <i>may include</i>	Potential inhibitors as they relate more specifically to change in the context of education <i>may include</i>
Elongated time for impact of change can breed apathy, loss of energy and enthusiasm;	Slow, inflexible systems -difficult to incorporate the change in educational targets, objectives, publically noted achievements and formal qualifications e.g. awarding bodies, university courses.
Too numerous, unachievable or demotivating targets may disenfranchise practitioners;	Management / practitioners unwilling to make changes to programmes of work and units, especially if they see no meaningful reason or potential improvement for learners; School inspection procedures perceived to be judgmental rather than acknowledging school priorities/helping with internal self – evaluation/review to stimulate improvements;
Bureaucracy, protocols, paperwork and officialdom are perceived to slow rate of change, lose momentum and may remove ownership from the practitioner;	Lack of resources to communicate and support the change in practice National examinations /high stakes assessment encourage ‘play safe’ approaches rather than incentivising innovation;
<i>Too much detail provided – no room for groundswell initiatives, no opportunities of freedom and flexibility unique to collective activism and localism of those involved</i>	Teachers feeling inadequately prepared for developing, planning and assessing new learning experiences; Lack of time to interpret and develop the required personal pedagogical content knowledge;
<i>Conflict of understanding e.g. relating to the reasons and purpose of change, resulting in stand-off, or personal dilemmas.</i>	Teachers feeling uncomfortable with the values and dealing with topics and controversial issues;

creation and review of the educational legislation, policies, and overall funding of the state educational system and for the curriculum for 3-18 year olds. [The current National Priorities are issued under the authority of Standards in Scotland’s Schools Act 2000.] Within this framework, the responsibility for enactment is assumed by 32 local councils. Since these local councils have responsibility for local educational budgets and they in turn devolve approximately 90% of the budget and management to their schools, and may be of different party political persuasions and alliances from those in central government, there is room for localised differences within

the overall principles. There is no mandatory ‘National Curriculum’. There is a national framework which comprises principles and purposes of education. National guidelines provide the experiences and outcomes that are considered to be the entitlement for all children and young people. Schools and teachers are given the professional responsibility for interpretation of the framework and guidelines into practice. Schools and teachers have the freedom to innovate. They are entitled, and encouraged to take professional decisions and make judgments.

A Journey Over Time: Policy Formulation

Over the past 20 years, there have been various ‘colours’ of government making decisions. The changes discussed here began under one political party, continued under a coalition government, and were further developed under a minority government. They are now (2013) fully accepted as having cross-party support. The key driver for this cross party ambition and aspiration for the citizens and for the future of the nation was for the country itself to be a responsible nation (within the global context), based on shared values with sustainability at its core - philosophically and structurally embedded. This required a national strategic approach at national and local level as related to changes in social, environmental and economic contexts, policies and practices.

Development work for the first national guidelines for education, for the learners aged between 5 and 14 years old, involved school teachers, initial teacher educators and local council education directors and officers on various curriculum development working parties convened by the Scottish Consultative Council on the Curriculum. This work resulted in the publication of 5-14 National Guidelines for all curriculum areas, with the first tranche focusing on English and Mathematics (SOEID, 1990).

During this time of curriculum development, a key signal for change came about with the publication of Agenda 21, adopted at the 1992 Earth Summit in Rio de Janeiro (United Nations, 1992 a & b) which called on governments to adopt national strategies for sustainable development. Agenda 21 put most of the responsibility for leading change on national governments, but stated that the national governments also needed to work in a broad series of partnerships with participation from international organizations, business, regional, state, provincial and local governments, non-governmental and citizens’ groups. The concepts and ideas from Agenda 21, Chapter 36, ‘Education, Training and Public Awareness’ (United Nations, 1992b) were adopted as the basis for the ‘Scottish Curriculum Guidelines for 5-14 Environmental Studies’ where Technology Education was placed in a cognate grouping of People in Place, People in Time, and Science (SOEID, 1993). The shared rationale was explicitly based on the development of knowledge, understanding and attitudes related to sustainable development, and the principles of environmental, societal, economical and ethical awareness, and consequences of actions.

Since the introduction of Technology Education to the Scottish school curriculum, there have been various editions of national guidelines for Technology Education e.g. 'Technology Education for Scottish Schools' (SCCC, 1996), 'National Guidelines for 5-14 Environmental Studies: Society, Science and Technology Education' (revised) (LTS, 2000), and 'Curriculum for Excellence (CfE) Technologies' (LTS, 2009a). They suggest the experiences and outcomes to which young people are entitled. Education for sustainability is given a central role. For example, 'Technology Education in Scottish Schools' (SCCC, 1996:12) described 'technological sensitivity' as an aspect of technological capability which is about having a habit of mind which asks questions about, and reflects on, social, moral, aesthetic and environmental issues, as well as technical and economic aspects of all technological activity. Teachers are to encourage learners to apply considered moral and ethical judgements in evaluating technologies and to appreciate that technological developments have consequences for people, society and the environment of the world. 'The National Guidelines for 5-14 Environmental Studies: Society, Science and Technology Education' (LTS, 2000) promoted developing informed attitudes of learners through the consideration and critique of consequences of actions proposed and of those taken. This included recognition of the provenance of resources and materials, and energy transfer, used in design and make activities. Generally learners were to be more aware of the full lifecycle of a product from inception through manufacture, transportation, marketing, and use to waste/disposal. Teachers were to help learners appreciate that although technological solutions may be acceptable to some they may be unacceptable to others (LTS, 2000: 76).

In 2002, the Scottish Government instigated a 'National Debate to examine the purposes and value of education for 21st century. The 'National Debate on Schools for the 21st Century', drew on a wide range of responses and consulted with representatives from many sectors, public and private, informal and official associations, groups and individuals, and aimed to identify what was considered to be the value and purpose of education, and what was hindering progress and social equity. This ran concurrently with a review of the whole educational system in Scotland (SEED, 2002; Munn et al, 2004). As a result there was a reformulation of the entire curriculum, including curriculum architecture, for 3-18 years olds. One of the first things to be addressed was the over-crowded nature of the curriculum and the need to limit the teaching of curriculum 'subjects' in silos, disconnected from other 'subjects' with little consideration of the way the world 'works' and the nature of interconnected systems thinking and holism generally. The value of interdisciplinary learning was acknowledged. Greater emphasis was also to be placed on interagency working, and a linking up of the plethora of educational initiatives. So, a significant rethink of the purpose and value of education began (Scottish Executive, 2004 a & b).

As the discussions, consultations and debates of the Curriculum Reform working party proceeded, significant events and publications filtered through from beyond the educational sphere. For example, the launch of the UNESCO Decade of Education

for Sustainable Development (2005-2014) was met at ministerial level with a commitment to Sustainable Development Education (SDE) evidenced in ‘Choosing our future: Scotland’s Sustainable Development Strategy’ (Scottish Government, 2005) which emphasised that learning for sustainable development should be a core function of the formal education system. Within ‘Choosing our future’ are clearly articulated statements with particular relevance to Technology Education (e.g.13.9; 13.13).

Education is directly linked to health and wellbeing, prosperity and economic security and this is further developed with ‘Learning for our Future: Scotland’s first action plan for the UN Decade of Education for Sustainable Development’ (Scottish Government, 2006b) and later ‘Learning for Change Scotland’s Action Plan for the Second Half of the UN Decade of Education for Sustainable Development’ (Scottish Government, 2010c), which advance six principles of SDE, namely:

- *Interdependence* – appreciating the interconnectedness of people and nature locally and globally;
- *Diversity* – valuing the importance of cultural diversity to our lives, economy and wellbeing;
- *Carrying capacity* – acknowledging that the world’s resources are finite and the consequences of unmanaged and unsustainable growth are increased poverty and hardship, and the degradation of the environment, to the disadvantage of all;
- *Rights and responsibilities* – understanding the importance of universal rights and recognising that our actions may have implications for current and future generations;
- *Equity and justice* – being aware of the underlying causes of injustice and recognising that for any development to be sustainable it must benefit people in an equitable way; and,
- *Uncertainty and precaution* – understanding actions may have unforeseen consequences, encouraging an informed and cautious approach to the welfare of the planet and its inhabitants.

These principles of SDE are embedded within the wider principles of developing global citizens and are essential across learning themes. They feature throughout the curriculum documentation that is used to inform and frame teaching and learning experiences.

This aspiration and ambition for national change established a radical new education framework and was the intent of the curriculum reform, but an education reform alone would not provide the transformational change required. The national priorities, aims and strategic objectives of the Scottish Government, and the on-going developments were being reviewed and evaluated. In summary, this resulted in the ‘Government of Scotland’s Purpose and Strategic Objectives’ (Scottish Government, 2007a). Five core national objectives are to develop a Wealthier and Fairer; Smarter; Healthier; Safer and Stronger; and Greener Scotland, and these are to be achieved within a low carbon economy. The National Outcomes (2007b) and targets are the

responsibility of various directorates and stakeholders. For educational reform this meant cognisance of, and links to, the overarching National Priorities (2000).

The Players on the Journey: Collaborators and Key Stakeholders

Developments in Scotland, drawn from the process of policy formulation through to enactment, specifically related to Learning for Sustainability (LfS) suggest that the central collaborators and key stakeholders of educational change are:

- National Government and related committees, government directorate, responsible for developing and progressing the strategic national core objectives for education, environment, health and economy and formulating policy;
- Local Government councils, Education committees, Directors of Education and Quality Improvement Officers; local council education employees - Head Teachers, Senior Management Teams of schools, teachers and school community more generally;
- Education Scotland – a key national advisory agency, responsible for quality and improvement in education, writing, reviewing and supporting curriculum guidance, continuing professional development (CPD) includes Her Majesty's Inspectorate in Education (HMIe);
- General Teaching Council of Scotland (GTCS) - an independent body who create standards/ benchmarks for professional registration, responsible for accreditation of initial teacher education (ITE) programmes, registering eligible teachers, determining entry to teaching degrees and qualifications; supporting practitioner enquiry / research, career long professional development, upholding professional standards;
- Teachers
- Universities – Education faculties, in their design and provision of ITE Programmes; research, dissemination and knowledge exchange; partnerships in developing curriculum, supporting resources, provision of CPD courses and programmes (credit bearing and non-credit bearing); further partnerships with faculties beyond ITE;
- Certificate Awarding/Examination Body, Scottish Qualification Authority (SQA) for all senior phase National Qualifications.
- Third sector agencies/ non-governmental organisations (not-for profit) such as World Wildlife Fund (WWF), eco-schools, Christian Aid, John Muir Trust, Development Education Centres, Planning Aid Scotland, Co-operative, Ellen McArthur Foundation, Grounds for Learning;
- Professional Associations and Institutes e.g. Royal Society of Edinburgh recommends that the Scottish Government and SQA use the revision of Higher and Advanced Higher courses (senior stage certificates) as an opportunity to embed education for sustainability and global citizenship throughout the secondary school curriculum (RSE, 2011).

- Teaching Unions;
- National Parent Forum;
- Future Employers;
- Colleges and Universities – as part of the continuum of education for students, with interest in entry qualifications and achievements, and prior experiences;
- Educational consultants and CPD providers; and
- School Learners and student council - the children and young people.

The role of some of these key players will be exemplified as the illustration is developed further.

FROM POLICY TO CURRICULUM FRAMEWORKS AND GUIDELINES FOR DESIGN AND TECHNOLOGY EDUCATION

The resultant national framework for 3-18 year olds, ‘Curriculum for Excellence’ (CfE), describes the purpose of education as being the development of four capacities and dispositions of children and young people, for example, being a responsible citizen (Scottish Government, 2006a). Global citizenship, and with it SDE, is a theme across learning, to be embedded by all practitioners at all stages, and in all learning areas. Each of the eight curriculum learning areas, of which Technologies is identified as one, is designed to contribute towards the development of the overall purposes and values of education through its own disciplinary contexts and through connections with other learning areas. The principles and purposes (i.e. the rationale) of CfE Technologies (LTS, 2009a) state explicitly that this learning area is about the development of responsible citizens, examining and debating the issues of sustainable development from an informed perspective. CfE Technologies also provides a framework for ‘Technological Developments in Society’ as a context for developing technological knowledge and understanding in direct relationship to sustainability. The summary purposes of CfE Technologies are to enable learners to:

- develop an understanding of the role and impact of technologies in changing and influencing societies;
- contribute to building a better world by taking responsible ethical actions to improve their lives, the lives of others and the environment;
- become informed consumers and producers who have an appreciation of the merits and impacts of products and services;
- be capable of making reasoned choices relating to the environment, to sustainable development and to ethical, economic and cultural issues. (LTS, 2009a).

The educational entitlement for all learners is that they should have active curricular learning experiences that develop their understanding of the interrelationship of environment, society and economy and equity, of the ecological limits to development and the interdependence of ecological and human well-being. Teachers and learners

focus on learning activities which are supported by a framework of ‘experiences and outcomes’ CfE Technologies (2009b) such as:

- I can investigate the use and development of renewable and sustainable energy to gain an awareness of their growing importance in Scotland or beyond. (*approx 7-11year olds*)
- Having analysed how lifestyle can impact on the environment and Earth’s resources, I can make suggestions about how to live in a more sustainable way. (*approx 7-11year olds*)
- From my studies of sustainable development, I can reflect on the implications and ethical issues arising from technological developments for individuals and societies. (*approx 11-14year olds*)
- I can examine a range of materials, processes or designs in my local community to consider and discuss their environmental, social and economic impact, discussing the possible lifetime cost to the environment in Scotland or beyond. (*approx 12-15year olds*)
- I can practise and apply a range of preparation techniques and processes to manufacture a variety of items in wood, metal, plastic or other material, showing imagination and creativity, and recognising the need to conserve resources. (*approx 11-14year olds*)
- I can debate the possible future impact of new and emerging technologies on economic prosperity and the environment. (*approx 14-15year olds*).

The CfE guidelines make direct links with other learning areas of the curriculum to encourage recognition of the mutually supportive and cross platform relationships within the overall framework. For example, CfE Sciences (2009c) suggest that 7 to 11 year old children explore ‘non-renewable energy sources and should be able to describe how they are used in Scotland today, and express an informed view on the implications for their future use’ with progression to ‘investigating renewable energy sources and taking part in practical activities to harness renewable energy sources, and discussing their benefits and potential problems’ for approximately 11 to 14 year olds.

All Qualification Development teams for new Scottish Qualification Authority (SQA) award-bearing certificate courses, for post 15 year olds, from 2013 onwards, were obliged to incorporate the underpinning rationale of CfE. The SQA acknowledged the role that qualifications play in raising awareness and deepening understanding of the need to focus learning for sustainability. The new qualifications have been developed with the key principles of SDE explicit in the majority of the courses, particularly in the new certificate courses for Technologies (SQA, 2011; 2012a,b,c).

Working Towards Change: Enabling Policies and Complementary Initiatives

Developing concurrently with the educational reforms led by the education directorate, were initiatives driven by other government directorates (Enterprise,

Employment, Waste, Energy, Planning) e.g. zero waste (Scottish Government 2010b), fair trade, sustainability in transport, building and procurement as evidenced in strategic policies with some resulting in acts of parliament, others as recommendations and non-statutory guidelines. For example, those linked to education include the Climate Change (Scotland) Act (2009) with commits to reduce Scotland's emissions levels by 80% by 2050 and 'Schools for the Future Programme' where projects must follow the principles of 'Building Better schools' and 'Building Research Establishments Environmental Assessment Methodology' (BREEAM). Under the Scottish Government's Sustainability Labelling policy a non-technical guide is to be available for all new schools to allow learners, teachers and other school occupants a better understanding on how to control their internal environment in an energy efficient manner. These policies are complemented by others such as investment in renewable energy and power generation technologies, apprenticeships and employment (Scottish Executive, 2003). There are Government Training and Employability incentives which are geared to raise awareness of the skills, knowledge and attitudes required to be able to contribute towards the process of change in society. These are being given a high profile in schools through the 'green sector careers and the renewables energy economy'.

In summary, with the range of cross party Government policies as described above, driven from internal, national and external, international factors, the enabling policies are now in place. These include the various education policies which state the explicit purposes of the curriculum and create the overall curriculum framework, namely CfE for 3-18 year olds (in development from 2002-2014), which requires all teachers to adopt an across-learning theme of Global Citizenship and Sustainability (Scottish Government, 2008) and also describes the distinctive contribution of D&T through the CfE Technologies learning area. CfE Senior Phase SQA Certificate courses for Technologies (implementation from 2013) embed cradle-to-cradle, design for sustainability, critique of impact, and examination of issues of resource stewardship in the mandatory syllabus content.

Further endorsement of the importance placed on SDE is evident through the publication of the Revised Standards for Registration and Standards for Full Registration (GTCS, 2012). This publication states that it is 'a whole-school commitment that helps the school and its wider community develop the knowledge, skills, attitudes, values and practices needed to take decisions which are compatible with a sustainable future in a just and equitable world.' These Standards require all teachers to be confident in their knowledge and understanding of the challenges facing society locally and globally and through learning for sustainability (LFS), teachers are to actively embrace and promote 'principles and practices of sustainability in all aspects of their work.' Further to teachers themselves displaying a commitment to, and sharing values of, learning for sustainability', Donaldson's 'Review of Teacher Education in Scotland: Teaching Scotland's Future' (Donaldson, 2011) includes revision of all initial teacher education courses, whereby Learning for Sustainability must be embedded in the revised / new programmes to gain

accreditation from the GTCS. The recommendations from the One Planet Schools Working Group (2012; Scottish Government, 2013) for Learning for Sustainability, has been further validated Outdoor Learning, Citizenship, Fair Trade schools, Rights Respecting schools, Youth Parliament, co-operative and social enterprise initiatives, etc. and greater value is now placed on recognising wider achievement. Together these policies have generated increased opportunities for learners to engage and take responsibility as active, global citizens and ESD/LfS has gained higher visibility and interest from learners and teachers.

TRANSLATING ENABLING POLICIES INTO PRACTICE

These enabling policies create the landscape and contribute to the window of opportunity within which developments in DT practice manifest as learning experiences for young people and children. D&T teachers are free to interpret and translate them into principles and ideas in their classrooms. Although McNaughton (2007) notes that it is less evident that such policies, principles and strategic frameworks for SDE in schools have been translated into practice, Grant and Borridale (2007) observe that there is some evidence of increased integration of the issues of sustainability in general school ethos and project planning with an environmental emphasis. However, this has, in the main, been through participation in the eco-schools initiative which takes environmental issues as the central driver, although more recently social and economic issues are also explored through global citizenship aspects of the eco-school programme. Eco-School Scotland website figures state that, in January 2013, 98% of all Scotland's local authority schools have registered (i.e. over 3,700 schools) with 46% achieving the highest status award of 'Green Flag'. There is much to critique related to eco-schools, and yet it has become a useful springboard for those who do recognise the limitations (e.g. the checklist and competitive mentality that it can create) at the cost of the intended values development. Such schools tend to develop practice beyond the 'colour of the flags' awarded for completing the activities on the scheme's checklist. Examples include eco-school groups who have campaigned to have transportation routes altered and to reduce private car use in relation to the 'school run' redesign of school grounds to maximise outdoor learning opportunities; involvement in new school designs; becoming politically active in exposing energy in-efficiency and school building fabric/estate issues; community outreach; and, fair trade enterprise partnership projects. To be successful, these approaches require more than the lone enthusiast teacher providing the opportunities for learners to collect awards for the school. These tend to be possible where sustainability and citizenship is embedded in whole-school systems thinking, or at the very least are driven by a collaboration of learners, teachers and community members. However, for those eco-school groups who cannot grow their collective mind-set further than the litter picking, putting recycling systems in place, and 'passing inspection', the eco-schools scheme remains limited and is rendered less helpful in the journey to transformational change in policy through to enactment.

D&T has a valuable role as part of the whole school ESD approach. The imperative therefore is to adopt sustainability as a frame of mind for a sustainable future. McLaren (2010) notes the need for personal dispositions to be examined and for D&T teachers to recognise the factors which enable or hinder their own willingness and readiness to engage in less familiar arenas of D&T, such as design for sustainability or concepts of the ‘circular economy’. Pavlova (2012) sets an agenda for further research and development. A clear and explicit articulation of the contribution of D&T to the curriculum may create the ‘desire’ that Hargreaves (1994) suggests is critical to teachers’ enactment of policy into practice. A well-defined set of principles, purposes and values describes the ‘elements’ teachers can incorporate in their planning to ensure the contribution is developed beyond rhetoric. In brief, through D&T, learners are to be enabled to:

- Recognise and develop their creativity and enterprising nature;
- Apply designerly thinking through action based challenges which explore issues and opportunities, seeking to address design challenges which offer engagement to enhance, alter, change, innovate;
- Recognise the integration and inter-dependency of people, place, culture, society, economy, industry, and environment through craft, design, engineering and developments over time;
- Critique consequences of proposed and / or existing actions, systems, environments and artefacts;
- Acknowledge value judgments, examine consequences- environmental, climate, economic, technological justice;
- Experience opportunities for direct interdisciplinary learning which links designing, making and critiquing authentically with thinking about sustainability principles in products, systems, buildings and landscapes and citizenship;
- Experience learning which involves partnerships with third-sector and non-governmental organisations and agencies working on real world global challenges;
- Design for sustainability adopting principles such as ‘cradle-to-cradle’, ‘made to be made again’, and concepts such as ‘waste = food’, ‘nature as teacher’, ‘material cascades’
- Participate in meaningful and authentic contexts;
- Identify complexity, issues and scenario-based design challenges;
- Recognise and select indigenous and appropriate technologies;
- Debate controversial issues and discuss contemporary topics.

For the policies to be interpreted into meaningful and authentic practice which incorporates the above, it is important to recognise what works and what does not, and what needs to be in place to stimulate, enhance, and grow effective enactment. In order to add to the growing evidence base (e.g. specific to DT: Pavlova and Turner, 2007; Elshof, 2009; Pitt and Luben, 2009; Elshof, 2009; Pavlova, 2012) regarding such matters and identifying enhancers and inhibitors, and also the positive benefits of learning for sustainability relating to attainment, achievement, health and

wellbeing and behaviour, the United Nations University has accredited a Regional Centre of Expertise in Education for Sustainable Development for Scotland. This will research and generate innovation through collaborative work between practitioners, academics, government and civic society.

With so many pieces of the policy jigsaw now finally revealed, after many iterations, permutations, consultations, and analysis over the past 20 years, the collaborators and those who were bystanders are now charged with the challenge of translation and implementation of the DT curriculum within the policy frameworks discussed here.

CONCLUSION

National drivers for changes to policies, educational and otherwise, tend to arise from issues with resources, food and energy (sufficiency and reliance), social care and health, industry and economy (with related emergent employment and careers), climate justice, social justice, and education. A strategic national approach for any change to policies needs to have support from the major bodies and players, who in turn will accept the need to set priorities in order to achieve a significant step change or indeed more transformational change. Drivers and stakeholders motivated towards change must recognise, and access, the mechanisms and opportunities at their disposal to drive the agenda forward in a strategic way. They use these and networks to create the shared responsibilities and acknowledge the contributions required to be made through distributed leadership in order to have greatest impact and influence.

Leicester, Bloomer & Stewart (2009) suggest that for transformational change to be possible the worldviews of those involved in creating the reconfigured learning experiences of practice are highly influential. Convergence of community of place with community of interest has the potential for the greatest impact for change to be enacted. Leicester et al. suggest that when educational change is considered to be wholly politically motivated no traction will be gained from the public, or the teaching profession. Leadership is a significant factor for success through enactment, but the role at the centre needs to be strategic and not one of micro- management. Over-centralisation can lead to a climate of compliance and conformity, limiting the range of approaches taken. Even when the original intention is specifically to empower practitioners at a local level and to encourage diversity to suit the context of learners, if the message or policy is not shared, the result can be that of excessive standardisation. As a result, teacher self-confidence can diminish. By encouraging localised change (individual or department or school context, or indeed local authority) there will be varying rates and parallel processes of change. Schools can develop their own ideas within their commitment to reform and, in their own way, encourage as high as possible proportion of engagement with the whole community. Although compromise may be inevitable, for policy to be enacted it is important that the distributed leadership and personal practice avoids compromise that loses sight of the underlying principles and purposes. Those need to remain consistent.

The planning and implementation of teaching, learning and assessment is in the hands of those who recognise the opportunities for change and work together with shared ambition and aspiration to make these feasible and realistic enough for implementation. This requires incorporation of the principles of the policies and motivation for change to be embedded in the educational culture, ethos of school community, and the framework and curriculum experiences for all young people. Early adopters who explore and innovate can serve as learning for others. They can help refine and act as reviewers and evaluators allowing others to benefit from their experience.

However, the pace of change should not proceed so slowly and in such a dissipated way as to lose the central concept and purpose for the change (s). If the pace is driven from centre, and a time line imposed, then there is a risk that policy may be perceived as ‘an event’ rather than a journey. Over the past 50 years Scottish education has undergone a series of policy-driven changes. Some have been essentially structural, but most have been concerned with curriculum and teaching methodology. Although acknowledging the extensive experience of policy driven change in education, the Commission on School Reform (2013) observe that the changes have not all been entirely successful. Those policies that created an environment that empowered those at school level to be innovative as part of daily practice allowed change to be better grounded, less burdensome and as a consequence, more rapid. This serves as a reminder of the importance of securing the buy-in from key stakeholders particularly teacher practitioners who are closest to where the impact on the learner takes effect and who can influence practice directly and immediately.

Times of transition and change create a sense of discomfort for many. Demands are made on existing knowledge and understanding, values, attitudes and world views. Change in education and curriculum requirements, society and learner expectation often require changes in pedagogy as well as content and learning experiences. Design and Technology teachers are being challenged to incorporate 21st century concepts of design for sustainability, appropriate technologies and democratic design.

This chapter has outlined, in summary, the changing purposes, expectations of the curriculum, policies and educational initiatives. It has attempted to describe some prevalent aims, aspirations and mindsets required for a 21st century Design and Technology education. Clearly, for a shift in classroom culture and traditional practice to occur, some serious reflection and action is required. The illustration adopted in this chapter shows the complexity; offers a caution of the time and effort required; and witnesses the importance of collaborative participation and empowerment of those who are charged with taking action with the support of the broader stakeholder consensus.

There are many who write about education for sustainability and D&T education. The majority seem to focus on the *why* things should change, not necessarily the *how* to affect change in D&T education. Although the process of enactment has begun, further support is required to enable the teachers to deal

with transformational and relational learning, complexity and trans-disciplinary thinking, whilst recognising and valuing the unique disciplinary contribution of D&T as a specialist learning area.

In conclusion, there is recognition, in policy at least, of the great potential for authentic D&T Education when it embraces the importance of education for, in and about sustainability. What does it take to move from the rhetoric to reality; to move from the policies to embedded practice? Time will tell, but the shoots are a healthy looking shade of green.

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10. AGAINST NEOLIBERALISM; FOR SUSTAINABLE-DEMOCRATIC CURRICULUM; THROUGH DESIGN AND TECHNOLOGY EDUCATION

The *educational* point of the public school curriculum is *understanding*, understanding the relations among academic knowledge, the state of society, the processes of self formation, and the character of the historical moment in which we live, in which others have lived, and in which our descendants will someday live. It is understanding that informs the ethical obligation to care for ourselves and our fellow human beings, that enables us to think and act with intelligence, sensitivity, and courage in both the public sphere – as citizens aspiring to establish a democratic society – and in the private sphere, as individuals committed to other individuals. (Pinar, 2004, p. 187)

Children born around the beginning of this Century, now at school, have futures of a most uncertain kind. The qualitative range of scenarios is formidable. Any curriculum today has a duty to serve all children well wherever they are on the planet. The curriculum that serves only a localised group of children is both a selfish curriculum and one that disempowers those children it purports to serve. For its contribution, Design and Technology (D&T) has a comprehensive role to play for *all* students *everywhere* (rather than a restricted role for only some students). In a related chapter I have talked of the learner-Bildung relationship working for the common good of both the student and the (global) community. I have also argued the ethical inter-dependence of sustainability, democracy and education - that they speak *to*, *for*, and *of*, each other ethically. To move from an ethical framing towards practical action in education calls for curriculum considerations. In this chapter I argue a case against the current dominant neoliberal ideology and try to show how D&T, while enmeshed in that agenda, can also act to subvert it by working towards a sustainable-democratic D&T curriculum. This begs serious questions for curriculum designers but most especially for teachers.

EDUCATION AND NEOLIBERALISM

Curriculum cannot be understood as something apart from its socio-political context so it is necessary to describe something of that context. In particular, the aggressive

Western global agenda being advanced warrants attention because of its influence across sustainability, communities and education systems alike. Once this dominant agenda is critiqued, it becomes possible to (re)consider Design and Technology curriculum's potential for shaping sustainable global futures.

The marriage of industrialism and capitalism over the past 200-plus years has cost the ecosphere deeply. The mid-20th Century saw Leopold (1949) and Carson (1962/2002) articulate serious environmental concerns. Since the 1970s, the concepts of 'sustainability' and 'sustainable development' gained currency with the latter now recognised as operating across four domains – the ecological, the economic, the political, and the cultural. Thus, holistically understood, 'sustainable futures' must accommodate multiple, interdependent domains. To address only one domain is to negate the others.

Concurrently, since the 1980s we have witnessed the development of ever more radical forms of capitalism described in such intentionally benign language as the 'market economy' (after Galbraith, 2004/2005) and accompanied by the seemingly innocuous 'knowledge society' and 'lifelong learning', but nonetheless driven by central motives of growth and profit. The 1990s witnessed the advent of globalisation, initially understood as an economic phenomenon but now accepted as being multi-faceted (Ong & Collier, 2005).

Also since the 1980s, the minority Western world has driven the neo-conservative or neo-liberal project with its particular brand of capitalist imperialism, that is, a singular and aggressive form of capitalism designed (sic) to be the 'right' one for all nations to adopt. ('Nations' is a multivalent concept here, being variously used to refer to governments, geographical delineations, collectives of people/cultures, and so on. Globalisation in its various forms is testing the concept of the nation quite severely.) Under neo-liberalism the 'market' and market values are paramount and a global monoculture is the aim. Here, environments, cultures and alternatives come under threat. Privatisation is to replace (public) ownership-in-common, governments' capacities to control economies or state interests are weakened, price controls evaporate, and public voice or criticism is marginalised. Ominously, any activity or organisation operating on principles of altruism, community or cooperation is deemed a target for criticism and derision, if not destruction.

Giving Democracy a Bad Name

What has also been engineered is a conflation of the term *democracy* with a particular interpretation of economics in order to colonise political systems to the ends of exploitative profit-seeking and cultural suppression. Once this conflation is established it makes it harder to argue against the economic-environmental case without being accused of being 'against democracy'. Especially important to question are the languages and codes (readily promoted by compliant media) used to reposition all people as consumers rather than as citizens. Under such powerful

conditions any care we might have for an ethically grounded triad of democracy-sustainability-education is seriously tested.

For neoliberals, the world in essence is a vast supermarket. “Consumer choice” is the guarantor of democracy. In effect, education is seen as simply one more product like bread, cars, and television... Thus, democracy is turned into consumption practices...the ideal of the citizen is that of purchaser. The ideological effects of this position are momentous. Rather than democracy being a *political* concept, it is transformed into a wholly *economic* one. (Apple, 2001, p. 39)

From an outsider’s perspective, failing to understand the history of this democracy-market conflation to which the Western populace has been subjected could reasonably lead to the conclusion that ‘democracy’ is a bad thing. By association, neoliberalism’s attempts to re-model the world in its particular image and doctrines also heightens concerns for democracy’s co-dependents: education and sustainability. In these neoliberal circumstances, democracy is corrupted, education is corrupted, and none of the four domains of sustainable development is sustainable.

Neoliberalism’s effective promulgation depends on a combination of blunt rhetoric, subtle influence, and manipulation via a compliant media as well as through an integrated strategy of shaping political policies in ways that advance the ideology. For the success of this strategy, having a public comprising critical, debating, questioning citizens (all key to sustainable democratic life) is not helpful. If a *climate* of suppression of opinion, control of speech and protest, and derision of criticism is created to subvert opposition then democracy withers. Knowingly or otherwise, education and educators play their part in this.

Smith (2003) draws attention to the dangers of our being ‘bought’ by comfortable sloganism and the uncritical perpetuated myths of neoliberal ideology. He cautions that we ought heed history to attend to the future: ‘Especially dangerous is the historical amnesia suffered by those claiming “the road ahead” (*Bill Gates*), that history has come to an “end” (*Francis Fukuyama*), or that “there is no alternative” (*Margaret Thatcher*).’ (Smith 2003, p. 37. My italicised adaptations). And, as Saul (1995) points out, when we are faced with seemingly insurmountable global problems, there is something appealing about any system that advocates a single-message one-shot solution because the express alternative is uncomfortable debates and difficult decisions. ‘It is ideology that insists upon relentless positivism. That’s why it opposes criticism and encourages passivity.’ (Saul, 1995, p. 38). Dumbing-down – a major educational issue for democratic sustainability – happens partly because of poor education but as much because the very challenge of challenging means personal discomfort.

Smith (2003) offers an excellent critique of neoliberalism’s impacts on education which, unfortunately, cannot be adequately reported here. He articulates the conditions and agenda that have been assembled to re-form education in the ideological mould. In 2003 he talked optimistically of, ‘...conditions that may be emerging for a new

kind of global dialogue regarding sustainable human futures.’ (Smith 2003, p. 35) but my deep concern remains today around the continuing lack of comprehensive curriculum dialogue in the public arena, in teacher education and in schools. Now, more than ever perhaps, new and vibrant dialogue can be reimagined and supported by ethically-framed Design and Technology curriculum discourse.

Drawing on international research, Smith (2003) shows how ‘...the application of neo-liberalist principles has resulted in a host of actions designed to change both the nature and delivery of educational work.’ A *selection* includes: the portrayal of public education as *‘failing’*; the *commercialisation* of education with accountability through outcomes or product-based measures; the creation of *competition* between, schools, teachers, districts and, now, countries; privileging *privatisation*; prioritising accounting over pedagogical need; ‘assaulting teacher unions’ *false decentralisation* with curriculum control remaining with governments; curriculum determination by non-education groups (national and international) to shape and control labour markets internationally; separating teachers’ pedagogical judgements from educational management issues; and, ‘...pressurizing governments...into accepting these actions as a condition for joining...international trade cartels...’ (All adapted from Smith, 2003, p. 38)

But this is not all. He nominates three actions which warrant Design and Technology’s particular attention: tying educational financing to technologised instruction and the privileging of science and technology subjects to serve global industrial competitiveness; adopting a human capital resource model for the production of workers to match markets; and, ‘(I)nvoking the language of life-long learning to abate concerns about the end of career labor (expect to lose your job frequently, and reskill, as companies perpetually restructure to remain globally competitive)’. (Adapted from Smith, 2003, p. 38). Calls for a ‘skilled workforce’ are nothing new (Whitehead, 1917/1962; Penfold, 1988) but a skilled workforce is not necessarily an educated one. It matters to differentiate between *general* education in the compulsory years of schooling for all future citizens and any *specialised* (for example, vocational) education. We might also heed Sennett’s (2008) reminder of: the long history of low social value attributed to craft skill in Western society; the inequitable remuneration of skilled workers; the maintenance of the class divisions imposed on such workers; and, the internationalisation of cheap labour and expertise.

Neoliberalism betrays democracy’s good name and education has been colonised ideologically to play its part. Fortunately, voices of resistance have been clarion: Freire, (1972); Apple, (1979); Lyotard, (1979/1984); Giroux, (1983); and, Simon, (1985; 1988). If an ethics of democratic practice, as a dimension of sustainable futures, is our aim, we might question whether the same old game is worth playing.

CURRICULUM IN PERSPECTIVE

Despite the need, this chapter cannot offer more than a brief overview of curriculum history and theory. However, a few key aspects should be noted. We can start by

saying what curriculum is not. It is not a syllabus – which is a prescriptive statement of what is to be taught. Nor is a curriculum simply an aggregation of subjects. Nor is it necessarily what a government curriculum statement or policy says so, apart from the *intended* curriculum, the *hidden* curriculum and the *actual* curriculum exist too. While curriculum is an *intentional act* towards the young in society, as with most technologies, *unintended* consequences occur. Despite state policy or schools' aims, there are always multiple values, positions, and unspoken messages at play. The hidden curriculum is pervasive, is values-rich, and can operate positively or negatively. As a result curriculum as a whole is political and contestable. 'Curriculum policies and actions are never simple. There are often many different players with widely divergent priorities. Sometimes a seemingly simple curriculum decision becomes highly controversial. Some controversial issues in curriculum never die – they just reappear in slightly different guises' (Marsh, 2005, Sleeve note).

Attempts at defining 'curriculum' are problematic but can be helpful if properly contextualised. Any comprehensive curriculum studies primer (e.g. Marsh & Stafford, 1988; Print, 1988/1993; Smith & Lovat, 2006) illustrates over a hundred years' worth of interpretations of 'curriculum'. Certainly, comprehensive interpretations get nearer the issues at hand. For example: 'The curriculum is all those discursive practices which affect what and how students learn, and what and how teachers teach.' (Reid and Johnson, 1999, p. ix). For another Australian curriculum thinker, curriculum was: '...the ultimate realisation for a complex enactment involving global, national, state, school, community, teacher and student actors, in terms of what students come to think, believe, know and do.' (Boomer, 1991/1999, p. 124). The spectrum of curriculum theorisations broadens again with, for example: Freire, (1972) on intentionality as consciousness; Morris (1966/1990) on existentialism; and Pinar (2004) on Bildung and autobiography. Curriculum articulations that valorise intentionality, existence, consciousness, and ethics offer qualitatively different opportunities for education for sustainable futures than does any instrumentalist device.

Curriculum Arrangements

At a rather uncritical level, curriculum discussions pivot around how 'knowledge' and practices are organised in schools – usually understood as *subjects*, with distinct identities in secondary school settings. While a richer, *integrated curriculum* has run in primary schools, we now witness worrying moves to establish (and test) subject-based curricula in that sector too. Beyond the orthodox and with long histories are *alternative curricular* models such as Steiner-Wahldorf, Montessori, and home-schooling. *Curriculum frameworks* have also been established which nominally reduce the numbers of subjects into loose amalgamations organised into *learning areas*. Along with such arrangements have been *outcomes* or *capabilities* curricula which have focussed on the attributes of students themselves as well as particular epistemological content. South Australia's (DETE, 2001) *Essential Learnings*

of: *communication, futures, identity, interdependence*, and *thinking* illustrate the capabilities approach. (For this book's purposes, other candidates readily suggest themselves, for example: *sustainability, design* and *ethics*.)

In addition to this technical analysis of curricula, Print (1988/1993) offers six *conceptions* or *orientations* of curriculum, namely: *academic-rationalist; cognitive processes; humanistic; social reconstructionist; technological* (based on efficiency of learning using technologies); and, drawing freely from across these, teacher and curriculum developer *eclectic* derivatives. Of these, the (competitive) *academic-rationalist* is the prime educational instrument of the neo-liberal project and is grounded in orthodox subjects, hierarchically ordered. Having historic roots in the schooling of an elite has not translated well into industrial age curricula let alone for postmodern conditions (Lyotard, 1979/1984) celebrating multiple knowledges and recognising competing social, political and cultural power relations. Whose knowledge is valorised and how it is shared matters. Today, multiple resistances to the dominant, culturally embedded, subject-based curriculum (which, arguably, has also been an instrument of imperialism) are met with monological neoliberal calls for 'back-to-basics' education.

Not only are subjects attributed a hierarchy of value; but they are accompanied by teacher-centred, classroom-based pedagogy; individualised learning; and, formal competitive assessment (Johnson & Reid, 1999). Such models advance the cultural transmission of 'the canon' (particular and culturally valorised knowledge) as opposed to '...higher-order and generic skills: communication, problem-solving, planning, decision-making, and so on. The former view is taken to be characteristic of social conservatives, while the latter is associated with social reform.' (Wilson, 2004/2005, p. 86).

Social re-form (as social justice) is not neoliberalism's purpose. Rather, people are to *con-form* to certain economic values and accept the positioning of persons as human capital. Here, government is by experts and elites and the state works to constrain social change and any threat to 'governance by the marketplace'. The individual is responsible for their own success and wellbeing while the curriculum is to create an elite of well-educated economic and political leaders, and a mass labour force, skilled and otherwise, to support the market. By contrast, a socially critical approach (or ideology) centres on the human and humans-as-persons capable of cooperative social progress. Here social interaction and participatory democracy are highly valued and economic and technological decision-making are held open to democratic ownership and control. The curriculum serves the common good by developing a critically reflective citizenry that participates in change for better and more equitable provision for all.

Democracy Cannot Be Left to Look After Itself

'If the schools of a democratic society do not exist for and work for the support and extension of democracy, then they are either socially useless or socially dangerous.'

(Mursell cited in Beane & Apple, 2007, p. 26). I have used this champion of music education's explicit words because they remind us to care for democracy in two ways: *maintenance* and *vigilance*. That is, to look after democracy sustainably. To maintain the democratic vision or the ethical values that constitute democracy is the greatest defence against either democracy's erosion from within or attack from beyond. The fact that Mursell was writing sixty years does not mean that democracy was dead then, nor that is now, nor that it was a hundred years ago when Dewey (1916/1966) wrote *Democracy and Education*. Continuous vigilance is crucial.

As key agents of democracy, curricula have dual roles to play: at once both educating *about* democracy (serving democracy) as well as *being democratic* in their conduct (themselves democratic). The same is true of education for sustainability. Once we see (and critique) democratic education as both servant and conserver we realise how inclusive it can be. Such a curriculum, grounded in ethics, offers far more than the reproduction of established orthodoxies and (socially decontextualised) subjects. '...(T)he role of schools is to develop the capabilities of all students to the fullest extent possible for productive participation in our society. A stratified curriculum, such as one that is divided on the basis of vocational or academic 'aptitude', is fundamentally undemocratic because it aims to develop capabilities unevenly and related to particular roles in life...' (Reid, 2004/2005, p. 97). A curriculum that is democratic does not, in the compulsory years of schooling, discriminate amongst its constituents. It is inclusive and broad and any loss of curriculum breadth is a potential loss of ethical depth.

Education-Enculturation-Socialisation-Indoctrination

'Teaching the skills of reasoned deliberation remains the educational aim most distinctively critical to a democratic society of free and equal citizens.' (Gutmann, 2003, p. 407). Since this is also the core requirement of ethical coexistence and sustainable global futures how can we ensure that it happens? To talk of curriculum as cultural reproduction or as maintenance of cultural norms is highly problematic in a multicultural society let alone in the multicultural world. Towards what should we enculturate our students – not least if the answer is contradictory to good ethical practice, democratic life and sustainable futures? Capacities to reason deliberatively are certainly needed.

In the absence of public consultation around the creation and adoption of *any* technologies, what role (other than, at best, socialisation) is left for education? Democratic participation in technological decision-making is minimal (Sclove, 1995; Keirl 2006) so technologies seem no more than objects for (undemocratically determined) adoption. Thus people and learners are deterministically socialised towards technologies and systems without any critical or ethical discussion.

Alongside such scenarios of enculturation and socialisation, lurks indoctrination – an enemy of democracy. In a climate of ideology, passive learning, passive media consumption, and greenwashing, teacher-education today must include, as it used

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to, the study of indoctrination. White (1967) highlights the need for people/learners: being given the fullest possible picture around any issue; being given an education to weigh up issues; and, having the political space to enact their conclusions – whether by debate, resistance or activism. When such criteria are not met indoctrination by default results from uncritical education, and democracy atrophies.

SUSTAINABLE-DEMOCRATIC CURRICULUM CONSIDERATIONS

Are curricula working from vision-led orientations of sustainable global futures or are they consolidating the destructive status quo? If neoliberalism is the worsening global problem of the last thirty-plus years then orthodox curricula are part of that problem. Barlow & Stone (2005) ask: ‘How do we cultivate in children the competencies of heart and mind that they will need to create sustainable communities? How can we design schools as “apprenticeship communities” that model the practice of living sustainably?’ (Barlow & Stone, 2005, p. 1). Kahn (2009), draws on Jickling’s concerns about ‘...the apparently instrumentalist and deterministic nature of education for sustainable development...(and how its)... tendency as a field to date is to treat education as merely a method for delivering and propagating experts’ ideas about sustainable development, rather than as a participatory and metacognitive engagement with students over what (if anything) sustainable development even means.’ Kahn, 2009, p. 531). From such a critique, epistemological, pedagogical and democratic concerns arise. Also absent is any suggestion of anticipating and engaging with the future in visionary ways that refute determinism and instrumentalism.

The arguments that Western education remains thoroughly unsustainable have never been stronger. Despite considerable efforts by teachers, activists, curriculum theorists and others to bring about more critical-democratic forms of education, there has remained a stubborn resistance to change. Boomer documents the ‘massive inertia in education’ and how little has changed pedagogically over a 100-year period (Boomer, 1989/1999, p. 78). If change is to be achieved, what might be appropriate considerations for sustainable curricula? Clearly there is a need to move away from academic-rationalist models and, while some ground has been gained in this direction, the pressures to maintain the traditional, Western, competitive, curriculum are stronger than ever.

Ethos

Rather than any ‘blueprint for change’ it is perhaps more helpful to express educational intentions as an ethos that speaks ethically, democratically and sustainably. This is not about *what* is to be taught but is about creating and maintaining an environment in which (after Dewey, 1916/1966; Bruner, 1960; Pinar, 2004) *experience deepens understanding*. Curriculum and learning can be led by *vision* towards better worlds and pursuing questions like ‘How could the world be?’ (on *possibilities*); ‘How

should the world be? (on *ethics*) and ‘How would the world be if...?’ (on *imaginings*). Similar to, but not the same as vision is curriculum orientation toward *foresight* enacted through recognising *intention*; developing *capacities to act* upon the world; taking *care*; understanding *risk* and *precaution*; and, (of course) *designing*.

Curriculum and learning could be framed by such thinking as Schumacher’s *three metaphysical ideas*: i) *levels of being* or *grades of significance* for helping understand our place in relation to all else in the universe; ii) *transcendence of opposites* to overcome the ways orthodox distributions of knowledge are dichotomised; and, iii) *ethics* as essential to our values-clarification. ‘Education which fails to clarify our central convictions is mere training or indulgence.’ (Schumacher, 1973/1974, p. 83). Similarly, curriculum might take an existential orientation by investigating histories, presents and futures across the *four realms of co-existence*, of how we/students *be-with*: other humans; other species; the planet; and, technologies. (Keirl, 2010). Such investigations help develop students’ rapport, empathy with and respect for ‘the other’ – in total, an ethics of care.

When adopting this curriculum ethos, *teaching* is not privileged over *learning*, and *content* is never the principal organising curriculum concept. Furthermore, the *hidden curriculum* is itself a site of critique and activism as democratic practices. Finally, the nature and purposes of any assessment activities must be seriously critiqued for how they privilege the ethos and the learners above any systemic functions.

Learners

In any sustainable-democratic curriculum all members of the school community and the related broader community are *co-learners* who develop understanding of the differences amongst *transmissive*, *transactional* and *transformative* models of education; amongst *cooperation*, *collaboration* and *competition*; as well as those amongst consumption, wellbeing and production. This facilitates education as *critically experienced process* rather than *administered (re-)production* in shaping the learner. The growth of the person as global thinker and citizen is key. This is the person as both individual and as participating member of community and society. This growth is lifelong and is understood as such by student and society alike perhaps as a reconceptualisation of the learner in the spirit of *Bildung* which ‘...grows out of an inner process of formation and cultivation, and therefore constantly remains in a state of continual *Bildung*.’ (Gadamer, 1975/2004, p. 10). It is both sustainable and sustaining. *Bildung* not only develops the critical-ethical self but it also develops society in a manner of ever self-questioning in order to ‘build better’ for the common good.

Knowledge/s and the Sustainable-Democratic Curriculum

Epistemology is a complex and contested field. Once ‘knowledge’ is restricted to mean traditional notions of facts, content and subjects (Freire’s, [1972] banking

concept) it can be used politically and instrumentally both to dictate curriculum form and to apportion the quality of learning inequitably. As Lyotard (1979/1984) and postmodernism have shown, there is not a grand narrative of singular knowledge but multiple knowledges and multiple ways of knowing. Thus the sustainable-democratic curriculum must be articulate not only in what it means by knowledge/s but also in how knowledges come to be and, importantly, whose interests are being served by the selected knowledges engaged by learners.

Drawing on critical theory (Habermas, 1971) highlights the way users and producers of knowledge have differing and competing 'interests' in that knowledge and how many learners do not have all of the interests met when, ethically and democratically, they should. The three knowledge interests are the technical, the practical-hermeneutic, and the critical-emancipatory. The first accommodates factual knowledge of the formal scientific kind and is what has shaped the dominant, traditional curriculum. The practical-hermeneutic knowledge interest facilitates meaning-making and understanding (Pinar, 2004) is deepened. Here, knowledge is developed in new ways and in new situations by the learner. Meaning is made culturally, socially and politically, that is, context plus applied-knowledge-as-experience leads to understanding. The critical-emancipatory interest frees the learner 'to be' in the world in ways that are reflective, emancipatory and fulfilling. The idea of the autonomous but engaged citizen emerges.

How, then, might curriculum move away from the subject-based knowledge segregation model? A well-established concept is that of curriculum integration, but why has it not been universally adopted? An illustration comes from UNESCO who, introducing the United Nations Decade of Education for Sustainable Development (DESD), sought: '...to integrate the principles, values and practices of sustainable development into all aspects of education and learning, in order to address the social, economic, cultural and environmental issues we face in the 21st century.' (UNESCO, 2005). Implicit here is an assumption that the dominant model will readily accommodate sustainable development: a) wholeheartedly; b) deeply; and c) in ways that challenge the instances where 'subjects' might be at the heart of the problem. In this modeling, sustainability and ethics *may* gain a curriculum profile but, arguably, as a tokenistic add-on, marginal and barely visible. In such a situation the privileged curriculum, having to compete in international tables in *some* 'subjects', offers limited hospitality to something as rich as ESD.

There have been some genuine proposals to redesign curricula in supportive sustainable-democratic ways. We can consider Boomer's (1991/1999) advocacy of a 'key concern' curriculum in which '...there will be promiscuous employment of any of the known human ways of processing, exploring and investigating, and use of any relevant fact, knowledge or concept.' (Boomer, 1991/1999, p. 117). He re-positions subjects to 'serve' learning through the key concerns:

...knowledge and skill in the service disciplines would be built up as required in investigations of a kind of Brunerian spiral curriculum in which the key

question is explored in ever more sophisticated depth.... The curriculum would not be logocentric in the way that current school offerings tend to be. A major resource or 'text' for this curriculum would be "lived experience" ...Global literacy (the capacity to 'read' the world), capacity to *make* and *do*, capacity to *interact* socially, and capacity to *imagine*, would be significant areas for assessing the success of the students. (Boomer, 1991/1999, p. 118)

Another aspect of knowledge consideration in the sustainable-democratic curriculum is to clarify the interplay of the quantitative and the qualitative. Rather than quantifying and weighing how much learners know and using assessment as a political and social sifting technology, we can consider *learning quality* in relation to knowledge. As Freire (2001) has put it, to know and to understand, we must 'know' that we are always '...unfinished. On the one hand this knowledge reveals to me my ignorance, but on the other hand, it reveals to me that there is much I may still come to know,' (Freire, 2001, p. 120). He refers here not only to *how much* there is to learn of our worlds (and those of others) but is alert to powerful forces too. He argues that 'critical consciousness' is needed whenever we receive information from media, government or business sources.

It is foundational that learners (students *and* those who educate them) are ever-receptive to new or different ways of knowing. Maintaining *humility toward new knowledge/s* as well as respecting *cognitive pluralism* (understanding the mind as socially created and that knowledge can be represented and accessed in multiple ways) are two examples. Differently, Eisner, highly critical of technocratic and behaviourist models of knowledge reproduction and assessment in schools, advanced a rich *aesthetics of curriculum* (Urmacher, 2001).

Three Curriculum Characteristics: Consciousness, Discomfort and Conversations

If significant steps away from educational instrumentalism are to be taken, then we embrace three characteristics of critical curriculum design and practice. First, multiple senses of *consciousness* matter and we can recall Gadamer's *Bildung* and the value of self-reflection, self-critique and transformation. He shunned passive acceptance of some form of 'natural consciousness' and preferred to advance '...*working consciousness* (which) contains all the elements that make up practical *Bildung*: the distancing from the immediacy of desire, of personal need and private interest...' (Gadamer 1975/2004, p. 12). Additionally, curriculum curriculum design might embrace Gadamer's *cultivated consciousness*; Freire's *critical consciousness*; Schumacher's *levels and degrees of consciousness*; *false consciousness*; in their respective ways, *material consciousness* (Sennett, 2008; Bennett, 2010); and, *altered consciousness* (Keirl & McLaren, 2013).

Discomfort matters because much of the content- and assessment-driven orthodox curriculum brings little intellectual discomfort for either learners or teachers. There is a psychological sense of disequilibrium when learners move from one mental

model to another (Edwards-Leis, 2010) but it is the deeper discomfort that comes when the learner's or educator's world-as-known is brought into question. Such discomfort comes when personal values are tested, when new ways of being-with the world and with others are encountered, and when challenges to the status quo are undertaken. Discomfort is also the companion of risk-taking and creativity. In all such situations learners are moving away from the ostensibly known, not to the unknown, but towards deeper understanding and to new knowings that are always provisional and uncertain. Education in, and for, intellectual discomfort is a characteristic of any sustainable-democratic curriculum. Kincheloe (2008/2010), for example, in developing his 'critical complex epistemology' puts things thus: 'This epistemological conversation cannot be separated from the future of the human species. Thus, it percolates into the depths of our humanity, our being in the world, raising disconcerting questions that offend individuals who have bought into some form of authoritarianism – whether its source is religious, political, or philosophical is irrelevant' (Kincheloe, 2008/2010, p. 58).

Which opens up a third characteristic of critical curriculum practice - that of *conversations* (a term that, for convenience, I use rather loosely as signalling conversation, dialogue, discourse and dialectic). The primary use of the term is exemplified in Pinar's (2004) articulation of *curriculum as complicated conversation*. That is, there are no instant solutions or curriculum blueprints. If complexity describes the problem, if change is necessary, and there are multiple actors at play, then conversations must engage ideologies, principles, values, issues, and more.

Learners' conversations are a part of this too. Drawing on Freire, dialogic, dialectic pedagogy is the key to an active, engaged citizenry and such dialogue should not be determined from the 'top down', transmissively nor should such pedagogy be passive. 'Banking education resists dialogue; problem-posing education regards dialogue as indispensable to the act of cognition which unveils reality' (Freire, 1972, p. 56). As Gadotti (1994) reports: 'In Paolo Freire's conception, dialogue is a horizontal relationship. It is fed by love, humility, hope, faith, and confidence. (He) refers to the experience of the dialogue when insisting that democracy should be practiced in public schools "It's necessary to have the courage to make democratic experiments"' (Gadotti, 1994, p. 50). When Barnes (1976) investigated the significance to learning of students' personal conversations he noted that '...the desire to communicate with others plays a dynamic part in the organising of knowledge.' (Barnes, 1976, p. 91) and he cites Esland's view of children being 'world-makers' rather than 'world-receivers' (Barnes, 1976, p. 115).

Saul (1995) discusses how, despite our having considerable knowledge of the challenges facing the world, we behave quite unconsciously towards those challenges. His concluding remarks illustrate the three sustainable-democratic curriculum characteristics:

The virtue of uncertainty is not a comfortable idea, but then a citizen-based democracy is built upon participation, which is the very expression of permanent

discomfort. The corporatist system depends upon the citizen's desire for inner comfort. Equilibrium is dependent upon our recognition of reality, which is the acceptance of permanent psychic discomfort. And the acceptance of psychic discomfort is the acceptance of consciousness. (Saul, 1995, p. 195)

Pedagogy

Pedagogy is as open to critique as any other key curriculum consideration for how it enables or inhibits sustainable and democratic education for preferred global futures. For Kahn (2009): 'Tomorrow's sustainable society – one that sustains all life, and not just its most powerful elements – if reliant upon education, will require a pedagogical revolution equal to its present socio-economic counterpart.' (Kahn, 2009, p. 526). More recently, he builds on Freire's critical pedagogy, articulating a radical ecopedagogy that cannot be reduced to environmental education, and showing how un-critical practices merely feed the neoliberal project:

...here environmental literacy has not only been co-opted by corporate state forces and morphed into a progressively-styled, touchy-feely method for achieving higher scores on standardized tests...but in an Orwellian turn it has come to stand in actuality for a real illiteracy about the nature of ecological catastrophe, its causes, and possible solutions. (Kahn, 2010, p. 9)

In line with a grounded, vision-led approach, Giroux (1983) advanced the centrality of ethics to critical pedagogy and argued for a '...radical pedagogy...informed by a passionate faith in the necessity of struggling to create a better world. (And for this)...radical pedagogy needs a vision – one that celebrates not what is but what could be, that looks beyond the immediate to the future and links struggle to a new set of possibilities. This is a call for a concrete utopianism.' (Giroux, 1983, p. 242). Pedagogically, we can align his advocacy for 'creative risk-taking' with Freire's argument that: 'Banking education treats students as objects of assistance; problem-posing education makes them critical thinkers.' (Freire, 1972, p. 56); and Capra's case for '...an experiential, participatory, and multidisciplinary' pedagogical approach (Capra, 2005, p. xiv).

DESIGN AND TECHNOLOGY'S CURRICULUM PLAY

I have argued that the impetus and ideological commitment of the neoliberal project is a major global concern for sustainable futures and that education is intertwined, by design, with this project. Implicitly, D&T curriculum is a part of this and its players have some choices to make. Because Technology itself is complex, pervasive and generally not well understood, the need has never been greater for a rich education in the phenomenon (Keirl, 2006). But what constitutes a *rich* D&T education leads to making some important and difficult decisions. We can identify the ways that D&T serves to further non-sustainable, anti-democratic, unethical practices in pursuit of

growth and profit and we can act to resist and change those practices, or we carry on as normal doing what 'seems obvious'.

Just because the phenomenon of Technology is complex does not mean that education and curriculum cannot handle that complexity. However, some basic questions apply. In what ways is D&T constrained by the neoliberal agenda to serving a largely vocational role in education? Conversely, how can D&T serve all students democratically and ethically? If curriculum were led by an ethical, future-focussed, global vision how different might D&T be and what curriculum role can it contribute? What if D&T were constituted, as many have argued, as a form of literacy to be taught throughout the curriculum as well as in some D&T identity-shaping way such as a learning area or as a set of capabilities? Can D&T be constituted primarily as a major contributor to an educated, ethical global citizenry rather than as a 'subject' devoted to 'skilling' for the uncritical adoption of technologies?

While D&T can rightly feel aggrieved when it comes to its inequitable status with the so-called 'academic' elite of subjects, there can be some advantages. So long as the field is free from rigorous testing regimes and content specifications then greater curriculum self-determination can occur. Besides, why would such an invaluable but thoroughly under-appreciated aspect of curriculum want to be 'academic'? This is a hollow aspiration.

Design and Technology Ethos

Once the focus moves to how D&T serves the general education of all students-as-future-global-citizens then a different D&T ethos can emerge. So long as D&T is to serve the economy, address (alleged) skills shortages, prioritise growth over sustainability, profit over environments, industries over communities, consumerism over citizenship, elites over social justice, and self-interest over the common good, it then lays itself open to most serious ethical critique. At best, it remains instrumental.

If, on the other hand, it takes the global democratic project to heart a different curriculum picture emerges. The field becomes liberated to educate holistically across the curriculum and even to offer innovative curriculum leadership to inform better practices. Design literacy and technological literacy need their share of curriculum air to breathe. To achieve this, teachers, curriculum workers and policymakers themselves will all have to consider their personal values and their political positions in order to act. To behave with apathy or passivity reinforces the status quo and helps the steamroller to crash on.

Layton (1994) showed us two decades ago that our (relatively new) curriculum field is highly contested amongst stakeholders. No longer can D&T be dominated by the limited interests of economic instrumentalists or select professions. It is now overdue that we accommodate the interests of girls and women, multiple cultures, defenders of participatory democracy, sustainable developers, and, for an existential dimension, liberal educators too (after Layton, 1994). If the field is to move beyond its own equivalent of banking education (competency-style skill training)

then it needs renewed identity and integrity – curriculum and public identity and curricular integrity – across all of epistemology, existentialism, critical pedagogy and ethics. As our understandings deepen of the nature of technological relationships and our realms of being-with the world, we see that there are indeed complicated conversations to be had.

Learners

Design and Technology learners are persons - not material to be worked on for economic consumption. For this reason alone, learners are considered before the discussion of knowledge or curriculum content that follows. Like all others with futures (persons, species, technologies, the planet) learners need understandings of ethics, sustainability, the very reasons for education, and what it means to be a responsible global citizen. If D&T has a place in such a curriculum then it must work for its learners accordingly. If D&T cannot meet these requirements then it has no part in the sustainable-democratic curriculum. As with all aspects of a critical curriculum for sustainable global futures, teachers and students are co-learners, co-constructing and designing the curriculum through negotiation. Learners in such an environment develop, and contribute to, Bildung – ever-forming and re-forming themselves, communities and society. Here, not only does consciousness in all its senses develop but the student learns the right as a citizen ‘...to criticise, to reject conformity, passivity, inevitability.’ (Saul, 1995 p. 39). Design and Technology can become a site for personal, cultural and political technological values clarification.

As with the total curriculum, instrumentally-conceived D&T cannot properly contribute to democratic learning. However, a design-based, critical approach sees multiple learning opportunities arise. Knowledge is never a given. Personal knowledge creation happens when learners design because a commitment is made to research and to creativity. (Who ‘knows’ what might result?) Critical learning demands the questioning of ideas, thoughts, designs, of what is, and of what could be. Critical D&T curriculum engages all of: imagination; creativity; technique; idealism; ethics; confidence; and, empathy. Learners’ personal empowerment, identity and efficacy are all enhanced through rich (rather than an impoverished) Design and Technology. They learn about possibilities beyond their current location, time and knowledge. In all, the existential is respected, the capacity to act towards better worlds is realised, and sustainable-democratic understanding deepens.

Seeking Knowledge in Design and Technology

In what I contend is the happy absence of a readily-identifiable body of knowledge for D&T (despite those actively seeking it) the field had tended to express itself simply through skilling and vocationalism or through a thin epistemological blending of the knowing-that/knowing-how kind. While a major epistemological debate is needed, I argue that the ‘body of knowledge’ goal is a mirage and a distraction. (In part, this

issue links with my deep personal concerns about the threat to quality D&T by the so-called STEM agenda.)

Our field is, in essence, a *doing* field – ideally, doing-with-wisdom in the sustainable-democratic curriculum. It is about intentional acts on an ever-changing world and, while it does draw on existing knowledge, much technological activity is both provisional and speculative. Drawing on Boomer (1991/1999), ‘subjects’ such as maths and science can *serve* D&T rather than dominating it.

Advancing such a position, a whole-curriculum design/technological literacy approach can permeate all years of general education. Such literacy applies both critical and ethical theory. In turn, D&T as a constituent field of learning can be articulated through a series of *verbs*. This strongly theorised and proven-in-practice curriculum design (DETE, 2001; Keirl, 2002a&b, 2004) saves D&T from the heavier knowledge ‘content’ games but, crucially, positions learners at the centre of their education. Further, it readily facilitates and maintains the ethically grounded sustainable-democratic curriculum. Thus, the Habermasian knowledge interests informed a new curriculum:

Technological literacy can be viewed as having three dimensions, all of which are equally valid and important. All students benefit from all dimensions of technological literacy and must not be constrained in their learning to one aspect alone. The three dimensions are:

- *the operational*, through which students develop skills and competencies at a technical level to use materials and equipment in order to make products and systems (they learn to use and do);
- *the cultural*, through which students contextualise their learning in the world of designed and made products, processes and systems. They recognise the interdependence of technologies with people...and they apply their technical learning in practical ways to realise designs and solve practical problems (they learn through technology); and,
- *the critical*, through which students are empowered to take a full and critical role as autonomous citizens in technological societies. They are able to make refined judgements about the worth of the intentions and consequences of technological products, processes and systems on themselves and others... (they learn about, and to be with, technology). (DETE, 2001)

While this illustrates the curriculum *intention*, it is articulated in *practice* through three strands (as verbs, action words): *Critiquing*, *Designing* and *Making* which, too, are not only interdependent but must all be addressed if the holism of sustainable-democratic D&T curriculum is to be realised.

Designing is to work with intention. It is neither about accident nor prescription. Designing is about choice-making and weighing up competing variables. It is values-rich, not values-neutral (as some argue technologies to be). It is about uncertainties and working with inadequate information and there is never a ‘right answer’, rather,

there are only ‘best defensible compromises’. Designing is a form of knowledge creation. Design, as noun or verb, is open to advocacy, defence and contestation. For all of these reasons, taught well, designing resists much orthodox education *and* orthodox technology education because the learner is key, transmissive teaching gives way to pedagogies of uncertainty, discomfort, critique and scepticism.

And in such a curriculum, *Critiquing* is a trait of ‘continuous Bildung’ for all. It is a way of thinking, acting and being. Critiquing is the purposeful, practical and metaphorical deconstruction and analysis of any product, process or system in order to expose the values and intentions behind designs, the unanticipated applications of technologies, and the relationships between people and technologies. As when designing, new meanings and knowledge emerge from critiquing and new realisations emerge for seeing, judging and living in the designed world.

D&T and the Three Sustainable-Democratic Curriculum Characteristics

When critiquing, designing and making in Design and Technology education, ethical, democratic and sustainability values contestations arise. What can be openly celebrated is that these technological values contestations bring vibrancy, focus and quality to the sustainable-democratic curriculum. They are the concern of *all* curriculum players and are central to the learning of *all* learners. What they also highlight are their significance to consciousness, how discomfort is an educationally-managed reality, and the need for dialogue across the whole curriculum enterprise.

Because such a curriculum celebrates values contestation, the breadths of ethical and political spectra become visible. Conversations become paramount – from the policy-maker to the student – and ideally between both such parties too! This is a genuine application of curriculum as complicated conversation and it is through such conversations that discomfort occurs as values positions are explored, tested, learned, refined, and promoted. As an outcome, consciousnesses are heightened. All of this is a far cry from the banking concept of education because it centres on sustainable, democratic and preferred global futures as perpetual goals. One major difference is that education becomes (‘should be’ is the ethical claim) an end in itself and not a means or instrument of other ends. In the spirit of Bildung, growth, formation and becoming happen. This kind of (Design and) Technology education offers democratic societies a new, critical technological consciousness – one which can *become* a shared way-of-being considerate of worlds yet-to-be-realised.

Pedagogy

Another of the considerable advantages D&T curriculum enjoys in the current dominant climate is that the pedagogical repertoire of teachers can be both rich and adventurous. Freed from restrictive assessment and curriculum prescriptions it becomes possible to use a future-focussed critical pedagogy (Freire, 1972; Darder et al., 2009; Kincheloe, 2008/2010; Kahn, 2010; Smyth, 2011) that advances

sustainable-democratic futures through all of critiquing, designing and making. The responsibilities on learners when they design and critique, and when they defend the decisions taken when they make, are such that their democratic capabilities are heightened. Assessment accompanying such pedagogy is equally democratic and participatory – not mandated by an external scaling system operated in the name of standards or accountability and positioning the learner as statistic in international league tables rather than as person. In total, if D&T curriculum is constructed and constrained technically it is also taught transmissively and uncritically. A values-rich curriculum demands an emancipated and emancipating pedagogy for learner and teacher alike. Such an ethically-based pedagogy is readily learner-centred but, importantly, it is also learner-as-future-being-and-citizen-centred. It serves the distant unknown, rather than what is already known.

Teachers (With Learners) at the Core

Noticeably perhaps, little has been said so far about those who are absolutely key to the success (or otherwise) of any curriculum. D&T teachers, usually marginalised in mainstream educational research and discourse, are considered as central to the following concluding remarks.

The professional deskilling of teachers began in the 1980s (Apple & Teitelbaum, 1986) and the metamorphosis to uncritical technical curriculum deliverer continues: ‘...standardised reforms have taken away teachers’ time to think; and their imposed, prescriptive requirements have replaced creativity with compliance.’ (Hargreaves 2003, pp. 82-83), and more recently:

...what is clearly being constructed through these neo-liberal manoeuvres is an identity of the “preferred” teacher – one who is dutiful, compliant, market responsive and uncritical of the circumstances and conditions around her – especially in respect of what the neo-liberal agenda is doing to schooling and groups within it. (Smyth, 2011, p. 29)

The literature on the ‘constructions’ of the teacher is an extensive branch of curriculum studies. There is no universal meaning of ‘teacher’ whether viewed externally or amongst teachers themselves. Documenting some of the literature, Keirl (2009) identified a range including teacher as: *worker* (Reid, 1998); *leader-learner* (Lingard et al., 2003); *ethical* (Campbell, 2003); *entrepreneur* (Sachs, 2003); *technician* (Hextall & Mahony, 1998); *activist professional* (Sachs, 2003); *reflective practitioner* (Schon, 1987); *critical practitioner* (Blackmore, 2002); *socially critical* (Smyth et al., 2000); *continuing learner-worker* (Groundwater-Smith et al., 2001). Smyth (2011) also references: ‘...*teacher-as-bricoleur*; *teacher-as-improviser*;...and *teacher-as-social activist*...’ (Smyth, 2011, p. 30. Italics added). A most significant contribution, recurrent in the literature, is Giroux’s comprehensively theorised case for teachers as *transformative intellectuals* (Aronowitz & Giroux, 1993).

Ultimately, the issues raised in this chapter hinge on Design and Technology teachers' personal identities and values determinations. Sustainable-democratic curricula are as key to sustainable global futures as instrumentally academic-rationalist curricula are to neoliberalism and non-sustainable futures. Throughout, the issues are ethical and political. Teaching is a political act (Keirl, 2007) and Postman & Weingartner's (1969/1971) thesis that teaching can be a subversive activity maintains its prescience. All of this is at once deeply challenging, discomfiting yet can be liberating. Curriculum courage is needed for much-needed curriculum conversations across classroom, community, policy-making and ideology.

Curriculum ceases to be a thing, and it is more than a process. It becomes a verb, an action, a social practice, a private meaning, and a public hope. Curriculum is not just the site of our labor, it becomes the product of our labor, changing as we are changed by it... It is an ongoing, if complicated, conversation. (Pinar, 2004, p. 188)

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11. SUSTAINING PEDAGOGICAL PRACTICE TO PROMOTE PRODUCTIVE PROBLEM SOLVING

Lighting a Fire Rather Than Filling a Bucket

INTRODUCTION

Effective pedagogical practice is not sustainable if it fails to focus on teaching pupils how to think and develop mental models that will enable them to be the productive designers required for the future. Pupils require skills and understanding that will enable them to recognize and articulate problems and seek opportunities. This recognition of complex conundrums will necessitate the ability to critique the socialised tapestry that forms modern life. Pupils designing real solutions to real challenges can occur in one-off, one-week celebratory experiences of a cross-curricular or theme-based event. However, a sustained focus on analysis, interpretation, and evaluation through designerly ways of thinking and acting requires teachers to develop a particular epistemological stance that embraces an authentic problem-based approach to learning presented within an integrated curriculum that engages pupils in critical thinking and dialogical debate. Authenticity in pedagogy matters because while it might be defined as being “in the eye of the beholder” (Gulikers, Bastiaens, Kirschner & Kester, 2008, p.401), it relates to the learner’s own context of participation and application (Herrington & Parker, 2013, p.610). This chapter weaves a review of the thinkers around pedagogical practice and curriculum approaches with mental model theory to explore how teaching and learning can contribute to pupils’ development of designerliness and attainment of skills for a sustainable future. It supports its claims through an empirical study of pupils working to solve design challenges. It proposes that the Mental Model Mode provides pupils and teachers with an understanding of the thought processes that enable creative approaches to problem solving resulting in useful metacognitive understanding and real learning. It celebrates the lighting of the fire of learning to fan, as Plutarch suggested, “a desire for knowledge and an ardent love of truth” (Goodwin, 1878, p.290).

PEDAGOGICAL PRACTICE

A desire to understand what constitutes effective pedagogical practice continues to ignite research about teaching and learning. Some historical practices and current approaches are clearly articulated through various methods to learning that adopt

behaviourist methods (Watson, 1913) such as classical (Pavlovian) and operant conditioning (Skinner, 1984) where the understanding of a living organism's response to a stimulus through physiological or psychological senses provides the pedagogical *modus operandi*. This behaviour-reward cycle was seen as necessary to train a pupil to respond, according to the desirable operands determined by the teacher, and resulted in a plethora of star charts, hierarchical reward structures, and plastic-sleeved display books filled with digitally-produced certificates all attesting to the greatness, cleverness, or speed of the recipient. Learning seemed to be placed second to appropriate institutionally favoured behaviour. But, changes were being mooted for formal education that seemed to better reflect Socratic methods where understanding the nature of knowledge was as essential as finding a suitable answer.

Constructivist theory emerged through the work of Piaget (1970) where he emphasised the importance of children (rather than pupils!) being able to hold false theories as a necessary step in constructing their understanding of phenomena. Children constructed such understanding through play, talk and trial-and-error rather than being bucket-like repositories for the distillation of facts from training sessions. Papert (1980) reinforced Piaget's (1970) suggestion of the natural learning path of children as containing false theories adding that such deviations can teach more about constructing, exploring and challenging knowledge than do true ones. Papert (1980, p.132) also suggested that children do give up these theories when ready but that the "educational system rejects the 'false theories' of children, thereby rejecting the way that children really learn". This perception of the constraints that formal education imposes on learning was not novel having been also explored by theorists such as Peters (1966) and Dewey (1938).

Peters (1966, p.38) saw learning by experience as being appropriate for pupils and for teachers to be responsible for using "various methods to get learning processes going". He was cognizant that teachers do not, in fact, always manage to teach but instead "instruct, which is quite compatible with the authoritarian exposition of inert ideas" (Peters, 1966, p.40). Similarly, teachers were guilty of putting pupils in positions where they were expected to learn by experience without any clear guidance on what was actually expected from such engagements. This learn-by-osmosis approach adheres somewhat to Foucault's (1981) proposition of power-knowledge where school discourses (pedagogical practices) are used to shape pupils and to legitimise change because whatever knowledge gained by the pupils in such action would be true. The education community appears to struggle from an identity crisis and those who practice in formal teaching environments are similarly confused as to which pedagogical stance to adopt.

Dewey (1938, p.19) contributed to the debate much earlier when he acknowledged that in many traditional classrooms knowledge was seen as "static" and "taught as a finished product". His concern about the continued teaching of knowledge as a "cultural product of societies" (Dewey, 1938, p.19) centred on his understanding that modernity would necessitate new approaches to address an ever-expanding body of knowledge; the future, and indeed the present, would not be the same as the past. But

he recognised that education would be an arena of conflict and struggle involving “new order (s) of conceptions leading to new modes of practice” (Dewey, 1938, p.5). Dewey’s was a fresh way of viewing what happened in the dark halls of educative power and was laden with his contempt for traditional-style education that divorced itself from intelligent modern activity. Freire’s (1972) emancipatory focus continued Dewey’s libertarian views and he believed that only true reflection on thought and action would lead to valued educative practice that was shared between teacher and pupil.

Freire (1972, p.45) discussed education’s “narration sickness” where one-way discourse was anathema to the “invention and re-invention” (p.46) of knowledge, such as that evident in Piaget’s (1970) false theories, which should be created through co-intentional education. Teachers and pupils should share the search for reality through problem-posing educative praxis and their methods should not be static because the reality being pursued is changing constantly. Dewey (1938) and Freire’s (1972) focus on the evolution of practice and changing knowledge clearly signaled the way to sustainable education as a valuable contributor to the future. Freire (1998, p.33) later put such ideas eloquently when he stated:

In the context of true learning, the learners will be engaged in a continuous transformation through which they become authentic subjects of the construction and reconstruction of what is being taught, side by side with the teacher, who is equally subject to the same process.

Co-learning highlights a symbiotic relationship between teacher and pupil where both, due to the support provided by each for each, can reach greater degrees of knowing. This approach is asynchronous to that espoused by oppressive focus of capitalism which seems to value human quantity over human quality (Nikolakaki, 2011) and which has seen a renewed interest in critical pedagogical approaches proposed by Freire.

Critical pedagogy focuses on disrupting the effects of oppression brought about by the marginalization and disempowerment of people through the focus on individualism that competition through capitalism creates (Nikolakaki, 2011). The ecopedagogical approach has evolved from critical pedagogy (Davis, 2013) creating a composition of methods that embrace the co-learning that Freire (2004) saw as fundamental to transforming society, and a framework that provides structure to the investigation of the forces that influence communities. These forces are of current interest and include sustainability issues, ecological literacy as well as the socio-political factors that contribute to social justice evident in critical pedagogy.

None of these ideas or thinking should be new to most teachers who see reflection as fundamental to effective practice. What has tended to subvert these beliefs is a political environment focused on the recognition (and celebration!) of learning success through naïve measurement tools. Naïve is a somewhat benign term when considering the reality of the savagery with which international, standardised tests have populated education and decimated the effective modes of practice that most teachers recognise as being beneficial for learning. While “being political is inherent”

in education because being neutral is impossible (Freire, 1998, p.33), teachers should not consider themselves the instruments of government and, therefore, responsible for propping up a country's standing in international league tables and, vis-à-vis, encouraging re-election of those same governments. The nature of what is taught is central to education as much as how it is taught and here, too, governments are encroaching (trampling in some cases) on education's estate.

PEDAGOGICAL ISSUES

What is taught in schools has been a political football kicked around the pitch both at home and away for some time. Barrow (1976), discussing Plato's view of a liberal education, suggested that even he would concede that in today's world absolute knowledge is unattainable. But, Barrow (1976) proposed that this eminent Greek scholar would support an approach to an ideal education that enabled learners to develop both their understanding of whatever forms of knowledge were evident at the time and an appreciation of the philosophical form of knowledge itself.

Curriculum change is an evolutionary process but some subjects appear to be cast in granite creating archeological cornerstones for the modern formal classroom. Their existence is unquestioned by many and remains unchallenged due, perhaps, to individual experiences and perceptions of contribution to successful careers or romanticised childhood excursion. Young (2010) goes so far as to promote a subject-led approach to curriculum formation as the reason we have schools rather than to achieving other goals such as economic development or motivation for active citizenship. He considers the school's role as not being one centred on solving social and economic ills nor that its curriculum should be a form of accountability for teachers (Young, 2010). This argument is somewhat naïve given Freire's (2004, p.47) view that "if education alone cannot transform society, without it society cannot change either" which places schools, as communities of educative practice, at the centre of curriculum delivery to the majority of humans.

A consideration of a sustainable pedagogical approach to knowledge and learning poses, by virtue of the inclusion of the adjective sustainable, "challenges for intellectual-moral development and identity development" (Myers & Beringer, 2010, p.51) because of the complexity of sustainability. Young's (2010) discussion of the two roles that subjects play in modern schools revolves around their existence as repositories of a set of concepts and related meanings as well as their provision for a community of specialist subject authorities. Both of these roles are dynamic and offer evolutionary opportunities due to the contestation of the boundaries of knowledge inherent in each discipline thereby making them 'sustainable' due to the ability to establish current identities. It would seem that Young's (2010) subject-centred approach does offer a backhanded, learner-centred parallel due to the context in which the learner lives being the vehicle for enculturation of subject matter. However, Fry (2009, p.12) has propounded the reality that humans are too many and that "there is a pressing need for the way we human beings live, act and engage the

world around us, to change". He has indicated that the way forward, rather than a subject-centred approach is through the development of design intelligence.

How pupils will 'act upon' their learning in the future is of interest given the possibility for rapid global change in economic wellbeing, social interdependence and environmental concerns and constraints. Knowledge has emancipatory potential (Welsh & Dehler, 2001) if it enables learners to develop the capacity to act on what they have learned. An action focus in teaching and learning should be adopted (Raelin, 1999) enabling what Giroux (1997) would entertain as a transformational and contextualized critical pedagogy. Using an ecopedagogical approach (Davis, 2013) embraces what Kahn (2010) says is required for the human experience of education to be based on policies and practices that are oriented towards ecological politics which make connections between culturally relevant forms of knowledge. The imposition of any one form of pedagogical practice and, with it, a uni-dimensional view of knowledge as a pre-digested morsel of historical understanding would likely fail to prepare learners to take their position as designers of the future. Freedman (2007, p.467) suggests, in accord with Kahn's (2010) ecopedagogical experience of education, that teachers have a responsibility to present multiple positions on "salient public issues and train students in a method of analysing these positions" thereby, in some respects, developing the critical thinking skills to act upon their opinions and conclusions in order to design intelligently.

So, what should a curriculum contain if it is to provide the tinder to ignite learning through a problem-centred approach? Freire (1998) discussed the existence of an "intimate" connection between the knowledge, that Young (2010) would see as a necessary inclusion in the subject-centred curriculum, and the knowledge that learners bring to the classroom as "fruit[s] of their lived experience" (Freire, 1998, p.36). He saw problem-posing education as "revolutionary futurity" (Freire, 1998, p.57) recognising that humans reside with and contribute to their own evolution. The subject-centred approach loses ground when knowledge is considered without thought to the continual shaping contributed by humankind. Dewey (1938, p.46) understood that:

It is not the subject per se that is educative or that is conducive to growth. There is no subject that is in and of itself, or without regard to the stage of growth attained by the learner, such that inherent educational value can be attributed to it.

Although he was speaking 75 years ago, little has changed. Modern subjects need to offer disenfranchised youth an opportunity to explore hands-on, creative, and abstract skills and knowledge through rigorous problem-solving approaches necessary to develop critical thinking skills. Schools should be, therefore, under pressure to select the curriculum content and processes that best promote sustainable pedagogical practice. A fundamental requirement for any learning is an environment where pupils can engage and interact with knowledge to create their own understanding whatever the subject. Design and Technology is the best-placed educational experience to engage children in robust problem-solving approaches through designerly behaviour.

Mental model theory offers the lens through which we can explore those journeys toward gaining greater conceptual understanding and stronger metacognitive skills: understanding and skills enable learners to act upon their learning.

MENTAL MODEL RESEARCH

Learning through engaging in problem-solving activities, such as those encountered in Design and Technology, involves learners undergoing some disequilibrium (Piaget, 1970) or perturbation (Ritchie, Tobin & Hook, 1997). Learning is mentally uncomfortable because it necessitates the realisation that a comparison between what is known and what needs to be known to complete a task is different. This gap needs to be filled for learning to occur and mental model theory offers a comprehensive explanation of how individuals use their memory and links with external information to create innovative and personalised strategies to do so.

Norman (1983) and, later, Jonassen (1995) suggested that mental models provide a platform from which individuals express what they know due to their inherent epistemic nature. This base from which all behaviour emanates (Barker, van Schaik & Hudson, 1998) is quite complex and often requires a radical accommodation in order for an individual to assimilate new experiences into existing cognitive structures such as schemes (Piaget, 1970). Anderson (1977) elaborated on Piaget's (1970) earlier work with schemes suggesting through his schema theory that knowledge was organised in more elaborate networks to better "account for novel situations, new actions or new arguments" (Schwamb, 1990, p.30). Learning, or cognitive growth, occurs when new mental models are created or existing ones are remodelled to enable a learner to understand, explain and act in some way to create a feasible solution to a gap in understanding.

Johnson-Laird (1983) conducted research using mental model theory to explain human thought processes in language comprehension. He proposed that mental model theory better explained how individuals reasoned than did the more traditional symbolic logic theories. Although symbolic representation, such as decoding text, is used, mental models provided the mechanism to explain the translation of an external process into an internal one (Norman, 1983; Johnson-Laird & Byrne, 1991; van der Veer & Peurta-Melguizo, 2002; Vosniado, 2002) where new symbols are derived through inference and then translated into actions through reasoning. It is during this reasoning process, where the mental model functions such as explaining, predicting, diagnosing, and communicating (Edwards-Leis, 2010, 2012) are enacted, that the individual constructs functional mental models that are cognitive representations of the interaction (Johnson-Laird, 2004; Johnson-Laird & Byrne, 1991; Vosniado, 2002). The resultant mental model incorporates a great deal of information including any relevant semantic information of the phenomena encountered as well as the problem itself and the solution created (Goodwin & Johnson-Laird, 2008; Johnson-Laird, 1983; Johnson-Laird, 2004).

Once a mental model is created or remodeled from a successful interaction it is stored for future use and becomes what an individual knows and believes to be true.

The structure of the mental model reflects that of the environmental phenomena under investigation (Halford, 1993) whether it is a design challenge or mathematical problem. Halford (1993) hypothesized that if an individual correctly or incorrectly understands the phenomena then they will store a respective mental model if there is some value for its retention. This hypothesis goes some way to explain why individuals perceive things differently, sometimes erroneously. If other ingredients of a mental model, such as superstitions, beliefs, and personal experiences are factored in, then the idiosyncratic nature of knowing can be better appreciated. The essence of the theory of mental models is its “capacity to explain how individuals interact with the world” (Edwards-Leis, 2010, p.36). The uniqueness of mental models reflects the individual and how their interactions engage knowledge, perception, memory and the dialogue necessary to communicate to create different ways of knowing.

Dewey (1938, p.25) talked about the “organic connection between education and personal experience” where the experiences to which learners are exposed can modify them. He believed educators had a responsibility to recognise “what surroundings are conducive to having experiences that lead to growth” (Dewey, 1938, p.40). Freire (1998, p.36) too saw the organic relationship or “intimate connection between knowledge considered basic to any school curriculum” and knowledge that came from the lived experience of the learners. Arguments about authentic and, therefore, sustainable pedagogical practice appear to foreground the creation of learning contexts that enable the individual learner to develop unique ways of knowing and interacting with the world through the recognition and understanding of their mental models. A decentred classroom moves the focus toward a learner-centred environment where issues are contested (Giroux, 1997) while creating space for learners to depend on their own knowledge and experience (Raab, 1997) to engage in solving problems.

The challenge in creating a pedagogical approach that is sustainable through problem solving in Design and Technology is the readiness of students to actually participate knowingly (metacognitively) in a learner-centred environment where values are often challenged through the very act of design. Fleury (2011) argues about history as a subject and its role in preparing citizens but a similar argument could be posited for Design and Technology. He highlighted the word ‘critical’ through his discussion where a learner’s knowledge of the thinking process is necessary if they are to engage in dissent. He criticised the “well-intentioned promotion of a more critical, reflective and participatory citizenship being brought about by a systemic advocacy of topically framed standards”, (Fleury, 2011, p.80) suggesting that effective inquiry does not fit a predetermined form. If learners are to engage in critical thinking then dissent from “multiple positions on salient ... issues” (Freedman, 2007, p.467) must enter the classroom.

Ross (2000, p.54) was equally concerned with pedagogical approaches that while advertising their modernity only served to promote the “dominant forms of knowledge” and failed to foster active learning. Freedman’s (2007) focus on the teacher’s institutional role also appears to channel inquiry into a predetermined mould where equality of participation for learners is challenged. Equity of outcomes

in a classroom is championed yet many of the learning experiences that are designed are created for the majority and governed by limitations of space and materials. Yet, if Dewey's (1938) focus on the learner and their wealth of individual experience were to guide pedagogical design it would promote a greater understanding of the capacity of the individual learner to enact their own innovative and personalised strategies in the pursuit of solutions to challenging problems. Welsh and Murray (2003, p.230) proposed that learners become "active knowledge producers instead of passive recipients" when they are able to problematise an issue. Such problematisation enables intentional learning (Dehler, 1996) where learners can recall prior knowledge to which they can relate new ideas so as to reach and assess conclusions. The Mental Model Mode (Mode) has been designed to enable learners, and their teachers, to gain a deeper understanding of what it means to engage in active or intentional learning by enacting the functions of mental models.

THE MODE

Mental models are internal cognitive structures that are externalised through action. Sometimes that action entails participating in discourse or selecting a process to undertake to reach a given goal. Decision-making engages the running of mental models that are retrieved purposefully and/or unconsciously by the individual based on previous experiences, knowledge, and cues in the task itself. The Mode in Figure 1 was designed from the mental model functions used in problem solving (Edwards-Leis, 2012). The term 'mode' was selected for its clarity of expression when describing how information is processed. As a process, a mode describes "a way or manner in which a thing is done" (Moore, 2004 p.900) relating specifically to

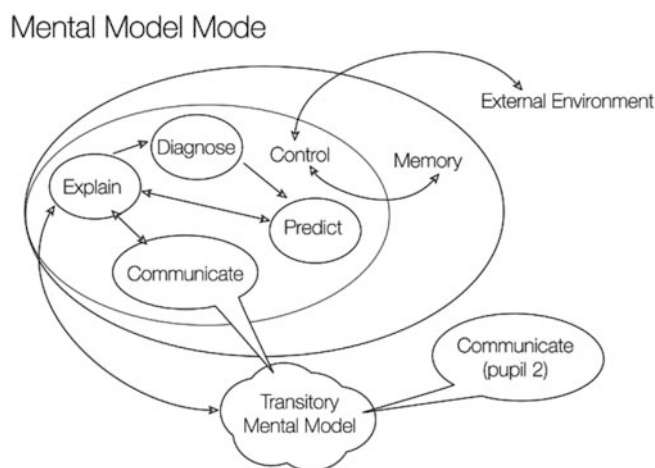


Figure 1. Mental Model Mode (Edwards-Leis, 2012)

the procedural aspect of the functions of the mode including explaining, predicting, diagnosing, recalling from memory, communicating and controlling. It explains the mental modeling that individuals undertake when designing.

The explanatory function enables individuals to understand and select strategies by “facilitating cognitive and physical interactions with the environment, with others, and with artefacts” (Henderson & Tallman, 2006, p.25); individuals explain what they know and what they are doing. The predictive function enables an individual to predict how a design or a strategy selected to solve the design problem will work (Johnson-Laird, 1983; Norman, 1983). This function serves to differentiate mental models from other cognitive structures, such as schema, that do not account for novel situations that individuals encounter. The diagnostic function exercises an individual’s metacognitive strategies because it enables a testing of the success of the chosen design or strategy alongside the individual’s capability to deliver the required knowledge for its application. This function relies on an understanding that the individual may be working with a mental model that does not allow them to assimilate the new concepts required to complete the task without further guidance or assistance (Royer, Cisero & Carlo, 1993).

Memory and its role as both a ‘location’ in the individual and a process of retrieval highlights the bimodal nature (Edwards-Leis, 2012) of mental models. Mental models are retrieved as a ‘product’ from long-term memory and used in working memory while they are being run (and therefore a process to act on information) and permanent in long-term memory (and therefore a product) when stored for future use (Gentner & Stevens, 1983; Henderson & Tallman, 2006). How well they are stored – and retrieved - relies on the individual’s network of related understandings (Henderson & Tallman, 2006) that are fashioned when the mental model is created and stored; such idiosyncratic matrices are imbued with the individual’s personalised interactions with and perceptions of the world. The communicating function enables individuals to see and understand the mental models of others because they facilitate the communication processes of writing, reading, talking, and listening while thinking through problem-solving situations (Barker, van Schaik & Hudson, 1998). Transitory mental models are created between individuals who are collaborating on a design or problem. Transitory mental models become evolutionary repositories for the exchange of ideas between individuals and each individual, while agreeing on and contributing to the composition or process of the design during the act of collaboration, will incorporate their own understanding of the exchange into their evolving mental models when the collaboration is concluded. The control function is of great interest because it is the overseer of the other five functions and coordinates, consciously or unconsciously (Henderson & Tallman, 2006) their running all the while evaluating the effectiveness of the design or strategies chosen to reach the goal.

The validity of the Mode to explain problem-solving processes was tested with Primary pupils in a London school who were given a design problem. The participants were in Year 6 and were 11 years of age at the time of the study. They were invited to design something that would be of use to an individual who was

commencing Secondary school. The brief was open although they were provided with some guidance (see Appendix A) to enable them to interrogate the context and assess their efforts including the artifact's user, purpose, and function. They also were required to consider the design decisions they would have to evaluate such as materials, components and production as well as how innovative the product was and whether it met an authentic need. Participants were given 15 minutes to complete the task so the pressure to think and act quickly was high. There was no requirement to make the artifact but a labelled drawing of the design was requested.

There were four participants and they could select whether they worked in pairs or as individuals. Two, Marci and Sage, decided to work in a pair, while Sam and Tara decided to work individually. Participants were filmed while working and Sam and Tara were asked to think aloud while working so that their thoughts would be exteriorised. Marci and Sage were required to communicate their ideas with each other verbally so that the exchanges could be heard. At the end of 15 minutes the video was stopped. On the same day the video of the design activity was played back to each participant individually, using Stimulated Recall Methodology to gain the in-action thoughts of each. This interview protocol allowed the functions being used to solve the problems to be captured and analysed so as to confirm the use of the Mode to explain problem-solving processes.

STIMULATED RECALL PROTOCOL

Stimulated Recall is a research method associated with introspective information processing where recall of thoughts can be enhanced by the use of prompts, such as replaying a video (Ericsson & Simon, 1984, 1987; Gass & Mackey, 2000; Henderson & Tallman, 2006). It was first used by Bloom (1954) as a method to study the recall reliability of students after a lesson. The usefulness of the Stimulated Recall Protocol is enhanced by providing a number of cues from the original situation, such as a video or audio recording, to "reactivate or refresh recollection of cognitive processes so that they can be accurately recalled and verbalised" (Gass & Mackey, 2000, p.53). The information being accessed by Stimulated Recall is the conscious thoughts of the participants during a previous activity and the use of the video (Pausawasdi, 2002) is an accurate documentation of what occurred during that activity.

The validity and reliability of responses are maximised by adhering to strict protocols including the immediacy of the interview after the event, clear instructions for pausing the video, clear question prompts and non-directive questioning (Gass & Mackey, 2000). Bloom (1954) found a 95 percent accuracy of recall if the interview was conducted within 48 hours of the event. Question prompts used by the researcher are a vital contributor to rigour, validity, and reliability. Questions such as, "What were you thinking here/at this point/right then?" (Gass & Mackey, 2000, p.154), should be used to prompt participant recall. When such a prompt is given, a response of "Don't remember/know" or "Can't remember" may be given by participants and these responses must be accepted without

further “fishing” (Gass & Mackey; 2000, p.154). Patience is required, particularly with young participants who want to please adults with what they might like to hear.

Edwards-Leis’s (2010) study of children’s problem solving in robotics revived a protocol change first used by Marland, Patching and Putt (1992). The open-ended question, “What were you doing then?” to prompt a participant to verbalize what they had been doing prior to recalling what they had been thinking, was utilised. Edwards-Leis (2010) found this addition to the protocol increased the number of recalled thoughts and decreased the number of ‘no thoughts’ considerably by participants during a second round of interviews after the first round provided little data. Given a similar age of participant in this study, the lead question, “What were you doing then?” preceded the prompt, “What were you thinking when you were doing that?” during most pauses in the videos. The total number of ‘there and then’ thoughts were 172 with an average of 43 per participant. There were very few ‘no thoughts’ responses.

HOW PUPILS DESIGNED

The four participants’ recalled thoughts were coded for their descriptor words and phrases to signify which function they represented using descriptive coding (Miles & Huberman, 1994). An example of descriptive coding for the diagnostic function was ‘what if they forget to bring their pencils’ (Marci, Stimulated Recall Interview (SRI), 8 November, 2012) which indicated that the participant was applying some what-if analysis in their thought process to trouble shoot a design feature’s capacity to meet the user’s needs. Three Mode functions dominated the ill-structured (Jonassen, 2011) problem-solving domain of design: explaining (44%), diagnosing (28%) and predicting (19%) were the most frequently used functions across the four participants.

The function most commonly used by the four participants was explaining. Johnson-Laird (1983, p.3) eloquently described an individual’s attempt to understand their world by constructing “models of it in their mind”. Understanding is externalised through explanation either through discourse, deed or diagram including graphical representations and script. In this study, the participants were explaining their understandings of the responses of the designing task such as Tara’s “I couldn’t think of a name so then it’s a badge that helps people so I called it the Help Badge” (SRI, 8 November 2012). Often, the explaining function preceded other functions such as diagnosing and predicting as seen by Tara’s recalled thoughts “with the mic (sic) one, I thought of it before [explaining], but I wasn’t sure about putting it in [diagnosing] and with the button you’d probably press it and it would start recording [predicting]” (SRI, 8 November, 2012). Another example of how individuals use the three functions to communicate their design processes through these functions was given by Sam who designed a “machine hat” to keep students on task and to provide digital information. He was explaining one of his design features that would keep the hat on users’ heads if they were running around: “Most people like running and falling over [explaining] and this will keep it on and if it didn’t have it, it will fall [predicting] and people have to be very careful and their life will be a bit boring [diagnosing]” (SRI, 8 November 2012).

Table 1 shows the breakdown of the functions for each participant. It is of interest because it clarifies the idiosyncratic nature of mental modeling in problem solving even when individuals are working together as were Sage and Marci. Working together on the same designing problem does not imply homogeneity of thought or cognitive function. The use of the Mode by teachers and pupils to track their individual cognitive strategies can highlight the areas where further guidance is needed for task completion.

Table 1. Frequency of functions executed by the four participants during the design task 8 November, 2012

<i>Function</i>	<i>Marci</i>	<i>Sage</i>	<i>Sam</i>	<i>Tara</i>
Explaining	42%	42%	40%	46%
Predicting	5%	16%	38%	17%
Diagnosing	20%	36%	22%	31%
Communicating	30%	6%	0%	0%
Memory	3%	0%	0%	6%

Sage executed the diagnostic function more than the other participants demonstrating her almost constant approach to critiquing each new idea or design component. Questions such as “Where would it be placed?. Which one was best?. What would the microphone look like?” as well as commentary “I had a picture in my head but it looked really odd” and “I didn’t really think of it because you can’t really hear that well through metal” (Sage, SRI, 8 November, 2012) clearly demonstrate her interrogative approach to designing. This strategy often frustrated her partner, Marci, who would have preferred to do the task on her own because “when there’s two people we can’t have our own ideas” (Marci, SRI, 8 November, 2012). Marci’s relatively high incidence of communicating function indicates that during the activity almost a third of her thoughts (see Table 1) were engaged in negotiating with Sage and quite possibly responding to her design method.

What is evident from the SRI responses in Table 1 is that encouraging pupils to engage in designerly behaviour offers a significant opportunity for them to explain how they interact with the world to solve modern and relevant challenges. The data also indicates that individuals operate quite differently during the design process even while working together, simultaneously, to reach a shared goal. A greater understanding of the individualistic approaches for the teacher and the pupil themselves would enable a greater emancipatory potential (Welsh & Dehler, 2001) to be possible for the development of knowledge.

IMPLICATIONS FOR PEDAGOGICAL PRACTICE

The use of the Mode in classrooms enables a problem-solving, learner-centred approach to designing because it provides a greater understanding of the interactions

that occur through the shaping of specific learning experiences. Dewey (1938, p.40) believed that:

a primary responsibility of educators is that they not only be aware of the general principles of the shaping of actual experience by envisioning conditions, but that they also recognise in the concrete what surroundings are conducive to having experiences that lead to growth.

He warned of a “mechanical uniformity of studies” (Dewey, 1938, p.62) which could lead to “uniform immobility” (p.62) quite different to intelligent activity that involves “selection of means-analysis – out of the variety of conditions that are present and their arrangement – synthesis – to reach an intended aim or purpose” (p.84). This study of how the Mode can be used to externalise the cognitive processes used in problem solving in design through the pursuit of relevant challenges highlights the idiosyncratic or ‘un-uniformity’ of what really happens when individuals learn. The Mode and how it can be used in classrooms to understand, diagnose, remediate and celebrate how individuals cognitively navigate pathways through learning experiences has the potential to give some structure to the “common reflection and action” (Freire, 1972, p.44) necessary for co-intentional and sustainable education. The Mode addresses deficiencies that Myers and Beringer (2010, p.53) see in the cognitive problem-construction skills necessary for embracing “diverse and conflicting claims about values, facts, and the bases of knowledge” evident in the ill-structured problems (Jonassen, 2010) about sustainability.

If, as Freire (1972, p.81) suggested, “all authentic education investigates thinking” then the Mode provides a structure for students to explore their own thought processes while engaged in thinking. The Mode as a way of approaching (and understanding) learning in a pedagogical approach based on authentic problem solving supports a move away from “one-dimensional understandings of the world ... that fail to foster active learning” (Ross, 2000, p.54) because it accommodates and clarifies the individual’s nature of thinking. It allows the pupil and their teacher to see how they can light their own fire for learning while understanding their unique contribution to the world.

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APPENDIX A

Design Brief

You have 15 minutes to design something that a student starting Year 7 at Secondary School will need.

Your design needs to consider:

User – what are the need/s you are addressing?

Purpose – what will the product do?

Function – how will the product work?

Design Decisions – what materials, components, techniques will you use to create and operate the product?

Innovative – needs to be something new – not copied

Authentic – needs to be a real product to meet a real need – believable

Task:

Brainstorm ideas – write or draw them. Once you have decided on an idea then draw a detailed plan of it including labels for parts and materials.

Fill in the table on the attached sheet to show you have thought about the design requirements above.

Secondary Student Product

Drawing – in this space you need to draw your design and give it labels to explain the different parts.

User	Purpose	Function	Design Decisions
Who will use the product?	What is the product for?	How will it work? Why will it help them?	Materials needed to make it. How will it be made?

SECTION 3

TRISTAN SCHULTZ

12. KARTOGRIFA IN-FLUX

A Pedagogical Tool to Challenge Eurocentrism in Post-Compulsory Education for Sustainable Design

INTRODUCTION

Kartogrifa In-Flux – Thinking, Talking, Building Alternative Pasts-Futures (KIF), the author’s project (Schultz, 2012), is a mediation object created on the East Coast of Australia in 2012, KIF revealed valuable insights in relation to aiding students in navigating the complexities of challenging ‘Eurocentrism’. Samir Amin (2011) provides a thorough theoretical critique of Eurocentrism from which the context of the word is aligned here. Eurocentrism is an unsustainable dominant modern Western narrative of European reach and power being imposed on other parts of the world. The case is made that socio-culturally situated pedagogical tools can effectively challenge Eurocentrism in post-compulsory education for sustainable design. KIF has been used as a pedagogical tool to its full capacity with undergraduate university students of visual communication design, product design, exhibition design and design theory. It is also designed to be effective in mediating discussion among students of humanities such as cultural studies, history, anthropology, sociology and psychology, notwithstanding evidence of effective engagement with K-12 compulsory students. In both cases of exhibiting the KIF event discussed in this chapter, there were a mix of post-compulsory students and disciplines, K-12 students and members of the public. In order to refine the scope here, a reflection of KIF as a pedagogical tool for post-compulsory students engagement is outlined. KIF is a pedagogical tool with a purpose of unravelling the concealment of other forms of knowledge, in this case, Australian Indigenous Knowledge (IK). It is also an exemplar of creative and lateral design-thinking. The design-thinking however has a ‘decolonising’ agency. As such, KIF is ‘decolonial/design-thinking’ directed via careful and deliberate use of elements such as colour, form, and textual signs. The motivation for KIF is to mediate complex ideas among participants that go towards securing more sustainable modes of existence (whatever that may be in any given locality).

Eurocentrism and Sustainability

As is the case with Australia, the world faces a multitude of problems, many of which are capable of rupturing any recognisable future for humanity. Many argue

that underpinning these problems is a dominance of Eurocentrism, or more simply, the West's inability to see value in other modes of being-in-the-world. These *other* modes exist; they are alive, yet mostly find themselves in the margins, resisting oppression from the colonial era's imposition of modernisation. Eurocentric thinking rejects other forms of knowledge that derives from cultures often described as 'inferior' and 'primitive'. Resisting Eurocentric thinking might open reservoirs for modern Western geographies to see alternative forms of knowledge as options of how they might survive extreme changes imminent in their own geographies. Learning from these cultures involves both unlearning Eurocentric modes, and learning other modes of being-in-the-world, of understanding sustaining qualities. Learning begins with the questions: what situated knowledge destroys futures and what creates futures?

If what destroys is rising sea levels, growing human populations, resource depletion, economic development based on consumer and industrial perpetual growth, then the underpinning problem is an inability to name what relationally connects these destructive forces. To begin to understand, to make accessible, to think and talk, hence, to build an ability to redirect the nature of the world, the West might identify Eurocentric thinking found in modernity and colonialism as if it were the relational connector of such problems.

To unravel and expose the foundations of modernity and colonialism gives the possibility of breaking out of its hold. Tony Fry (2011) suggests that this task is not one of 're-making' technologies or daily behaviours, but being of a mind-set for the re-making of 'us'. For the West, one example of this is to leave behind an assumed superiority over Indigenous Knowledge. Walter D. Mignolo (2011) calls this rejecting the 'logic of coloniality'. He argues this logic is the presumption that western civilisations were the most recent civilisation in human history and that the rest of the world should follow suit. The logic of decoloniality would quite simply respond: this doesn't mean they're the best (Mignolo, 2011).

Re-making is a conscious project, which will occur mostly by design, and as Fry (2011) admits, might be many decades or centuries in action. Kartogrifa In-Flux (KIF), the pedagogical tool case studied here, is one such contribution towards this goal. Design-thinking as a discourse aims to recognise such relational impacts, however, as is underpinning this chapter and KIF, decolonial/design-thinking adds agency to design-thinking: that of unravelling coloniality by design. This gives life to reservoirs of knowledge that may have far greater abilities to sustain than modern dominant narratives, but have been oppressed through the last 500 years of the modern era of colonisation.

Colonialism and Australia

Upon Captain Cook's mapping of the east coast in 1770, and Governor Phillip's arrival with eleven ships (The First Fleet) to create a penal colony in 1788, the geography of Australia was the last of Europe's major colonial conquests. Australia,

as a categorisation of land under British law, was ‘desert and uncultivated’, which gave the British their own authority and justification to seize the territory under their doctrine of *terra nullius*—as unowned land (Banner, 2005). As was the charge of the harsh, impenetrable, rugged wilderness of Australia, Aboriginal people were regarded as more of a burden than an asset. It is a commonly accepted argument in studies of Aboriginal issues, for example from Attwood and Arnold (1992) and Lattas (1997), that during the early decades colonisers were ignorant to the existence, or potential usefulness of the forms of knowledge used by Aboriginal inhabitants of the land. As was the case in other geographies, dominant European narratives obstructed, or at worst cancelled out, entire Indigenous patterns of knowledge writing, which have at least in the last few decades, noted to be extremely sustainable modes of living. People concerned with Australian droughts, fires, extreme climates and degrading soil, along with those concerned with a search for more sustainable mind-sets, might find answers within Indigenous patterns of knowledge.

The perception of the Australian Indigenous people as ‘primitive’ came with the boats to Australia in 1788. To deconstruct this perception is the first step to opening the reservoirs of knowledge that might secure more sustainable modes of existence. Knowledge transfer in Australian pre-colonial Indigenous societies was a pedagogical transfer of spatial-historical narratives. Mary Graham offers a succinct conclusion for her conception of modes of knowledge production: ‘multiple places = multiple dreamings = multiple laws = multiple logics = multiple truths’ (2007, p. 6). This is a clear distinction from the Eurocentric view that imposes knowledge through both colonisation of the mind and geographies.

KARTOGRIFA IN-FLUX

The case is made that KIF acts as a critical tool in exposing and unraveling the relationship of Eurocentrism with sustainability via decolonial/design-thinking. Even though KIF is socio-culturally placed in Australia, readers will identify outcomes and insights that can be transferred into other pedagogical tools in other localities, including: (i) rejecting dominant Western linear pedagogy through employing post-structural¹ methods; (ii) using narrative fictions to write alternative histories, sediments for alternative futures; and, (iii) using culturally constructive (rather than culturally destructive) semiotic and symbolic deployments to trigger a questioning of the politics of representation inherent in each locality.

There are two positions underpinning this chapter. First, sustainable design might only be effectively taught once an educator has unravelled and challenged Eurocentric tendencies in student designers. Second, the act of mediating complex ideas, such as challenging Eurocentrism, works most effectively when socio-culturally situated; as a positive and culturally constructive semiotic deployment via careful and deliberate use of sign functions.

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Background

Kartogrifa In-Flux (KIF) is an interactive event where participants move around a table (2400mm x 3600mm) while reading a textual narrative within a graphic layout (see [fig.1](#)). On the interactive table are tactile, moveable objects (printed acrylic discs and metal objects) symbolising land, human and the artificial, which participants are encouraged to move and slide in and out of ‘place’ (see [fig.2](#)). The tactile objects correlate with the textual narrative. Both these mediators function to expose Eurocentric thinking. They literally appear and read as Indigenous knowledge and values represented through the contrast between living in reciprocity with land, and arriving as a European culture ‘separated’ from the land. The ‘branched’ narrative tells an original fictional story, of a Cartographer walking with an Australian Aboriginal tribe around the time of ‘First Contact’ in 1788. One branch leans toward the *kartogrifa* valuing Indigenous Knowledge (IK) systems and ways-of-being. The other branch reads as though the *cartographer* does not. Hence the two branches are on one hand similar stories, yet remarkably different.



Figure 1. Top-view of table



Figure 2. Participants moving ‘human/land/artificial’ objects

Objective

The main objective is for participants to reflect on the value the Cartographer finds in IK and whether these values are evident in their society today, or whether these values fit into their perceptions of a sustainable future in any given locality—as ‘options’ for different viable futures. Hence, participants are alienating themselves from Eurocentric thinking through reading a narrative and visual signs, and interpreting seemingly non-sensical Eurocentric thinking that came with the ‘First Fleet’ in 1788.

Pedagogy

Pedagogical success has rested on the ability to trigger responses specifically accessible in the Australian modern, post-colonial context, with people who are willing to engage in other ways of being-in their world. It shows that participants are willing to engage in complex information when that information is mediated by a creative and interactive multisensory experience.

At first glance, two disc colours signify the two cultures, while green signifies the land. The metal nuts immediately signify that which is not human or nature. The discs and colours alone stimulate an explorative response. Once students engage, they find they are interacting with an oversized visual diagram. The diagram visualises patterns of the consequences of colonialism, instead of relying on heavy theoretical writing on the subject. This allows students to arrive at their own questions that further reading in texts can assist to answer. The fictional narrative in KIF is also a major pedagogical tool aimed at teaching students that history is subjective, and is written in accordance with agendas. Both the diagrammatic and fictional natures of the project represent post-structural methods of pedagogy. This aligns with rejecting the Eurocentric tendency of placing superiority on structured linear forms of learning such as from academic texts.

SUSTAINABILITY / LEARNING

KIF and Sustainability

The tactile moveable objects in the tool aim to direct the conversation toward thinking about the separation of ‘human’ and ‘land’ as being intrinsic to ‘our’ ability to sustain. ‘Sustainability’ in dominant discourse all too often does not reach such a deep level of questioning. Sustainability is still (mostly) rhetorically employed within the terms of a human-centred conversation. This human-centredness means the word retains its relation to human technological and scientific ‘progress’ and ‘development’ through control over nature (Fry, 2011). Arturo Escobar (2008) argues that this ‘integration of the natural, human, and supernatural worlds [leads to] the complex historical developments associated with capitalism and modernity [hence] the objectification of nature as external to humans and its subsequent treatment as a commodity’.

KIF attempts to alienate the participant from this conditioned normality by exposing this perception as only one story. The project provides another imaginary—an Aboriginal conception of ‘human’ and ‘land’ as being in a reciprocal bind. This is known by Mary Graham as ‘custodial ethics’ (2007), ethics that one could argue have proved to sustain Aboriginal cultures for thousands of years. Graham defines ‘custodial ethics’ also as ‘looking after country, looking after kin’ (2007). Custodial ethics, in common Western discourse and Aboriginal discourse, is also often described as the ‘dreaming’. It can also be described as ‘Aboriginal Law/Lore’ or ‘Law of Place’. Custodial Ethics are such that all perspectives are valid and reasonable and all localities/Places, have their own unique voice. It is a system of geo politics of knowledge writing.

The narrative in KIF depicts potential exchanges of custodial ethics between a cartographer and an Aboriginal tribe, if only taken on board as a new way of being-in-the-world by the colonisers. On one side of the branched narrative participants read, they unpack conceptions of ‘progress’ as intrinsically tied with custodial ethics with land; as an immaterial culture living ‘in’ the environment, with less human-centred tendencies. On the other side, they read conceptions of ‘progress’ as Eurocentrically understood - as ‘nature’ commodified.

KIF raises the stakes past the dominant discourse around the term ‘sustainability’ and posits it in a new realm. One where ‘sustaining of *being*’ is found in a shift of mind-sets, not in a techno-centric fix.

Terms of ‘Learning’

To learn from KIF, is to learn with and from the mobilisation of a decolonising mind, rejecting what Mignolo (2011) calls the ‘ego-politics of knowledge’ (knowledge that has been imported and imposed from other geographies). To be most effective, a conscious effort would be made by the KIF participant to see beyond the veil of their colonised minds in order to view decolonial options as ‘sustainable’ futures. Mignolo (2011, p. 217) frames the task:

Decolonial options are roads toward the future. If you follow them you would break away from the legacies of the Renaissance and the Enlightenment, you would begin to shift the geography of reasoning; shaking off your body the enchantments of liquid modernity and the chains of coloniality toward the sear of an-other language, an-other thought, an-other way of being in the world.

A ‘sustainable future’ means different things within different localities, and decolonial options recognise plural ‘geo-politics of knowledge’ (Mignolo, 2011), that is, knowledge which is socio-culturally placed.

Western education for sustainable design rarely recognises this. Western educational institutions tend to be steeped in historically constructed, Eurocentric ego-politics of knowledge, underpinned by development, superiority, universality of reason, globalisation and broken capitalist ideologies—all of which are part of the

same unsustainable story. KIF, as a pedagogical tool, aims to rupture this perception, essentially providing an entry point for students into what needs to be un-learned in order to learn. Through trigger events in the narrative, KIF brings criticality to thinking about what ‘we’ are, what ‘we’ desire, what ‘we’ value, and how this may serve what Fry (2011) coins, a *sustain-able* future, or *sustainment*’.

THEORETICAL UNDERPINNINGS

Translating Difference into Values

The task in designing KIF, is inescapably involved in sign coding, or “re-valuing what modernity devalued” (Mignolo, 2011, p. 179). The illusion of Eurocentrism is that difference is an object of exchange, a commodification, not an actual real and living alternative world. Unlike the illusions floating in air as commodified sign values, the solid differences are situated in place having socio-cultural functions.

KIF highlights several signs of difference between the Aboriginal and Non-Aboriginal parties colliding in the textual narrative, and aims to translate those differences into values, not of political economic values tied in with globalism, but rather as equitable cultural values. In KIF’s visual language, aligning with the textual narrative, the project rejects a coding biased to either a tokenistic Western or Aboriginal sign value. Avoiding this trap is extremely important in Australia, as what commonly occurs is appropriation of visual language of Aboriginal culture, reduced to a tokenistic, decontextualised and commodified sign value. As Fry (1990, p. 92) cautions:

The nationalistic search for signs to symbolize Australian identity has resulted in a raid on Aboriginal culture - a cruel appropriation when viewed against the history of genocide and neglect of Aboriginals by the state.

It masquerades the appalling situation many Aboriginal communities are in today, allowing at best a Eurocentric reductive iconographic analysis by the viewer, and at worst a disinterested aesthetic ‘spectacle’ (Debord, 1994).

This highlights the importance of careful and deliberate socio-culturally situated, semiotic mediation when designing pedagogical tools. In this context, there can be no universal notion of ‘sustainability’ sign values to unravel Eurocentrism. The task is socio-culturally situated within what Modernity devalued in each locality in order to eliminate the difference, and therefore can only be engaged through re-valuing that difference with critical knowledge from within that locality. So, in educating for ‘sustain-able design’ anywhere in the world, it is necessary to engage culturally relative forms of the sign including language, systems for counting, diagrams, maps, mechanical drawings and so on (Vygotsky cited in: Wertsch, 1989, p. 137). Wertsch (1989, p. 140) extends Vygotsky’s theory, pointing out “all human mental functioning is inherently situated in cultural, historical, and institutional settings.” As such the human mental functioning of complex ideas, such as exposing Eurocentrism to a

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student designer, might also be socio-culturally situated, via careful and deliberate use of culturally relative and constructive signs, mediating differences and values.

DESIGNING THE KARTOGRIFA IN-FLUX EVENT

The first stage of KIF involved understanding and prioritising what needed to be said, and how best to communicate it to the largest number of people. Furthermore, it was a process of framing this in a way that would alienate and deproximise participants from the dominant Australian Eurocentric order of thinking, without seeming non-sensical.

The designing of a material and spatial event was chosen as the most effective method to initiate and pollinate this conversation. The actual object is large enough to allow large groups of people to talk face to face. 'Narrative' was chosen as a useful way to draw people into deeper engagement with the tool. Participants are required to invest time into remaining inside the event once they begin reading the story. Narrative also humanises the otherwise complex issues underpinning the tool.

Key triggers in the narrative force readers to contemplate actions and consequences in an emotional story that relates to their own lived human experiences. There is a moment when a mother dies upon giving birth to her child and this is a trigger that personalises the story through engaging the emotions. The intention is for the reader to become emotionally attached and therefore more inclined to search for a way out of the situation, between the lines of the story. This attachment becomes ever more potent, the more socio-culturally situated the participant is.

Complex terminologies and sentences are introduced in key areas to direct the reader toward more advanced concepts and language not often used in mainstream society that can assist in more efficient and rhetorically accessible conversations. As is the case with the branched narrative, intended to fixate the participants in solitude and contemplation for longer periods of time, the tactile objects also engage and sustain the audience. Both the nature of a branched narrative and the moveable tactile objects serve as an effective post-structuralist mapping experience. The main character Kartogrifa, would have also had this experience if we imagine him walking with the Indigenous tribe. He may have increasingly found value in Indigenous Knowledge, shifting between imposing linear cartographic practices and witnessing subjective lived experiences of mapping land. It must have been a real moment of *flux*. Here is an excerpt from the narrative illustrating one such moment:

Valuing Indigenous Knowledge Side

...their movements within the country are guided by the tribe's sharp observational abilities in reading signs and patterns of the land. Living in simple

dwellings often assembled and disassembled in place, the guests remained free of contact from their fellow boat arrivals. By the fire conversations with the tribe remained free of the shackles of imposing western science and philosophy. The guest family could feel their minds pushing and pulling between western linear knowledge that seemed separated from land, and Indigenous knowledge that seemed to ebb and flow within the land.

Not valuing Indigenous Knowledge Side

...their movements within the country are guided by their probes and devices. Living in simple campsites, the invaders often encountered the native population, trying to conciliate affections from a safe distance. Campfire conversations with the white expedition filled their minds with aspirations of heroic pioneering and control over land in the face of such a harsh inhospitable environment.

The timeline seems amongst the most inescapable metaphors we have as a way of representing history (Rosenberg & Grafton, 2012). The object represents a single axis timeline in Australia from 1788 to Federation in 1901. Distribution of time along the timeline however, is irregular and conceptual rather than measured, coded and evenly spaced. There is a sense of arbitrary time intrinsic to the event, in line with a non-compliance with Western linear thinking. The objects represent both the Kartogrifa's mind, and time. They are chronological indicators of events rupturing Kartogrifa's 'colonised mind' as he journeys with the Aboriginal tribe. Below is an example excerpt from the narrative immediately after Kartogrifa has been exposed to a totem initiation:

Valuing Indigenous Knowledge Side

...The inconceivable differences between the West and the 'Other', differences he had been taught to fear, and eliminate, soon begin to be translated into values, ethics for a new way of seeing the world. A new reality... (See [fig. 3](#))

Not valuing Indigenous Knowledge Side

...These differences were translated into disadvantages in advancing modern civilisation. There was only one way of seeing the world, only one reality, and whatever the natives were doing did not fit.

The event is effective as a multisensory experience: the room is dark, and Australian bird sounds play loudly through several speakers. This muffles outside noise, allowing participants to immerse themselves in isolation to digest complex and critical information. The object is best experienced when directionally lit in a way that commands attention.



Figure 3. Differences translating into values

RESULTS

Preliminary findings of the KIF project have shown a strong dichotomy in levels of engagement, according to the environmental placement of the event and the presence of a facilitator. Environment (a), enjoyed high volume traffic (15-20 people around the object at all times), with a highly immersed multisensory atmosphere. A facilitator was present at all times (during a five hour session) to offer verbal prompts, inevitably resulting in mediation via an author's subjective contextualisation. This resulted in a high percentage of 'high to very high' levels of engagement. This level, as an observing ethnographer reported, included:

People who read both sides of the story board, interacted with the moving parts in response to the story, responded to the audio and indicated a full understanding of the message at a conceptual level (time spent in exhibit between 6-10 minutes). The majority of people who made this depth of commitment progressed further to complete the feedback form and to talk to the designer. These people tended to return to the exhibit one or more times throughout the evening, bring others with them, explaining and guiding them through the process.

Environment (b) was a situation in which there was a low level of natural traffic and resulted in an almost opposite level of engagement from environment (a). The traffic volume was 1-2 people every hour. No facilitator was present, but contextual reading leaflets were provided, and the event remained displayed for 7 days. Evaluations of environment (b) show that participants committed to mostly 'medium' levels of engagement, explained as:

When people entered the space, they scanned the environment, read one full text block, or one side of the story board, showed acknowledgement of the background audio, moved the pieces of the exhibit in response to the story and indicated understanding of the main aspects of the story (time spent in exhibit an average of 3 – 5 minutes).

Whilst in environment (a) over 60 feedback forms were collected in 5 hours, in environment (b), only 6 feedback forms were left in the feedback box over 7 days. This highlights an obvious issue with environment (b) lacking contextual verbal mediation.

In environment (a) written feedback from participants stated that it “demonstrated a distinctive way of teaching that is more intuitive” and that it “opens conversation about topics Australians are not used to talking about”. Many students commented how the event was also “a great example of lateral creative thinking”. On the other hand, environment (b) showed that the lack of verbal contextual mediation resulted in a lack of commitment by the participants to critically engage in the content, or give useful feedback.

Also, it is evident in environment (b) that effectiveness was minimised through the lack of group/peer encouragement to collectively absorb the complex information, i.e., there was no collective mental functioning to ‘act critically’ in reading the signs. For the individual participating in the event alone, the participant’s inherent Eurocentric thinking may preclude the intended ‘semiotic mediation’ of identifying value.

DISCUSSION

The results briefly discussed above highlight both the effectiveness and limitations of KIF. There is a need to test KIF in further varied environments in order to locate a balance, where levels of engagement are high and critical, but also where the requirement for verbal contextual mediation is low. If mediation through excessive verbal facilitation is needed, students will be swayed and not develop their own abilities to read the signs built into the object. Verbal interjection both (negatively) influences the effectiveness of the object as a pedagogical tool for semiotic reading, and as an inanimate tool for decolonial/design-thinking. On the other hand, in the spirit of unraveling Eurocentrism for students via the most efficient approach, verbal interjection proved to fruit the highest levels of understanding and engagement. Verbal mediation therefore also requires further framing within calculated triggers, openings and questioning, rather than explanatory conclusions.

Understanding the potential of the socio-culturally placed pedagogical tool for educating sustainable design requires further understanding of how it might be developed, in order to transcend its obvious appearance as ‘medium’ or ‘image’. For all its intents and purposes as a visual communication tool it should appear as rupturing and restructuring power relations between the coloniser and the colonised.

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The message should not be mistakenly found in the medium, or the image. The social relations are the message (Vodeb & Janovic, 2010). In this case, it is the relations between the Kartogrifa and the Aboriginal tribe. KIF attempts to highlight the unsustainable social relations inherent in Australia's modern colonial world.

KIF presents an opening to a conversation—a 'thinking-in-action' about 'our' relationship with the natural environment, and 'our' social relations. This may be regarded as an initial phase, which with time requires further framing within the wider context of shifting ongoing perceptions through experiences that follow the initial interaction. KIF proved to educate students in the short term. A larger project in line with KIF may strive to restructure public social relations in the long term.

CONCLUSION

Regardless of the global locality, KIF highlights commonalities that could bind the premise of what it brings into existence with what other projects in other localities might reveal. The ultimate goal is a critical exposing and unraveling of the relationship of Eurocentrism with sustainability via decolonial/design-thinking. Commonalities across localities are: (i) rejecting dominant Western linear pedagogy, such as employing post-structural methods; (ii) using narrative fictions to write alternative histories, sediments for alternative futures; and, (iii) using culturally constructive (rather than culturally destructive) semiotic and symbolic deployments to trigger a questioning of dominant narratives inherent in each locality.

The situated learning practices developed in KIF reveal effective outcomes and valuable insights in relation to aiding students in navigating the complexities of challenging Eurocentrism and unraveling its relationship to sustainability. Although this chapter refined the reflection of the projects effectiveness at a post-compulsory level, subsequent events have been with K-12 participants. As was anticipated, the younger the group, the more context and verbal mediation needed. Considering the complex nature of the socio-cultural connotations there is opportunity for further investigation into using accessible rhetoric in briefing younger students. In the instances discussed in this chapter, and in subsequent events, KIF is proving to be a strong example of creative and lateral design-thinking. What is most important to note is that design-thinking in this instance is one with agency - of 'decolonial/design-thinking': of unravelling coloniality and Eurocentric thinking by design.

NOTE

- ¹ Post-structuralism is a label given to a critique occurring since the mid 20th century, on structuralism. Structuralism is a model developed in Europe from the early 20th century arguing that all human cultures can be understood by means of models and structures, such as 'structural linguistics'. Post-structuralist authors would reject structural models, such as the binary oppositions primitive/civilised and inferior/superior. Key authors of the critique of structuralism some of whom reject the label 'post-structuralism', include Michael Foucault, Gilles Deleuze, Jacques Derrida, Jean Baudrillard.

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13. A CASE STUDY OF EDUCATION FOR SUSTAINABLE DEVELOPMENT

The Case of Design and Technology in Botswana

INTRODUCTION

The Revised National Policy on Education (RNPE) in Botswana of 1994 and other policy documents including curriculum blueprints and syllabi reflect major discourses associated with economic development, such as ‘economic competitiveness’, and ‘world of work’, which according to Tabulawa (2009) is a result of globalisation. ‘Literature on globalisation claims that changed global patterns of production and industrial organisation have intensified international economic competition’, observes Tabulawa (2009, p. 87). De Souza and Dejean (cited in Moalosi, Popovic, and Hicking-Hudson, 2010) observed that globalisation should be strongly contested because it was a force that resulted in homogenisation of peoples’ culture through standardisation of products.

The goals of the Revised National Policy on Education (RNPE) are to prepare Batswana [the people of Botswana] for the transition from a traditional agro-based economy to the industrial economy that the country aspires to. The education and training strategy . will aim at ensuring that the people of Botswana, as a major resource, will have invested in them the education necessary for national development. (Republic of Botswana, 1994)

Two assumptions could be drawn from the first part of the quotation above. Preparation of the people of Botswana for the transition from a traditional agro-based economy seems to divorce the people from the process of transforming their own country. It seems the objective was to get people to be ready and willing to accept the transformation from somewhere else rather than to be ready to carry out the transformation themselves. It could also be taken to imply that education reform is aimed to address the human resource needs of the country. According to the Fox report (1988) Design and Technology was introduced in Botswana on the basis of preparing Batswana for a drastic and far reaching cultural and industrial change. This statement resonates very well with the goal of preparing the people of Botswana for the transition from a traditional agro-based economy to the industrial economy that the country aspires to.

Botswana's national development planning objectives are rapid economic growth, social justice, economic independence and sustainable development. The strategy for education necessary for these objectives would most likely suffer from conflicting ideologies. Perhaps this is what Tabulawa (2009) referred to as policy contradictions and paradoxes. According to Sterling (2008), a strategy for education necessary for these objectives would have to uncritically support, either directly or indirectly, the growth paradigm; individualism; consumerism and therefore educate people to 'compete and consume' rather than to 'conserve and care'.

Education, traditionally practiced, can be seen to reflect the inequalities apparent in a capitalist society; designed to produce people ready for the industrial market: it functions to fit young people into the existing economy and can be seen to play a part in reproducing an unsustainable society. (Nichols, n.d.)

Economic growth is inevitable but it must be realised that it brings challenges, some of which work against the spirit of sustainable development. Rapid economic growth in Botswana meant that the challenges became sudden. The rate of change ultimately outstripped the ability of scientific disciplines and people's capacity to assess and advise. The static approach to the problem of development through which success was measured in terms of output or income (judged through quantitative measures of national aggregates) was an unfortunate precedent for education in Botswana.

Social justice implies that considerations are made in the distribution of resources and facilities among different areas and groups of people. It implies that all persons are treated equally and without prejudice, irrespective of their origin, race, ethnicity, gender, possessions, religion and so forth. This is a difficult objective to achieve through rapid economic growth and globalisation.

This reflection on the national objectives is just an attempt to say that perhaps the education system, and Design and Technology in particular, in Botswana is set on conflicting ideologies. It must be clearly understood that this is not by any means to underrate the national objectives of Botswana; they may just not be right for Design and Technology and for education for sustainable development. Upon analysing the RNPE, Tabulawa (2005, p.16) observed that the policy's emphasis on the education-economy nexus was bound to produce very parochial individuals whose main ambition in life is making money. Such individuals, according to Tabulawa have very little appreciation for things that are not material. A similar point of view was made by Sterling (2008) when he observed that, with the prospect of the marketisation and control of education in the UK being taken further through the General Agreement on Trade in Services (GATS), education is far from being the universal solution to sustainability but largely still being part of the problem.

The case study presented here illustrates how the introduction and development of Design and Technology education in Botswana over two decades has not contributed significantly towards Education for Sustainable Development (ESD). The case study highlights challenges and limitations of a Design and Technology education curriculum that was founded on the culture, history, and philosophies of

Euro-Western thought and is therefore indigenous to Western culture, a culture that has failed to make any meaningful contribution to sustainable development.

UNDERSTANDING THE CONCEPT OF EDUCATION FOR SUSTAINABLE
DEVELOPMENT AND THE RELEVANCE OF DESIGN AND TECHNOLOGY
EDUCATION IN SUPPORTING IT

As a result of several international conferences and regional actions and reports relating to ESD, ESD and sustainable development have become catchphrases. However, there is little understanding of the concept of ESD among Design and Technology educators in Botswana. Notwithstanding the limited notion of ESD among Design and Technology educators, the subject remains an important vehicle through which values of sustainable development can be instilled in the people of Botswana.

Sustainable development has been described as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987), and education has been identified as one of the keys to sustainable development (Brundtland, 1987; Huckle & Sterling, 1996; Sterling, 2001b; Venkataraman, 2009). The following definition of sustainable development by UNESCO offers a useful description of the concept and a basis to establish the role Design and Technology could play towards the significant educational goal of attaining sustainable global futures of the people of Botswana.

Sustainable development is not a fixed concept; rather it is a culturally directed search for a dynamic balance in the relationship between social, economic and natural systems, a balance that seeks to promote equity between countries, races, social classes and genders. The interdependence of people and the environment requires that no single development or environmental objective be pursued to the detriment of others. (UNESCO – UNEVOC, 2004, p. 8)

The core of Design and Technology education is that the user and purpose of products and services are at the heart of the subject. Consideration of the user and purpose of every designed activity makes the subject a key to sustainable development that encompasses environmental, ethical, and cultural values perspectives set in the broader context of socio-cultural and socio-political issues of equity, democracy, poverty and quality of life. This is exactly what Benson (2009) meant when she observed that:

Design and Technology education in our rapidly changing society has never been more important. The skills, knowledge and understanding that are at the centre of this subject prepare young people for their future lives in so many ways. (Benson, 2009, p. 81)

The discussion of the philosophy and aims of education in Botswana in the introductory section of this case study provides a basis for one to understand and

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appreciate the theory and practice of the subject of Design and Technology in Botswana as it pertains to sustainable development.

THEORY AND PRACTICE OF DESIGN AND TECHNOLOGY EDUCATION IN BOTSWANA

Design and Technology was first introduced in Botswana at the then Botswana Polytechnic (Now Faculty of Engineering and Technology of the University of Botswana) in 1988. This was a teacher training programme that was meant to prepare secondary school teachers of Design and Technology, a subject that was yet to be introduced at secondary school level. It was later introduced at the secondary school level in 1990 following a recommendation of a consultancy that was commissioned by the British Council and the Botswana government to review technical education in Botswana.

The drastic and far reaching changes anticipated by the Fox Report (1988) would obviously impact upon important values perspectives of the environment, ethics and cultures of the people of Botswana. These same values are important determinants in attaining global futures of a people of any nation.

In 1992 the government of Botswana instituted a commission to, among other things, identify problems and strategies for its [the education system] further development in the context of Botswana's changing and complex economy (Republic of Botswana, 1993, p. V). The commission was instituted against a backdrop of a global economic recession that affected Botswana's diamond revenues due to a depressed world diamond market. As a result of this global economic recession there was an upsurge in the youth unemployment rate. Given this background it was not surprising that the RNPE of 1994 and the resultant curriculum and its syllabi were aligned to labour requirements of the economy as the global market determined. However, in an attempt to respond to globalization (Tabulawa, 2005; 2009), it seems that the local context was completely ignored, to the detriment of important values perspectives of the people of Botswana. What happened and continues to happen is what Sterling (2001a) views as an educational theory and practice that supports unsustainable practices; an education in which people are educated by and large to 'compete and consume' rather than to 'care and conserve'.

In 2002 Design and Technology education was introduced at primary school level, but this time as Creative and Performing Arts (CAPA), an amalgam of subjects such as: Art and Craft; Design and Technology; Home Economics; Business Studies; Drama; Dance; Music; and Physical Education.

Design and Technology Education in Botswana Secondary Schools

Reviewing the rationales and aims of both the revised junior secondary school Design and Technology syllabus (Republic of Botswana, 2006) and the Botswana General Certificate of Secondary Design and Technology Education teaching syllabus

(Republic of Botswana, 2000) one cannot miss the emphasis on the tightening of the relationship between education and the economy. Unfortunately economic development as influenced by globalization seems to have been understood to mean the global influencing the local and not the other way round, such that there is no mention of indigenous knowledge, materials and technologies in both syllabi.

Due to the upsurge in the youth unemployment rate which came as a result of a harsh global economic reality, concerns were raised about the relevance of education being provided (Tabulawa, 2009, p. 91). As a result of these concerns government instituted the commission that gave birth to the RNPE. The aligning of the RNPE and the resultant curriculum and its syllabi to labour requirements of the economy as the global market determined, coupled with the influence of ‘developments in ‘Craft, Design and Technology’ teaching in the UK’ (Fox, 1988), is a clear indication that the introduction and development of Design and Technology was shaped by events occurring in the United Kingdom.

Globalisation is the intensification of worldwide social relations that link distant localities in such a way that local happenings are shaped by events occurring many miles away, and vice versa. Local transformation is as much a part of globalisation as lateral extension of social connections across time and space. (Giddens, 1990, p. 64)

It was inevitable for the commission on education to draw upon global influences, but to claim that there was a general movement away from low skill, mass production assembly techniques towards higher degrees of automation and flexible specialization which require higher level of skills (Republic of Botswana, 1993) was a misrepresentation of the local situation. The truth is that Botswana is a mineral-led economy with a poorly developed manufacturing base (Tabulawa, 2009). Recently a National Human Resource Development Strategy was launched to address issues of education, training and employment. These issues come as a result of a mismatch between the skills taught and the needs of industry. This situation has contributed to a high rate of graduate unemployment which is contrary to the spirit of ESD.

Design and Technology Education in Botswana Primary Schools

Design and Technology education in Botswana primary schools is offered through the subject of CAPA. Within CAPA Design and Technology is subsumed in a conglomerate of disciplines with differing epistemological underpinnings. This could not have happened by chance, it replicates the systems intentions and conceptions of design and technology in Botswana primary schools. Compton and Jones (2004) observed that just as different concepts of technology drive different critical agendas, they also drive curriculum development in technology education.

Before 2002 Design and Technology education was neglected and non-existent at primary school level, the arts were marginalized and only offered as enrichment

curricula. Although the introduction of CAPA draws from the neglected and the marginalized subject areas, it may be viewed as a positive development in light of ESD.

It must be noted however that the curriculum at this level does not explicitly address issues of sustainable development; however, some content of the CAPA curriculum is supportive of the implementation of ESD, for example content dealing with issues of:

- Safety
- Waste management
- Recycling and reuse
- Energy conservation
- Environmental conservation
- Business ethics
- HIV/AIDS
- Indigenous material
- Culture; and
- Climate change.

Content dealing with such issues provides a great opportunity for teachers to infuse and integrate sustainable development in their teaching provided that such content is planned and taught with a sustainable development focus. While the CAPA curriculum is supportive of sustainable development, in practice the teaching of the subject does not align with the values of sustainable development. Lack of understanding of the nature of CAPA, and of the concept of ESD among the teachers, is a barrier to effective planning and teaching with a sustainable development focus. The philosophy and aims of education as discussed in the introductory section of this case study also act as barrier in this regard. The philosophy and aims of education in Botswana has been influenced so much and affected by neo-liberal forms of globalization whose aim is the homogenisation of people's culture through standardized curricula and products. Referring back to the conception of sustainable development by UNESCO, if sustainable development is culturally directed search [for a dynamic balance in the relationship between social, economic and natural systems] that seeks to promote equity between countries, races, social classes, then the planning and teaching of CAPA must strongly foster cultural diversity through localisation of products in the face of globalisation (Moalosi, Popovic, and Hickling-Hudson 2010).

DESIGN AND TECHNOLOGY EDUCATION FOR SUSTAINABLE DEVELOPMENT

The role of Design and Technology in promoting ESD in Botswana lies in the renewal of the mind of the African indigenous people and that of the other people of the world who are committed to sustainable development. There is widespread

literature (Chilisa, 2012; Kamwendo, 2010; Mapara, 2009) lamenting the tendency of the African people to denigrate anything that is local and glorify all that is foreign. This mindset is not in line with the values of sustainable development and any drive towards ESD should begin by addressing this issue. Pavlova and Pitt, (2007) indicate that there is a causal connection between the high levels of consumption of the Euro-Western countries and greenhouse gases and climate change which has a disproportionate impact in the poorer countries of Africa. African indigenous people and other people of the world committed to sustainable development must celebrate and promote their commendable relatively low impact contribution to global ecological footprints of the countries of Africa. As global networks expand, African indigenous people need to appreciate, nurture, and contribute local indigenous knowledge systems and technology to respond to globalisation and its [globalisation] implication on environmental, social, cultural and economic issues.

Pavlova and Pitt (2007) cite John Huckle as having distinguished between ESD as policy and ESD as a frame of mind. It is argued here that the way in which sustainable development has been approached in education is as policy and this has not changed society's behaviour. School Design and Technology laboratories and/or workshops in Botswana are equipped with the latest high-tech equipment for skills that are not available in the local industry, all in the quest to be like industrialized nations, while there is shortage of simple equipment that is relevant to provide learners with appropriate skills necessary for the local industry. Such practice is wasteful and against the spirit of sustainable development. Pavlova and Pitt (2007) observed that people in the industrialized world need to radically rethink how they live – their buildings, travel, diet, use of energy and in particular the type of technology they use, but we in Africa want to be like them. An alternative approach recommended particularly for Africa is to view ESD as a frame of mind. In that way the people of Africa will realize that they are better ecologically endowed and would stop chasing after Euro-western lifestyles, rather the people of the west would have to stop in their tracks of living lifestyles beyond the Earth's carrying capacity. Africa is endowed with indigenous knowledge, materials and technologies that support the values of sustainable development, but such knowledge, materials and technologies are denigrated because they are not foreign.

The following example illustrates the potential of linking indigenous knowledge with Design and Technology in addressing issues of Design and Technology for sustainable development. In this illustration, two examples of the same product are compared. Wooden coasters contained in a wooden container (African Indigenous design) and glass coasters in a glass/aluminium stand (Euro-Western design) shown in [Figure 1](#) are compared in terms of conformity to the values of sustainable development.

The wooden coasters and container were hand crafted using a couple of chisels, sandpaper, and some wax polish. This product was bought at a local Botswana craft



Figure 1. Wooden coasters contained in a wooden container and glass coasters in a glass/aluminium stand.



Figure 2. Wooden coasters removed from their container and glass coasters removed from their stand.

market for a price of P100 / £10 [P = pula, Botswana currency]. On the other hand the glass coasters and stand were made from glass and aluminium, involving processes that demand expensive equipment such as CNC Lathe, glass cutting and etching equipment. This product was bought at an upmarket shop in the City of Cardiff in Wales for a price of £35 / P350. The glass coasters and stand though expensive in terms of materials and equipment is not durable; out of the six original coasters, four were broken within a few months of purchase and only two remain. One of the four aluminium holders also snapped from the glass base (Figure 2).

Design and Technology education for sustainable development should promote African indigenous designs, technologies, and products because of several reasons illustrative from the above example, and explained in Table 1.

Table 1. African indigenous design vs Euro-western design

<i>African Indigenous Design</i>	<i>Euro –Western Design</i>
<ul style="list-style-type: none"> • Not expensive to make nor to buy. • Durable. • Has greater potential in promoting local entrepreneurial enterprise. • Minimised production output. • Ethics is the prevailing paradigm. • Designed to last for life. • Win-win case scenario. 	<ul style="list-style-type: none"> • Relatively very expensive to make and to buy. • Not durable. • Has great potential of contributing to environmental impact. • Designed not to last a long time. • Maximised production output. • Aesthetics is the prevailing paradigm. • Win-lose case scenario.

CONCLUSION

It is important that for Botswana to address issues of sustainable development through education in general and Design and Technology in particular, the people’s inclination to ascribe greater value to foreign culture at the expense of the local culture should be addressed with vigour and without compromise. Unlike Design and Technology at secondary school, CAPA was conceived from within Botswana and there is evidence of influence from Botswana’s Long Term Vision – “Towards Prosperity for All” commonly known as Vision 2016. Similarly unlike the Fox Report and the RNPE, Vision 2016 posits that the challenge for the future of Botswana will be to adapt to the changing and competitive world without sacrificing the positive aspects of our culture and values (Republic of Botswana, 1996). Because of Design and Technology’s origin and the philosophy and aims of education in Botswana, the subject has relied too much on western systems of production that reflect the inequalities apparent in capitalist societies and can be seen to play a part in reproducing an unsustainable society. Most indigenous knowledge, materials and technologies have the following characteristics that can be explored in the quest to providing a Design and Technology curriculum that promotes ESD:

- They conform to high labour and low capital demands; Unsustainable societies come as a result of high capital demands of modern life or high-tech technologies that form the basis of post-Fordism.
- They are dynamic and have diverse adaptive strategies for use at times of stress (e.g. global warming; unemployment; poverty, etc).
- They are locally appropriate and dependent on locally available resources.
- Integration with social institutions is easy.
- They are flexible with considerable potential for entrepreneurial abilities.

Moalosi et al (2010, p. 177) observed that globalisation has sparked off a new awareness of local identity, and that designers are challenged to foster cultural diversity through localisation of products in the face of globalisation. However, this awareness of local identity will not bear much fruit unless a ‘frame of mind’ approach

is adopted. A ‘frame of mind’ approach has the advantage of engaging learners and teachers in the kind of enquiry which reveal the underlying dominant motives that are at play in this materialistic, individualistic, hedonistic, high-consumption, instant gratification, global society. John Huckle (2005) in Pavlova and Pitt, 2007 warns that the ‘frame of mind’ approach will not be comfortable and that we must be prepared to deal with conflict.

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14. THE SHOE SHOW

*Using Simulation and Role-Play as Ways of Exposing and Questioning
Learners' Tacit Attitudes to Themselves as Ethical Consumers*

INTRODUCTION

Teaching and learning in the context of changing learner attitudes are not 'clear cut'. How to intervene in ways that are meaningful to learners are both messy, complicated and confront the more simplistic ideas of 'learning objectives' driven educational experiences.

This chapter came out of the experience of developing and trialling activity based workshops with school learners. The process of the workshops, over time, became those of acting in the roles of 'designer/maker' and as a 'trader' in a simulated part of a global manufacturing system. The intention was that through engagement with these two activities the learners could engage first hand with the issues and complexities of the designed and marketed world and by doing this would, 'shine a light' onto their own attitudes and tacit assumptions about themselves as consumers and future citizens.

There were two activities both based around training shoes. Early trials showed this as a 'rich' context. Young people were found to be both enthusiastic and vocal about the values and reasons behind their choices of training shoes. The first part was a designing and manufacturing simulation, the second a trading activity. Both sessions ended in a discussion/presentation where the aim was to lead the participants to consider their own positions as designers, makers and consumers and to try to suggest possible new ways of operating that have a more sustainable ethical positioning relating to less impact on the environment, more concern for the workers in the process and a greater awareness of what they could or would not do.

THE CONTEXT OF THE ACTIVITIES

Initially this work grew out of Goldsmiths, University of London's Widening Participation scheme. This in essence brought selected groups of pupils from secondary level schools (11 to 18 years of age) into the university for a day as a part of a programme of school and university contact.

The first time one of these sessions was undertaken it operated jointly between the Media, Anthropology and Design departments. The learners were engaged in

activities around global production, brand image and workers' conditions in the context of global mass production then leading them to look at their own views about branding, global production and workers conditions. As a plenary to the day, and in the spirit of role-play, We ran a presentation/discussion where one of the presenters pretended that they represented a major training shoe manufacturer and outlined the company's eco-credentials to show what a caring manufacturer they were. The session began with the presentation of some simple alternatives of training shoes that covered the issues of: disposable versus long lasting; branded versus 'non' branded (or popular versus a 'non-groovy' brand); expensive versus cheap. The idea was to question indirectly the learners' assumptions of value for money and the power of the brand over their personal judgements. The presentation set out to be gently confrontational (a conflict in terms) causing them to reflect on what they had done during the day and their own assumptions as consumers. The pupils were asked to choose at the beginning and end of the session, which was their preference in terms of the training shoes displayed.

What emerged, from their comments, were that learners were very committed to ideas of 'recycling' and in varying degrees had an idea of why they should do this but they were unable to distance themselves from their role and needs as consumers. This was particularly highlighted when one of my co-presenters declared that 'nothing that they were wearing that day, had not been previously owned by someone else.' The effect of this on the audience was a mixture of surprise and outrage. To me this indicated that whilst the issues around ethical and sustainable futures have moved progressively into the public domain, the complexity and difficulty of highlighting the effects of our actions remains. Thus as consumers, most of us move between thoughtful and well reasoned principles and ill considered emotionally charged actions. The group of learners had demonstrated that their notions of self, in our discussion, were linked to 'newness' and the power of the 'brand' of the things that they owned.

Whilst being thoroughly zealous about the need to recycle, and consume less, this illustrated ours, and their, confusions over what seems such a simple idea.

There is no shortage of educational materials produced by 'worthy' organizations and collaborations ranging from the early writings of Vance Packard's *Waste Makers* (1960), the polemic writings of Naomi Klein's, *No Logo* (1999) through to more recent reports from www.youthxchange.net and the work of the Ellen MacArthur Foundation highlighting and giving guidance as to the global situation and gives a series of what could be school based activities that will engage young people in global issues, are, to an extent, aware of them. The ability to understand and go beyond the requirement in the UK to 'recycle' waste materials, the school pupils, their parents and teachers were often justifiably confused as to what to do.

The aims of the activities of the 'Shoe Show' workshops were thus seen as both 'shining a light' onto the more complex issues involved in ethical consumer decisions and hopefully changing opinions, attitudes and actions of the consumers of the future.

THE USE OF ROLE PLAY ACTIVITIES TO HIGHLIGHT ISSUES AND CONFRONT
VALUES, BELIEFS ATTITUDES AND BEHAVIOUR

Role-play activities have, I believe, evolved from the two areas of drama and performance and job training and education. In Drama 'becoming' a character for dramatic effect brings the necessity to 'adopt' the values and attitudes of that person and through this gives an intimate feeling of what it is to 'be' that person in that situation. This means that the actor has a feeling of the pressures and situation that their adopted character experiences. With this comes and ability to 'empathise' with their character and compare that to their own personal and real life. Also because of their ability to simulate reality, role-play activities are often used within professional training as a 'safe' way to explore activities in both recruitment and training. The 'virtual' nature of role-play means that action can be analysed, and reflections-on-action can be made, to either learn from, or assess and predict what the 'actor's' behaviour might be in real life.

In role-play activities, the ability to not so much suspend reality, as one might in the theatre with 'acting', but to manipulate and balance a level of un-reality, can be seen as something that we all do in our everyday lives to entertain ourselves and to 'make sense' of our existence.

Attitudes, Values, Opinions, Beliefs and Changing Behaviour

In the context of describing human behaviour it is necessary to have some discussion as to the words used and their perceived differences in the literature. Smith describes the terms as follows:

One's affection for Louisville is an attitude. The view that Louisville is a good place to live is a belief. The overt expression of that belief is an opinion. The extent or degree that Louisville is a good place to live is a value. (Smith, 1979, p.231)

Smith further defines these terms as having a hierarchy

There is a hierarchy of concepts in regard to beliefs, values, and attitudes with beliefs resting as the foundation for the other two and fairly well entrenched in the individual's learned predispositions. Values are second in the hierarchy, are less permanent than beliefs, and are the result of beliefs and the individual's environment. As the third level on the hierarchy, attitudes are the result of beliefs plus values and are the most flexible of the three concepts. Thus, it is more likely that attitudes can be changed as compared to values and values are more likely to be changed than beliefs. It appears that attitudes can be changed, and to a lesser extent, that values can be re-ordered as a result of an individual's experience. (Smith, 1979, p.231)

This could be summarised diagrammatically as follows with the most embedded areas (within a person as being in the centre, and the easiest to change towards the outside)

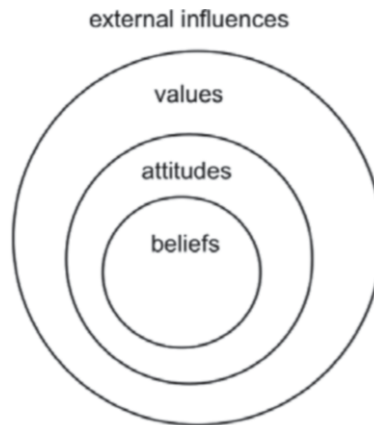


Figure 1. Bloom's notion of the relationship between values, attitudes, and beliefs and their ability to be changed by external influences

This is further supported by Bloom (1964,) where the relationship between 'modification' or change in the areas and the perceptions of 'self'. He relates modification of attitudes as being related to the manner in which the attitude was acquired and its relation to one's self. Thus, attitudes toward fairly unrelated objects or subjects are easier to change than are those which may take the form of prejudices or are based on early home and/or religious training. Attitudes based on self-perceptions are also relatively stable and difficult to change'.

Halloran further comments on the ways to change attitude and its efficacy;

In order to produce change, a suggestion for change must be received and accepted. Reception and acceptance are more likely to occur where the suggestion meets existing personality needs or drives.

The suggestion is more likely to be accepted if (a) it is in harmony with valued group norms and loyalties, (b) the source of the message is perceived as trustworthy or expert, (c) the message follows certain rules of "rhetoric" regarding order of presentation, organization of content, nature of appeal, etc. (Halloran, 1967, p.59)

What we were attempting, through the role play activities was to encourage learners to behave in certain ways, and through doing that to adopt or engage with certain attitudes to the topic. These attitudes whilst in most cases may not have conflicted with their beliefs, did cause them to make value judgements between conflicting attitudes, for example making a profit or paying a fair wage to their workers. The activities were further designed to not only rehearse changes in attitude but to manifest these in behaviour. They were 'forced' to make design and management decisions and

do things in order to maintain their roles in the activity. As to changing behaviour this was implicit in the activity yet because it was unreal allowed the learners to all engage at a suitable level, which for some this was far from comfortable or familiar.

Utilising role-play activities within an educational context also poses certain questions with regards to assessing what has been learned I prefer to see this in the context of solving a design problem. Within design education the concept of the 'design brief' is well established. The brief encapsulates the learning objectives in such a way that, in order to successfully negotiate the task, the learners are exposed to a range of learning objectives that confront values, beliefs and attitudes and have required behavioural changes (Lawler, 2012). Within the role-play activities the over-arching responsibilities and philosophies are exposed through the minor actions required of those roles. Participants have found this both liberating and confronting, in that it did not often fit their expectations of teaching and learning, yet they could recognise its value. Heyman (1975) in his work on simulation games for the classroom much supports our approach, he states;

'that simulations help people to see themselves better; I'm not sure that this will change values or attitudes. Certainly simulations will cause most participants to examine their values. If value analysis is an important key in ethical behavior, then gaming does seem to hold promise of (at least) encouraging (or requiring) the student to examine his value system. (Heyman, 1975, p.30)

The Problems of Measurement of Outcomes Within Role-Play Activities

In a very simplified teaching and learning model, the teacher teaches facts, the learners learn and then are tested on what they have learned. It is easy to prove that educational changes have been made. Q.E.D. There is an inherent and comforting security in the activity for all of the participants. Whereas within a 'game' or 'role play' activity the issues are complex and difficult to define as;

- There are no definitive 'right' answers, so what to teach is less clear.
- The questions involve complex cultural and ethical beliefs and practices, which may vary widely in the learners.
- The scale of change possible within learners is ultimately a 'behavioural' change through changes in attitude, opinions, values and beliefs. The application of which, whilst supported within their culture, may lead them into conflict with their parents and peers.
- The ability to assess successful accomplishment is difficult.

It is therefore difficult to decide the learning objectives and the purpose of the activity and 'prove' what has been 'learned'. Thus some of the objectives of the activity become qualitative at best or experiential rather than quantitative. So why do it? As highlighted in the introduction, these are issues that are both personal and societal. We all need to rehearse constantly our reactions to the complex world

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around us. And it is just too complicated to break it down into a few universal, simple steps. It may be that the activity serves to ‘shine a light’ on the issues on one level rather than give the tools with which to understand and change consumer behaviour on another. (See highlights of survey questionnaires)

So using this role-play activity to expose confront and change young peoples attitudes to global production and consumption (in one day) was therefore ambitious, some might say fool-hardy, but the belief always has to be that it was better than doing nothing, just because it was in traditional terms too difficult!

THE PROCESS OF THE DESIGNING/PROTOTYPING AND TRADING, WORKSHOPS

We set out to provide the experience of –

- What it feels like to be the designer and maker of a training shoe for the future.
- What it feels like to be a part of the globalised production ‘world’, illuminating the issues in global production of consumer products.
- What it feels like to be involved in a trading activity.
- Engaging in activities which exposed values, attitudes and beliefs in the trading activity and in developing and managing products and services to make a profit.

1. Designing/Prototyping Workshop- Designing and Prototyping a Training Shoe of the Future

The aim of this activity was to simulate the process of design and manufacture as closely as possible to the ‘real’ thing. Learners were playing the roles of the designer, and thus were aware of their position as providers for the client and the influence that both future lifestyles and technologies have on their designed items (within the constraints of time and place). We began with a presentation by a professional shoe designer showing their own process of generating shoe ‘ideas’ from ‘mood’ boards, and illustrating how they followed this through to sketches, models and prototypes with reference to both client and technologies to training shoes that they had designed. Also the sessions were co-presented by a lecturer from the Design Department the intention being as far as possible to put the school pupils into the role of undergraduate designers. The participants, the learners and their teachers, were then introduced to the task and the materials available. Mostly the school teachers worked alongside their pupils for this task. The brief was as follows:

Design and prototype a training shoe of the future

- Try to predict how far into the future you are working one year, ten years, fifty years etc
- Say who you have designed it for specifically. It should not be for you, or generally for teenagers. Think of particular people, for example ballet dancers, royalty, old people, people on a journey. Be creative!
- Think about what it is and what kinds of technology may be possible in the future.

Small groups of pupils were given a ‘last’ (the shoe-form onto which the shoe was to be built) The ‘upper’ (the part that covers your foot) was to be made from felt, which had been laser cut to a shape that could be stretched over the last (as happens in real shoe production but with less need for industrial machinery). The sole of the trainer and other details were made, mainly, from expanded foam sheet.

The design of the shoes and the details could be made from any of the general materials that were made available (a variety of modelling materials and objects like sequins and laces). Pieces were joined together with either ‘hot glue’ guns or latex adhesive.

Participants worked on the models and their ideas concurrently, they presented their first ideas after about 20 minutes and then finally ‘pitched’ their finished ideas and models an hour later, at the end of the activity, to the whole group. The groups then voted on the ideas, apart from their own, choosing which they felt was the ‘best’. All of the groups took away the models and drawings they had made.

2. *Trading Workshop. Role-play the Trading of the Aspects of Manufacture, Delivery and Marketing of a Training Shoe*

The learners and their teachers were split into groups, normally either 2 or 3 people. Each group was given each given a role in the manufacturing and marketing process. Each group was given a written briefing sheet and a series of cards, which gave them ideas what to do, and were introduced. These were re-stated as the complexity of the tasks progressed, There was a level of management of the composition and group roles to provide extra support in particular groups. The individual group’s roles were to ‘act’ as:

- Consumers- a group of people that buy shoes.
- Retailers- A sports shoe shop on the high street.
- Delivery and Logistics- a transport company moving materials and finished products from the factory to the retailer.
- The Brand Named Company- the central organising company.
- A Marketing and Advertising Company – a marketing support to the design and brand, working for the main company.
- A Trend forecasting and new product development company ‘sniffing out’ trends and marketing directions for the main company’s new product development.
- The Manufacturing Factory owners and managers.
- The Factory workers, who made the shoes.
- A group of peasant farmers who became ‘outworkers’- a group who are drawn into the manufacturing process because they will work for very little money. Initially they are relatively self-sufficient small farmers, but poor.

The different parts of the operation were notionally based in different parts of the world, with the learner groups deciding where in the world they were based. For

example perhaps, the factory was in China, the parent company in the USA and the retailer in Central London.

Initially the groups were asked to describe a typical day in their lives, in their designated role. This allowed them to settle into some understanding of what and who they were ‘pretending’ to be. At this point they were introduced to their place in the structure and how they related to the whole process. The groups were then introduced to the idea that they should negotiate with the people directly above and below them in the chain of the process to attempt to maximise the money they made for themselves (in essence buy for less and sell for more). The ‘trading’ was done with post-it note written messages rather than face-to-face meetings. The initial overall pricing structure was explained and demonstrated how training shoes that cost £5 to make end up selling at £126.



Figure 2. Group briefing details

Their briefing notes gave some guidance as to what they might do, and these were quite provocative, but not unusual in industrial relations. For example it was suggested to the workers that they might go on strike, to the consumers that they might create a demonstration against the parent company. It was not compulsory for the participants to follow these guidelines but allowed them to begin to ‘act’ in their roles. After about 20 minutes (or a number of ‘trading notes being exchanged’) the groups summarized their positions by presenting to the

whole group. This gave the whole group the first ‘overview’ of the activity and their position within the whole.

After a break each group was given a revised briefing statement, these made changes typical of world and economic changes that effect the production process. For instance: natural disasters like floods and tornados; unnatural disasters like oil wells sinking; marketing changes like internet trading; ethical and sustainability regulation changes with regards to workers rights. The groups were also encouraged to trade beyond their nearest link in the chain and to therefore realise greater profits, though sometimes on the edge of legality. Trading then continued for about 10 minutes and then progress reviewed across the group. For example, if the manufacturing company had ‘by-passed’ the parent company by selling directly to the retailer their profit could go from £5 per pair of training shoes to £50 per pair, but in fact, they were selling ‘counterfeit’ products. The central company was getting nothing towards their role in marketing, designing and promoting the product. Trading (often very heatedly) then went on for another 10 minutes, with mergers and sackings and in one case a kidnapping threat. The group then reviewed their final positions. Some groups showed success, whilst some groups found themselves locked into unsavoury and loss making situations.

The penultimate element of the activity was a presentation about making footballs in Pakistan and the use of child labour and the reality of global manufacture at its least attractive.

This presentation led into a discussion about the activity of the day, how it ‘felt’ to the groups of participants, in the roles as designers and traders they had experienced in the activities and what this meant for the consumption and production of the products with which we surround ourselves.

The aims of those running the discussion was to highlight the ethical issues and to explore any recognition of acting responsibly such as ‘fair trade’ arrangements and fair pay and working conditions for workers. Or shortening the ‘chain of production to market’ so that what the consumer gets is a fairer reflection of the ‘value’ the object cost to make. Here again issues of the cost of labour, materials and electricity in the UK, as compared to other parts of the world, were highlighted if relevant

QUESTIONNAIRE HIGHLIGHTS

Some of the participating groups were given a ‘before and after’ survey, 50 were completed and analysed. The learner’s ‘before’ survey was designed to explore their attitudes and values before they engaged in the day’s activity:

- as consumers by exploring their ‘favourite’ and most recent possessions;
- as consumers of ‘Fair Trade’ products and ‘globalised production’
- as citizens to recycling and sustainability.

The ‘after’ survey followed the day’s activity and explored whether the learners have been ‘changed’ by the experience. Not all of the learners answered all of the

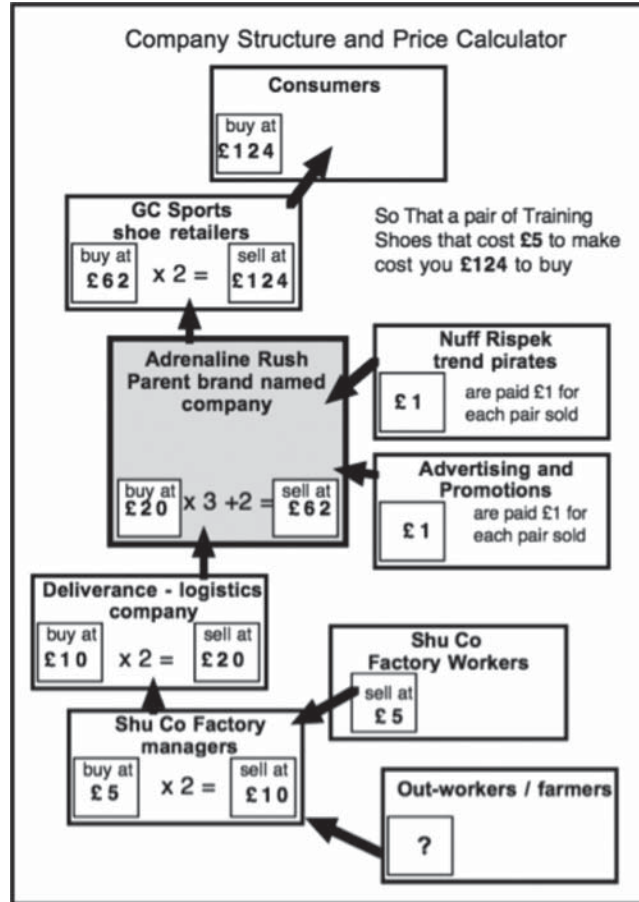


Figure 3. Manufacturing, marketing and trading chart

questions, and the sample, in comparison to the number who have participated in this activity over the years is quite small. Certain things emerged, from both the before and after surveys:

- Virtually none of the learners could attempt to say how much either their favourite product or their shoes cost to make.
- Most of the learners said that they did 'recycle' and all of those gave positive reasons for the value of the activity. They all also listed items that they recycled.
- Most knew what 'fair-trade' products were and two thirds of those learners said they would buy 'fair-trade' products even if they were more expensive.
- Around a half could describe 'globalised production' and of them they were split evenly between it being a good or bad thing. (33% good/ 20% bad)

- In the questions around what made products better, there was a 50/50 split between the premise that better products are more expensive, and 'betterness' was an aspect of the brand i.e. brand equals quality rather than quality being linked to performance. The reasons given for things being better were evenly spread between functional qualities, cost and emotional qualities.
- Of the learners that answered this survey there were twice as many who said that their behaviour had been changed by the workshops as those who said it hadn't (56% changed / 27% unchanged)
- On the success of the day, most said that they had enjoyed it and felt it worthwhile. Though one said it was confronting and horrible and scary!

There is therefore evidence that some change in attitudes could be recorded in the short term. But there has not been any attempt to see whether this had any lasting effect on the learner's future consumer behaviours.

CONCLUDING STATEMENTS

Trading and Working to Make a Profit

Like many educators I have always tried to see educational value above financial gain. Similarly it would seem that some families and often teachers try to avoid children having to deal with money and profit. To the extent that the combined pressures of the 'brand' as a defining quality of products and the lack of understandings of what are the costs, social or financial of their consumer behaviour would appear to be less a part of some children's lives. From the evidence of this work, unless future citizens can 'unpack' the conundrum of their need for 'stuff' and the planetary 'cost', which has to be related to real money, then progress towards understandings of ethical consumption will be even slower.

Whilst we hoped to have some effect in engaging participants in these two activities, in the short term the questionnaires do indicate we have changed values, attitudes and beliefs that may lead to different consumer and designer behaviours. Evidence undoubtedly suggests that the day was memorable, and word 'got around' so that the pupils fed back to their younger peers who looked forward to their day in university or to the activity with enthusiasm. We felt as though this is a valid and genuine attempt to raise awareness of ethical and sustainable issues of school pupils and the part that the designer and marketer play in this. Following the initial workshop series the workshops have also been done in the school setting and as a part of the curriculum rather than in the university setting. The activities were favourably received in both cases, though it was more difficult to take participants out of their role as pupils when they were still constrained by the school, its timetable and behavioural norms and expectations. Some of the survey data was from this cohort and showed compatible results from those of the 'in university' groups of learners.

T. LAWLER

For the future, this structure can easily be applied to other products and systems other than training shoes. The critical factor is that the learners engage with the product or system. It could easily be applied to clothing and there is much material on the adverse side of their production with readily available source materials e.g. youthXchange (2008), Ellen Macarthur foundation (2012), or TV programmes such as the BBC documentary 'Blood sweat and tee shirts' (2012). We have no problems with anyone appropriating or modifying these ideas to their own situations. On a subjective level the value of this activity is such that its inclusion into the educational experience of many learners can be seen as valuable. Complex issues are easier to demonstrate and talk about, in the abstract, than they are to engage with, in person. It is less confronting to the learner and easier to organise for the teacher. The question is, how best to produce a change in attitude or behaviour which will affect their futures as citizens?

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15. WITH HEAD, HAND, AND HEART

Children Address Ethical Issues of Design in Technology Education

INTRODUCTION

Although many technologies appear to have had positive effects on individuals, societies and environments, there is considerable controversy surrounding the ‘throw-away ethic’ that pervades many current product design processes (Slade, 2006). Not everyone supports, for instance, ‘engineered failure’ that appears to be designed into some technologies – suggesting, for example, that this practice increases landfill content and associated health problems. In this chapter, we describe cases of 12 year-old children’s efforts towards sustainable engineering design. As part of a larger project described herein, these students worked to build durable school locker organizers. To explore the nature and extent of students’ thinking and learning about sustainable design, qualitative ethnographic data collected included: the teacher’s instructional materials and field notes; artefacts of students’ work (e.g., sketches, notes, and prototypes); and, a follow-up video interview of four students who reflected on results of their project as they attempted to address issues such as ‘bad design,’ planned obsolescence, and externalized costs of production. Using constructivist grounded theory methods (Charmaz, 2006) we show how a Science, Technology, Society and Environment (STSE) framework adopted by the Ontario Ministry of Education appeared to contribute to the nature and extent of students’ sustainable engineering designs. Findings of this case study have relevance for future studies in learning and thinking about Technology Education. Overall, findings suggest that problem-based activities with an STSE focus can assist young people to become critically literate citizens capable of addressing social and ethical issues through active engagement in both tool-related and discursive practices of technology.

In 2007, a significantly-revised new curriculum prioritized development of critical thinking and critical literacy in Ontario students as a way to achieve scientific and technological capability. As defined by the Ontario Ministry of Education curriculum for *Science and Technology, Grades 1 – 8*,

Critical literacy goes beyond conventional critical thinking by focusing on issues related to fairness, equity, and social justice. Critically literate students adopt a critical stance, asking what view of the world the text advances and whether they find this view acceptable. (MoE, 2007, p. 38)

To this end, 'relating science and technology to society and the environment' (STSE) was set as the first of three major goals identified for elementary students in grades one to eight. STSE education is an extremely important curriculum focus - given the potential seriousness of various possible personal, social and environmental problems associated with fields of science and technology (Hodson, 2011). Fields of science and technology have, with little argument, had many positive effects on the wellbeing of individuals, societies and environments. Humans enjoy longer life spans, for instance, largely because of advances in the life sciences and medicine and in fields of agricultural science and technology. Nevertheless, many people are concerned about various *socioscientific issues* (e.g., Zeidler, Sadler, Simmons, & Howe, 2005); that is, debates concerning uses, mainly, of products and services of fields of science and technology/engineering. 'Socioscientific issues (SSI)' is one of several terms in use to describe issues or potential problems stemming from interactions among fields of science and technology and societies (or, more likely, interest groups in them). SSI are, more or less, synonymous with 'STS' or 'STSE' issues, the former referring to relationships among fields of science (S) and technology (T) and societies (S), while the latter also considers environments (E). Different authors tend to use different terms for approximately the same meaning. Arguably our most pressing problems pertain to potential Climate Change. According to the Intergovernmental Panel on this issue, for example, Earth is on course for catastrophic loss of life, assuming the currently-predicted average global temperature increases by about 6°C within the next 100 years (Lynas, 2008). There are many other potential problems, however, including health and social justice issues relating to: fast foods and other processed foods (e.g., Schlosser, 2001), pharmaceuticals (e.g., Angell, 2004), various biotechnologies (e.g., Krinsky, 2003), toxic chemicals in everyday things (e.g., Vasil, 2007) and agricultural research and practices (e.g., Kleinman, 2003).

Some argue compellingly that social reform is more than a moral imperative when the acceleration of technology and our reckless and excessive consumption and pollution of the planet's resources are threatening the very survival of our present civilization. Historical philosopher Ronald Wright (2004) asserts that long-term thinking about long-range consequences must replace short-term thinking driven by arrogance and greed. Yet, system reform continues to be slow and even actively resisted by wealthy nations that have the greatest capabilities to share resources and set limits in line with natural ones. 'The concentration of power at the top of large-scale societies,' explains Wright (2004), 'gives the elite a vested interest in the status quo; they continue to prosper in darkening times long after the environment and general populace begin to suffer' (p. 109). It is with a sense of urgency that he pronounces, 'Now is our last chance to get the future right' (Wright, 2004, p. 132).

There has been considerable academic work promoting sustainable technology design, distribution, etc. (e.g., Capewell, 2007; Elshof, 2009; Petrina, 2006; Stables, 2009). Indeed, scholarship seems to have advanced to the point that prominent technology education conferences, like the Pupils Attitudes Towards Technology (PATT), have - since at least 1993 (PATT-6) - given priority to sustainable practices

in technology and design and its educational counterpart. On the other hand, sustainability principles appear not to have gained currency in schools - including those suggested by Leo Elshof (2009): *the precautionary principle; polluter pays*; and, *reverse onus*. He adds, that:

Nor [is there emphasis on] the importance of assessing knowledge of sustainable consumption/ production practices, life cycle analysis (LCA) of products, industrial ecologies, integrated product policies, technical metabolisms, the rebound effect, extended producer responsibility, or the insights ecological and carbon foot printing (Goodall, 2007; Rees, 2002) provide about the environmental impacts of technological systems. (Elshof, 2009, p. 135)

Design and Technology education contexts are identified as being among the more important for changing the general societal zeitgeist towards principles of sustainability, yet little information has been published regarding how technology students might best learn about it (Middleton, 2009). As with any formal educational context, technology and design education can help generate societies that prioritize life-style choices that are more sustainable (Petrina, 2000). But, as Elshof (2009) points out, remembering the truism that ‘if you’re not part of the problem, you can’t be part of the solution’ (Kahane, 2004, p. 105), we should not just be thinking of them as future players in systems of for-profit production and consumption that appear to be so culpable with regards to many personal, social and environmental problems (McMurtry, 1999; United Nations, 1992). Indeed, in terms of actor network theory (Latour, 2005), students - as consumers or those who influence other consumers (e.g., parents) - are key actants in capitalist networks of production and consumption of goods and services. Moreover, they also appear to be particularly important in recent capitalist systems - which are said to focus great proportions of their energies (and capital) on promoting habits of unsustainable consumption by young people (e.g., Barber, 2007; Norris, 2011).

In the research reported here, we focused on a group of grade seven students (i.e., in their seventh year of compulsory education) who participated in a design-and-build project as part of their regular science and technology education program. Data pertained especially to issues concerning technology and the environment. Beyond teaching basic hand tools and machine skills through a problem-solving process, this project aimed to broaden the learners’ scope of design thinking by introducing discussions about product life cycles and sustainability issues — including issues associated with capitalist principles of planned and perceived obsolescence.

RESEARCH CONTEXT AND METHODOLOGY

Research Context

This study was part of a larger research project that focuses on the effectiveness of teaching strategies used in Science and Technology Education to Promote

Wellbeing (i.e., individual skills, social harmony and environmental sustainability) for Individuals, Societies and Environments (STEPWISE). This theoretical and practical framework organizes learning goals in a way that recognizes their reciprocal nature, and in a way that prioritizes student-led, research-informed, actions to address potential problems for individuals, societies and environments resulting from decisions about fields of science and technology made by powerful people and groups. (For a description of the STEPWISE project, go to <http://www.stepwiser.ca>). The teacher, who is one of the authors, (T. W.) had over 20 years' experience in elementary school Design and Technology education and was a member of the STEPWISE action-research group. Her school was a large urban middle school for grades seven and eight with a population of approximately 630 students, and was located in an affluent middle to upper-middle class neighbourhood. The program was approximately 14 hours in length and was conducted on a five day rotary cycle in 100 minute periods. The target class contained 16 grade seven pupils, six of whom (two boys and four girls) had ethical approval from their parents to take part in the study. To protect confidentiality, all names have been changed. The students had little or no previous experience working with tools or participating in design-and-make activities.

Before the design brief and challenge was received, the class watched Annie Leonard's (2007) animated video *The Story of Stuff* and engaged in two cooperative learning activities aimed to generate meaningful discussions about our consumer-driven culture. The video presents a critique of the problems inherent in the North American lowest cost linear production-consumption-disposal thinking. Leonard (2007) locates human experience within what Jennifer Sandlin and Peter McLaren (2010) refer to as 'specific relations of production' (p. 14). For example, Leonard traces back through the life cycle of a portable radio from the shelf of a big box store, through the hands of a minimum wage cashier, shelf stocker, transport driver, ocean freight handler, 'some 15-year-old in a maquiadora in Mexico,' and 'the kids in parts of the Congo.[who] have had to drop out of school to mine coltan.' Key ideas presented in the video include exploitation and over-consumption of the world's resources, the use of toxic chemicals in manufacturing, the externalized costs of production for profit, planned and perceived obsolescence, and the unsustainable cradle-to-grave approach to waste management. It was the teacher's intention to assist her students in designing an alternative device that would help organize the space inside their school lockers. Situated within the everyday context of school culture, the problem was framed in two ways: 1) as a personal 'need' to address many students' dissatisfaction and frustration (as passive consumers) with existing commercial locker shelves that frequently collapsed under the weight of their textbooks, and 2) as an environmental 'need' to stop contributing to landfill waste. Since many such 'cheap' products (whether broken or not) were frequently discarded in the school's garbage bins, this personal (school) life scenario provided a suitable entry point for engaging young people in 'critical literacy.' The learners

analyzed their commercial locker shelving devices for existing design problems (e.g., weak, collapsing legs, poor construction) and identified underlying STSE-related concerns for health, safety, and social justice (e.g., use of toxic and non-recyclable materials that end up in the landfill, and a reliance on ‘cheap’ outsourced labour). After determining the particular way in which they wanted to organize their locker space, the students made sketches, measured the locker interior, prepared a bill of materials, and constructed their prototypes. The instructor took a process-oriented approach to teach very basic sketching, fabrication, and joining techniques for materials that included basswood, metal, and plastic. At opportune moments throughout the building phase, she also tried to engage her students in dialogue that related to materials conservation. Furthermore, she gave suggestions about how their new skills and knowledge could be useful in their future lives outside the realm of school.

Data-collection and Analysis Methods

While research data collected included: i) the teacher’s instructional materials and field notes, ii) artefacts of six students’ work (which include sketches, activity sheets, learning logs, and photographs of prototypes), and iii) a video-recorded focus group interview, the findings presented here are based on a qualitative analysis of two sources of data collected at the project’s completion. Specifically, we focused on the written work of six students who responded to a set of questions that linked material costs, ‘hidden costs,’ and the ‘true cost’ of their constructed prototype to environmental conservation. Four students also agreed to participate in a semi-structured 20-minute video-recorded interview, which afforded the opportunity for multiple viewings and provided a detailed picture of their thinking and learning. A transcription of the final semi-structured interview session was made, noting visual cues and social semiotic signs such as facial expressions, hand and body gestures that offered an additional layer of meaning to the communication. Based on constructivist grounded theory principles (Charmaz, 2006), preliminary coding categories were generated, then compared and modified or combined.

The Locker Organizer Report

The students were given an itemized list of possible materials and bulk quantity prices that they might have used. They were then asked to calculate the approximate total cost of the materials needed to construct their product (e.g., a box of 100 screws costs \$10, an 80 cm x 90 cm sheet of tin plate (sheet metal) costs \$10, a 300 cm x 15 cm x 18 cm dressed (planed) length of basswood costs \$25, and so forth). The subsequent questions in their locker organizer report were specifically intended to have students consider the information about the materials economy that was

presented in *The Story of Stuff* by comparing the costs of a commercial product with their recent design-and-make undertaking. The questions were as follows:

- Identify some of the ‘hidden costs’ of your design. (Remember what Annie Leonard reported in *The Story of Stuff* and consider where your materials came from).
- Approximately how much time did you spend making your device?
- Many environmentalists think that true conservation will only arrive when consumers pay the true cost of a product. What do you think is meant by this statement?
- What would you consider to be a fair price to pay for a product like yours? Explain.
- Do you believe that paying the ‘true cost’ would result in real conservation? Justify your opinion.

The Focus Group Interview

Four students participated in a video interview, in which they were asked open-ended questions such as:

- What did you learn by doing this project?
- What did you do with your locker shelves to make them last longer? Is there any technique that you used?
- When you were designing the shelf, were you thinking about how to make it look good?
- What would you say were the main challenges about making the locker project? What were the difficulties?
- Did you learn anything about yourself doing this process? Anything that you were surprised about?
- So what would you say might be some suggestions on maybe how to improve the project for next time? What changes might you suggest making?
- What would you say this project has taught you about technology and the environment?

RESULTS

Addressing Ethical Issues of Design

The following findings are presented in the next section: constructing durable structures as a landfill waste reduction strategy, the young people’s concerns for fairness, and embodied agency as a potential means to disrupt uncritical and passive consumption.

Landfill Waste Reduction

The premise for the locker organizer design challenge was couched as an alternative to ‘bad design’: design and make a durable product as a way to reduce landfill waste.

However, when the students chose their materials, environmental sustainability did not appear to be among the factors they considered. Design justifications for materials included availability of time, properties of strength to support a load, perceived difficulty of a technical operation, and aesthetics. One possible explanation for this could be that the durability requirement as a waste reduction strategy was already embedded in the original challenge.

True Cost of a Product

The children were also asked to explain the meaning of the following statement: *'Many environmentalists think that true conservation will only arrive when consumers pay the true cost of a product.'* In this instance, three pupils spoke clearly against the idea of getting something-for-nothing, wastefulness, and environmental damage caused by resource extraction methods.

We are not paying as much as we should and...that we will only start like saving our world and not wasting as much when we start paying the true price. (Lynn, written report)

It will pay off for people's lives working and people can repair the damage from doing so. (Billy, written report)

Unless people are willing to pay \$50 -\$100 for a locker shelf, they are going to keep buying the ones that have planned obsolescence, which creates more waste. (Donna, written report)

Donna learned the meaning of the term 'planned obsolescence' when it was introduced in *The Story of Stuff* by Leonard (2007) to problematize the ideology of hypercapitalism with the clever alliteration 'designed for the dump'. As young consumers, the children indicated they were already quite familiar with 'cheap' products that break easily, but expressed surprise and disdain for the ethic of deliberate design for product failure. While it could be argued that the students' narrow interpretation of 'fair' and 'true' costs of materials and work was an effect of the way in which the questions were worded, it might also be that their answers reflect some of the socio-economic values of their middle to upper-middle class neighbourhood. Further questioning would be necessary to resolve this. Nevertheless, the emergence of a critical consciousness about our current production-consumption-waste cycle is encouraging. We suggest that this account is of value for Technology Educators as it demonstrates how a change of conceptual framework (i.e., STSE) may help students – as consumers and producers of 'stuff' - begin to develop a critical stance.

Fair Price/Fair Trade

From their comments, we can also infer an ethic of fair pricing or trade for what one receives. Billy directly cited his critique of 'hidden costs' from *The Story of Stuff*

when the group seemed to lean toward concerns about social injustices done to ‘the workers’ in developing countries who are exploited.

[Paying the true cost] will pay off for people’s lives working and people can repair the damage from doing so. (Billy, written report)

... I think that no resources should be used without paying the real amount for it. I also think that people shouldn’t be ripped off. (Nick, written report)

Line 330, Nick: [I learned] that people try and make money, that they don’t really care...

Line 332, Billy: They don’t care about other people...

It would seem that the students’ earlier discussions and personal experiences helped them understand to some degree that the dollar costs assigned to consumer products do not represent the ‘real costs’ to the natural and social world. They were able to comprehend the multi-layered meaning of ‘cost’ first of all, on a personal level in terms of time and effort. As Donna explains:

Line 336, Donna: I think that we’re going to have to start investing in fair trade stuff because I paid like maybe \$10 for my [store-purchased] locker shelves, but if they took as long to figure out how to make as my shelves, they should be like \$400! So, I mean, I’ve been here in total for almost 10 hours and. and it’s ridiculous!

In addition to their own time and effort, the learners also believed their materials were undervalued. In the next excerpts, Nick wrestles with the concept of externalized costs of resources and human activity that are not reflected in the market pricing:

...when I was checking, I was really surprised. I was like, ‘*Did I calculate this right when I was checking the price for the material?*’ I was like ... \$3.50 for like my wood, and legs, and metal, and everything? Like that’s like what you could get for like, ...an apple or something, ...or an ice cream cone? ... (Nick, Lines 364-373)

I think that some of the hidden costs in my design are the costs for the workers who extracted the metal from natural resources who don’t usually get paid enough for their work. Another one of those costs is for the lumberjacks. It may not seem like much in this [locker organizer], but people could be using [*sic*] their lives to find the right rock and turn it into metal and they may not get paid enough. So people could waste their lives just for us. (Nick, written report, May 2009)

In preparing their locker organizer report, the students were first asked to make the unit cost calculations for their materials, and then were asked what they thought would be ‘*a fair price to pay for a product like yours.*’ The nature of Billy’s ethical considerations was revealed when he attempted to bridge the discrepancy between

what he called the ‘official’ and the ‘more ideal’ price (Billy, written report May 2009). He again raised the issue of ‘fair price’ during the focus group interview:

When I was putting the regular, the right price down on my locker report, it’s actually the material thing’s probably about \$3, but like I added in like shipping and everything and people’s [lives?], so I made it more like \$20, like adding everything, and the work took into it. So, like I mean, like that was [an?] official price, but \$20 or \$25 would be I think, a more *ideal* price...that, not just how much the material cost, how much I put in labour to this, how much other people found these materials for, how much all this kind of stuff, so it more adds up to be around \$25.... (Billy, Lines 346-355)

Billy’s answer reveals an attempt to reconcile the small dollar sum calculated for materials, with the large personal investment of time and effort. More interestingly, he extended his accounting beyond his own sphere of experience to include ethical considerations for payment owed to ‘other people’.

Active Engagement

The students spoke enthusiastically about their learning during the construction of their prototypes. Billy and Donna, in particular, spoke confidently about the difference between the level of technical knowledge and skill required for designing ‘from scratch’ and building ‘from one of those kits’. Billy indicated that ‘DT [Design and Technology] ... is a *really* different approach that you don’t see when you build stuff at home’ (Lines 277-278). In agreement with Billy’s analysis, Donna added,

... So like someone might go like ‘Oh yeah, like I built a birdhouse, you know. I got one of those kits.’ Well you got a kit—you didn’t have to measure, you didn’t have to file, all you had to do is like, put it together, which I think once you have all the holes drilled, is the easiest part of building a shelf, is just attaching it. ... Well, you put it together, which is not even a quarter of the process of making something! (Donna, Lines 404-411)

It is important to take a moment and consider the significance the children ascribed to ‘building from scratch’. Their critique of pre-fabricated kits lends uncanny support to what Matthew B. Crawford (2009) identifies as the disburdenment of fabrication and the displacement of ‘embodied agency’ (p. 69). Paradoxically, more commercial products are marketed with promises of greater personal choice, while the important design decisions have been remotely controlled, leaving only a ‘playground-safe field of options’ for narcissistic gratification. Crawford (2009) warns that the preclusion of active engagement or cultivation of embodied agency effectively grooms children for uncritical dependency and passive consumption. The comments made by our participants appeared to be founded on their recent experiential learning about designing and ‘building from scratch’ and underpinned their critique of the false sense of agency afforded by ready-to-assemble kits.

CONCLUDING REMARKS

Designing with Head and Hand

The original goal of this STEPWISE project was to introduce students to a new way of thinking about technology and the environment that extends beyond the conventional design-and-make cycle of prototype construction. Although the time line for teaching the unit was very limited, there were some positive outcomes. In the follow-up interview, the participants thought that their activities had extended and deepened their awareness of technology-related issues such as the externalization of costs and designed obsolescence. Their enthusiastic comments indicated an increased sense of capability and agency when describing new procedural knowledge and practical skills in prototype construction.

Designing with Heart

Although concerns about environmental impact did not appear to have affected the students' choices during the designing process, the children did reveal ethical concerns about how the manufacturing of products impact on people other than themselves, and an emerging moral stance against social and environmental exploitation. The students' unequivocal statements regarding fair treatment and compensation for other people's labour ('people shouldn't be ripped off'), and their critical concern about environmental damage ('no resources should be used without paying the real amount for it'), are noteworthy values of designing *with heart*.

Moving Along a Trajectory of Ethical Design

According to social learning theorist Etienne Wenger (1998), a meaningful experience involves the close interplay between participation in the social world and representations of that participation. Concrete representations of activity (for example, knowledge, words, tools, procedures, locker organizers) are products of reification that can remain conscious but tenuous signs of propositional knowledge about sustainability principles. Indeed, it could be argued that the 12 year-old students' awareness of some of the issues of our current production-consumption-waste cycle was superficial at this stage, but the values they did express point favourably towards a trajectory of ethical design activity. In our view, there is great potential - with more time and continued active participation in both tool-related and discursive practices - the children's talk and actions could develop into powerful reflections of meaningful practice in sustainable design as they grow older.

Some might argue that the changes in students' thinking noted in this design investigation are small effects of 'tinkering at the edges' of sustainability practices within technology education (Elshof, 2009). Admittedly, the limited program time

provided in the school day to teach basic design processes and safe tool practice within an STSE framework was, and will continue to be an enormous challenge in elementary education. While fundamental concepts of sustainability and stewardship are well-intentioned, Elshof (2005) acknowledges that,

Changing social and cultural practices or ‘lifestyles’ as well as expectations as they relate to material consumption and energy use are much easier conceptualized than enacted. Moving ‘sustainable development’ beyond the realm of empty political rhetoric entails substantive change to the way in which products are designed, used and reintegrated into the material stream. (Elshof, 2005, p. 174)

Sharing Elshof’s desire for substantive change in system approaches to product design and material consumption, Sandlin and McLaren (2010) view consumer education as critical practice and imagine school as a place of contestation where consumer capitalism is questioned, and consumer resistance works as a space of learning. Advocating for a ‘critical pedagogy of consumption,’ Sandlin and McLaren (2010) want learners to ‘question assumptions and challenge the status of existing structures as natural’ (p. 16). They argue that locating human experience within a ‘specific social relations of production’ framework will enable students to ‘see how, through the exercise of power, the dominant structures of class rule protect their practices from being publicly scrutinized as they appropriate resources to serve the interests of the few at the expense of the many’ (Sandlin & McLaren, p. 14). Extending beyond the acquire-use-dispose logic of products, such a ‘social relations of production’ framework may indeed be an effective teaching approach. It might well be that tracing a locker shelf’s material origins helped our young designers to consider the work required by many hands along the product’s evolutionary journey, and thereby aligns with the work on radical consumer research by Norman Denzin (2001), who proposes that instead of creating consumers, the job of the educator is to create consumer advocates and cultural critics.

We are therefore cautiously optimistic. The findings presented here suggest that, over time, use of a multimedia resource such as *The Story of Stuff* and active engagement in ethical design processes can potentially disrupt the ideology of consumerism, and mediate an entry into a cultural critique of technological products and systems. If, as Mike Martin (2003) suggests, our emphasis in Design and Technology education should be to develop learners ‘as informed users of technology rather than passive consumers’ (p. 170), then this study holds out a modest, although hopeful starting point for further praxis at the elementary classroom level. The activities we have described offer a practical example of how an ethic of care—roused by a new discourse and critical literacy framework concerned with sustainability, justice, and the human condition—may prepare young people to take their place of shared responsibility in a world shaped by technological design.

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16. INTRODUCING IDEAS OF A CIRCULAR ECONOMY

INTRODUCTION

The circular economy is a new way of thinking about the future and how we organize ourselves, our economies and societies. It is a positive and restorative approach that goes ‘beyond sustainability’: rather than minimizing the harm we do to natural ecosystems, (e.g. through recycling a percentage of products) we can seek to do them good (Webster & Johnson, 2009).

The origins of this approach are the following areas of work:

- **Systems thinking** as an holistic approach to dealing with problems – as opposed to ‘problem solving’, which tends to be a linear model (see for example Capra 1982; de Rosnay 1975);
- A **‘cradle-to-cradle’ philosophy** as a design strategy, applied both to materials and the systems within which they are used (see McDonough & Braungart, 2009).
- **The concept of a ‘performance economy’** - thinking emerging from the Product Life Institute on substituting manpower for energy, extending the service-life of goods and buying performance (see Stahel, 1976, 1982, 2006).
- **Biomimicry** – being inspired by natural systems (see Beynus, 1997).

Combining these elements refocuses design education onto the economics and design of systems, rather than appealing to consumer behaviour and personal ethics as a way of achieving positive change. It calls for the designing of eco-restorative models of production and consumption. This is more engaging than attempting to persuade individual consumers to buy fewer or less polluting products.

As the circular economy approach gains ground in business and society in many countries, school leavers will increasingly need to be literate in this new model of design. The Ellen MacArthur Foundation has developed a wide range of learning materials with a view to getting circular economy thinking into the classroom. We present a case study illustrating how circular economy thinking is embedded in one of these resources, and its impact on learners in UK schools and teacher education.

WHAT IS A LINEAR ECONOMY?

Both materials shortages (leading to price increases and volatility), and the risk of irreversible changes to planetary systems, mean that humans need to be much more

careful in using resources. At the same time, the economic crisis pits advocates of environmental responsibility against advocates of growth and jobs. This chapter argues that this is a false opposition, growing out of a world-view that is no longer valid.

The current economic model is essentially a linear one of ‘take-make-dump’ in which companies make money through selling things and much of the stuff produced ends up in landfill. Governments want to keep up their tax revenue benefit from this throughput of resources – but in a finite system (aka the planet Earth) it cannot work long term.

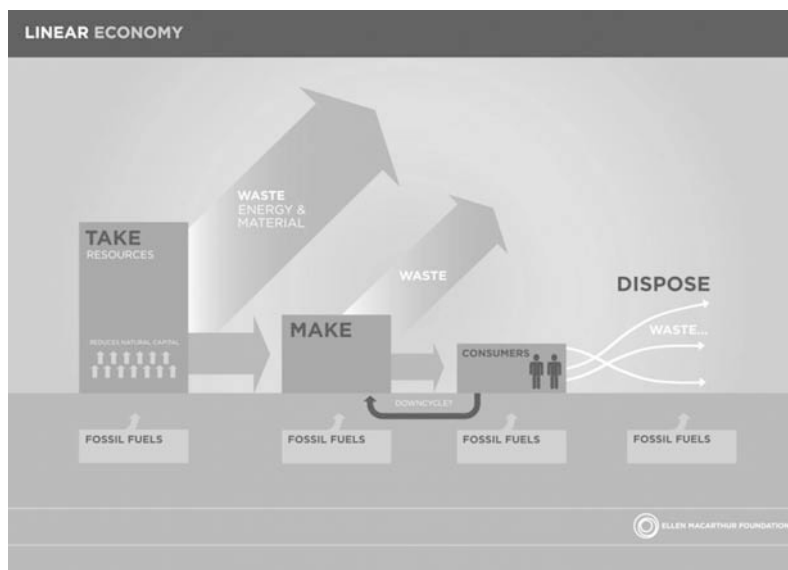


Figure 1. The linear economy (www.ellenmacarthurfoundation.org)

In a linear economy nature is seen as a resource to be used for the benefit of people. This has been made possible through the availability of cheap oil, particularly in the post second world war war period, along with the range of minerals required for industrial production. But these are all finite. Indeed there is a shortage of certain chemical elements known as the rare earth metals, such as indium (used for screens on computers and phones) and ebrium (a key element in the optical fibres used in telecommunications). At present, these come mainly from China, which is cutting back on exports as domestic demand increases. Some common materials come from few sources – for example, phosphorus, used widely in detergents and fertilizers, comes almost entirely from China and the Middle East.

Insecurity, scarcity and price volatility all help to make the ‘take-make-dump’ model seem less and less viable and, not surprisingly, many companies are looking for alternatives.

INTRODUCING IDEAS OF A CIRCULAR ECONOMY

Recycling is only a partial and indeed short-term answer. Even supposing 80% of a substance is recycled per year, the stock will have degraded to less than a third in five years. Moreover, most products are not really designed to be recycled. A wide variety of materials are often combined together in ways that make them difficult to separate and recapture – thus constituent materials are recycled at a lower quality, or **‘downcycled’**. For example, high quality plastics are often melted down and combined to make a low-grade plastic suitable only for park benches or planters.

The problem with recycling more, or ‘cutting our footprint’, is that these approaches are ultimately about doing something that is slightly ‘less bad’ rather than actively ‘doing good’. By analogy, if I beat my child five times a day and then cut it down to once a day then that is a step in the right direction. But it is still not doing good by my son! Calls to personal morality, or enlightened self-interest, ask people to swim against the tide of the system. Rather, we need to redesign the system. We need to employ technological and scientific expertise, but also our creativity, social skills and intuition, to move towards an economy that is *eco-effective* rather than just eco-efficient – an economy that actively restores natural ecosystems and rebuilds natural capital.

WHAT IS A CIRCULAR ECONOMY?

A widely held definition is:

The circular economy is a generic term for an industrial economy that is, by design or intention, restorative and in which materials flows are of two types, biological nutrients, designed to re-enter the biosphere safely, and technical nutrients, which are designed to circulate at high quality without entering the biosphere. (www.ellenmacarthurfoundation.org)

We can draw an analogy with a natural system such as a forest, home to a myriad of species living in interconnected, often symbiotic, ways. Crucially, the ‘waste’ from any one species or process (a falling leaf) always provides the feedstock for something else (bacteria which improve the soil).

In the model below, nature is seen as a store of capital to be maintained rather than a resource to be plundered. Thus economic activity needs to be restorative. This requires keeping **‘technical nutrients’** (metals, polymers, composites) separate from the biodegradable **‘biological nutrients’**, and systematically detoxifying materials. Technical materials are used again and again and again (are **‘upcycled’**). This has two important preconditions: everything is designed for a circular flow of materials, and systems need to be in place to make this possible. Waste is designed out of the system. And, as in a forest, energy comes from the sun.

The appeal of this for educators is that students are highly motivated by the idea of redesigning products and rethinking systems for such an economy and society. Rather than being told that their desires and interests are at odds with a sustainable future, their innovative skills are called on to help achieve it.

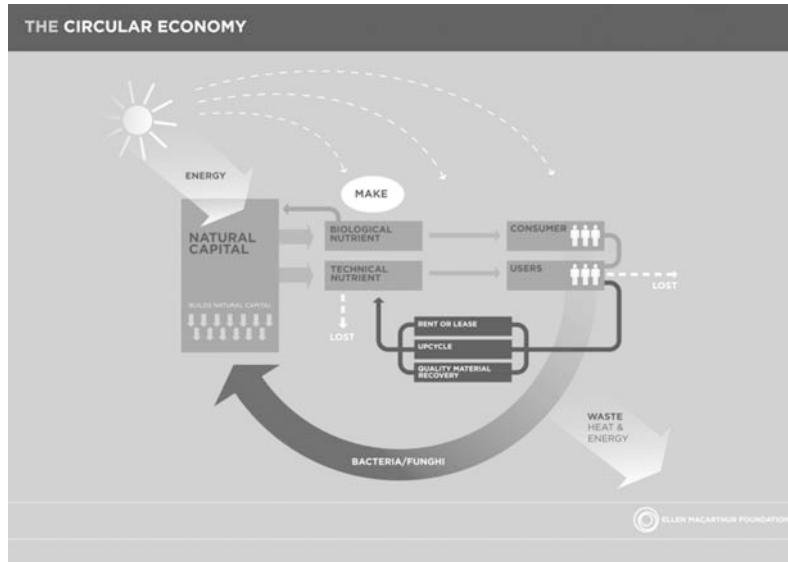


Figure 2. The circular economy (www.ellenmacarthurfoundation.org)

LOOKING AT THE CIRCULAR ECONOMY IN MORE DETAIL – IS IT A REALISTIC POSSIBILITY?

A report by the Ellen MacArthur Foundation and the consulting firm McKinsey (Ellen MacArthur Foundation, 2012) found that short-term gains to the EU economy from even a modest and realistic adoption of such business practices (a 12-14% recovery of materials in eight sectors) could save material costs of \$340-380bn per year in Europe alone; with adoption at 19-23% these figures go up to \$520-630bn per year.

What business models make this possible? Consider two examples, a washing machine and a light van.

Cheaper washing machines are designed to supply about 2,000 washes (costing 27 cents per cycle); top-quality machines about 10,000 washes (12 cents per cycle). At the 'end of life' the machines are scrapped and probably some of the materials recovered through recycling. But the manufacturer does not benefit from this; to produce new machines they have to buy in ever more expensive new materials. Suppose that the manufacturer designs for *leasing* rather than *sale*. They have an immediate incentive to make a high quality product that can be easily maintained, refurbished and upgraded. At the end of its useful life the machine can be stripped down and components and materials recovered. In this way manufacturer can make more profit, and the user gets better and cheaper washes.

Automotive manufacturers typically sell light vans with a 4-year warranty. But there are only a few components that fail after this time. Renault have worked out

Waste = food Eliminate waste. The biological and technical materials or components of any product should be designed for disassembly and re-purposing. The biological parts are non-toxic and can be fed back into natural systems via composting. The technical, polymers, alloys and other manufactured materials, are designed to be kept in their own cycle and used again with as little loss of embedded energy and quality as possible.

Diversity = strength Diverse systems, with many nodes, connections and scales are more resilient in the face of external shocks. They can recover, while systems which are too streamlined are brittle; failure, when it comes, is more serious. This applies to financial systems, economies, ecosystems and communities alike. Diversity is the key to change, and creativity is also worth celebrating.

Energy -> renewables Energy shifts increasingly to renewable sources.

Prices = real cost Prices are messages; they must 'tell the truth', reflecting full costs in order to inform rational decisions.

Money = stuff Money is made available to the extent that it is required as a medium of exchange for goods and services. Money is more a social agreement rather than a commodity, diversity is welcomed (e.g. complementary currencies). (Ellen MacArthur Foundation 2012a, p.23)

WHY ISN'T THIS HAPPENING ALREADY?

If it is better ethically, environmentally and economically to hang onto materials and components rather than throw them away, why isn't everyone doing it? The Ellen MacArthur Foundation (2012) argues that our economies are

...strongly locked into a system where everything from production economics to contracts, and from regulation to mindsets, favours the linear model of production and consumption. In this linear world, design in products and systems for reuse will damage a company's incremental sales and weaken revenues and profits. (Ellen MacArthur Foundation, 2012, p.78)

But they go on to say that resource scarcity, price volatility and environmental standards are here to stay, that we now possess the IT that will allow us to shift, and that we are witnessing a pervasive shift in consumer behaviour. Companies will build core competencies in circular design, and will drive business model innovation. They will explore new service models that challenge today's orthodoxies of ownership-driven consumption; it will be the performance that counts.

It is significant that the European Resource Efficiency Platform issued a statement in December 2012 calling on business, labour and civil society leaders to support resource efficiency and the transformation to a circular economy and society without delay; this offers a path out of the current crisis towards a reindustrialisation of the

European economy on the basis of resource-efficient growth that will last. (European Resource Efficiency Platform, 2012, p.1)

We are in a transition towards a circular economy; growth is possible within a regenerative economy, many new jobs will be created within design, engineering, materials science, reverse logistics and systems design. This has huge implications for design education.

PRINCIPLES OF DESIGN IN A CIRCULAR ECONOMY

Systems thinking

A systems approach is when we do not just look at one thing and decide how to make it better. Instead we view the ‘problems’ under consideration as inter-related parts of a larger system. We try to optimise the system rather than just make one element more efficient.

A systems thinker recognises that the world is complex and changing the whole time. Humans are part of that complexity and our decisions and actions have many impacts. But rather than asking what are the impacts of a particular action by a particular individual in trying to decide what is right and wrong, systems thinkers seek out a bigger picture, trying to look at the wider consequences of any intervention or (possibly more importantly) lack of intervention. Systems thinking recognises that most actions will have multiple consequences and that we will be able to spot only a small part of these, let alone predict and control them.

Donella H Meadows (2009) offers this advice on how to live in a world of systems:

The future can't be predicted, but it can be envisioned and brought lovingly into being. Systems can't be controlled, but they can be designed and redesigned. We can't surge forward with certainty into a world of no surprises, but we can expect surprises and learn from them and even profit from them. We can't impose our will on a system. We can listen to what the system tells us, and discover how its properties and our values can work together to bring something forth much better than could ever be produced by our will alone.

We can't control systems or figure them out. But we can dance with them!.
(Meadows, 2009, pp169-170)

This, of course, begs the question of what is meant by ‘better’! Meadows offers ‘Guidelines for Living in a World of Systems’ (pp. 194-5) in which she advocates a dynamic approach, looking at the whole rather than just the individual parts, seeking the feedback mechanisms that are in place and trying to identify key points of leverage. Designers no longer develop a product and bring it to market according to specification; they look at the wider parameters in which the product flows and the interests of multiple stakeholders. It requires an understanding of complexity, which is a different way of thinking. (For a good discussion of complexity theory, see Homer-Dixon, 2011.)

A Cradle-to-Cradle Design Philosophy

The chemist Michael Braungart and architect William McDonough (2009) propose a radical design philosophy that is consistent with designing for a circular economy; indeed Cradle-to-Cradle or C2C™ is one of the progenitors of circular economy thinking. Why not redesign materials and artefacts so that *all* the materials used can be recovered?

Technical nutrients - metals and plastics - can be recovered and used again without loss of quality. Biological nutrients can be broken down and ultimately improve the soil. Ideally they can be ‘cascaded’ before going back into the soil. For example wood (biomass) can be used for burning to generate electricity (single use) or it can first be used for building, then for furniture, then for particle board or paper before being burned. The ash can be used in fertilizers. But this will only work if toxic chemicals are not used or produced in the process.

In this context a hybrid is something in which there are mixtures of technical and/or biological nutrient materials that cannot be separated and recovered at a product’s end of life. Hybrid products typically cannot be upcycled or even downcycled, but instead end up in landfills or incinerators.

If a) all products are so designed so that the biological and technical nutrients can be separated on disassembly *AND* b) if the systems are in place for recovery of the technical nutrients (a ‘reverse logistics cycle’) and decomposition of the biological nutrients *AND* c) all the transport, manufacture and other processes are powered by renewable energy, then the issue of shortages has gone a long way to being addressed. Designing needs to conform to the principles of a circular economy, as described earlier in this chapter.

It is, of course, not sufficient to redesign products. The circular economy model is the extension of these principles to entire systems, revolutionising business models, and this thinking, too, is gaining ground in industry. For example, B&Q has suggested that by 2030 it may be leasing many of its products rather than selling them – as what its customers want is not a power drill as such, but holes in their walls. The incentive for the company then becomes to design high-quality, robust products, which are easily repaired and designed for disassembly so that components and the valuable and scarce materials contained in them remain in the company’s hands. The same principle can be applied to many other ‘products of service’ – photocopiers, washing machines, mobile phones.

TEACHING THE CIRCULAR ECONOMY TO STUDENTS AND TEACHERS
OF DESIGN AND TECHNOLOGY

Below we present an analysis of learning resources prepared by the Ellen MacArthur Foundation for Design and Technology (D&T) based on the principles above. We focus on one resource, Activity One from the Foundation’s key Design and Technology (D&T) resource suite, *System Reset*, in greater detail, and summarise

the others briefly. This is followed by data gathered from evaluations of Continuing Professional Development events, organised by the Foundation to introduce D&T teachers to the circular economy resources, held in 2012. Additional data has come from interviews with five teachers and teacher trainers who have made extensive use of the resources. Finally, we extract key themes from the data.

System Reset

This is a suite of resources (Ellen MacArthur Foundation 2012a) comprising six sets of activities, all designed to introduce the principles of the circular economy to students aged 11 – 18. The first set looks at the built environment, concentrating on the design of buildings, their use and eco-effectiveness. Students can see how, through applying circular economy principles, new buildings can be created that have a positive impact – buildings that do good rather than less harm.

The students explore inspirational case studies, analyse existing buildings and investigate how these are used by communities. They then identify key circular economy principles and elements of cradle-to-cradle thinking that they can incorporate into their own design for a new building.

Lesson One starts with the students looking at how materials can be recovered from buildings – at present most buildings are simply demolished at ‘end-of-life’. They examine eight case studies of buildings or cities that exemplify cradle-to-cradle design philosophy and systems thinking. In groups they research these further. Each group is invited to assess their case study against circular economy principles, leading them to compare and contrast the currently dominant linear model with the circular alternative.

In Lesson Two they explore the Cradle-to-Cradle™ Manifesto, relating this to the buildings they have been examining, and from this develop a complex specification for a new circular economy development.

Lesson Three asks the students in groups to develop (using CAD) circular economy strategies for both buildings and communities. The idea now is to think beyond the building itself to the system within which it exists.

In Lesson Four they use de Bono’s (1999) Thinking Hats to evaluate ideas, and generate three key criteria for circular economy built environments. Realisation of their designs is completed using 2D and 3D design computer modelling. They then present and review all their proposals in full class.

This is just one of the resources in System Reset. The full collection comprises:

- Circular economy in the built environment: see above.
- Waste = food: introduces aspects of the circular economy through engaging students with accessible design-and-make tasks, focusing on food packaging for festivals.
- Rethinking the system: develops students’ understanding of the principles of a circular economy, in particular of the biological and technical cycles. They bring

these principles to bear on the design of a new product, presented as a business proposal.

- *Intheloop*: a design-and-make project using CAD/CAM in which students explore the principles of materials recovery. They learn how products can be ‘made to be made again’, reusing materials with nothing lost to the system.
- *Biomimicry*: looks at nature for inspiration to solve engineering problems and to develop innovative new designs for products and architecture. It recognises three levels of biomimicry: mimicking form, mimicking movement and articulation, and mimicking systems.
- *Rethinking textiles products*: focuses on textiles in fashion design. Students learn how textiles companies are applying a circular economy perspective to developing textiles products, eliminating waste for the product lifecycle.

PRELIMINARY FINDINGS

System Reset and the Future of Energy

These resources have been used with students aged 12-18. One teacher says that they have transformed teaching to such an extent that he no longer seems to be teaching just ‘Design and Technology’ but ‘design economics’ – focusing on opportunities for remanufacture, or ways that companies could remodel their businesses. Students’ finished products may not be as aesthetically pleasing as if they had focused purely on the product design brief, but the thought processes behind them are much deeper, engaging with strategies such as design for disassembly, and the students love the additional challenge. One student, who at age 15 told this teacher that he could not think of anything to design that hadn’t been done before, studied the System Reset materials and a year later said that in fact, “everything needs redesigning!” This teacher observed that the systems thinking emphasis particularly engaged girls, who have a real strength in systems thinking and setting products in context, even if they are not, on average, as interested in the technological dimensions of a product.

Early experience suggests that all students are stimulated by them, but that 11-16-year-old students may need 5-6 hours to get to grips with the basic concepts, while post-16 students can rapidly (in two hours) understand and explore the wider implications for business models and economic systems. Students across these age ranges - and their teachers - need some help to understand the distinction between a circular economy and sustainability, with the latter’s emphasis on recycling and behaviour change. While teachers certainly do not want to dissuade their students from making positive behaviour changes, there does appear to be an intellectual barrier to overcome if students are to engage fully with the exciting design challenges of a circular economy.

This same issue was visible in the reflections of a group of Scottish teachers who went on a circular economy study visit to the Netherlands in 2012. Although most ‘got it’ immediately, some of the teachers were still viewing the circular economy

as a sub-set of sustainability at the end of a visit. In another instance (a workshop for chemistry teachers) a new entrant to the profession who had previously been an industrial chemist said after seconds “This is a no-brainer” whereas another teacher who was thoroughly steeped in the framework of sustainability was still struggling with the basic concepts of a circular economy at the end of a five-hour session on the subject.

One teacher expressed the view that with demand for qualified engineers predicted to surge, and increasing numbers of companies investigating circular economy models, pupils who have absorbed circular economy thinking will be at a distinct advantage when they hit the labour market in a few years time. It is noticeable that the Edexcel AS-level curriculum (a qualification typically taken by 17-year-olds at the halfway point in their further education), which allows for blue-skies thinking and thus higher-level concepts such as circular economy, provides an opportunity for this; but there is a lack of freedom to do this in the English exams at GCSE (16-year-old) level.

G2 Card Game

One of the most effective tools has proved to be the G2 Card Game. This is a participatory group card activity through which, with a minimum of direction, groups can quickly elucidate the difference between a circular and a linear economy for themselves. Feedback from Continuing Professional Development workshops shows that teachers may come to such a workshop with very little idea of what a ‘circular economy’ might be – typical expectations at the beginning of the day were rather general, e.g. “To develop my teaching skills by moving away from more traditional design and manufacture techniques” and “To find relevant links to encourage ALL people to think about global citizenship”. By the end of the day, feedback comments demonstrated that the card game quickly focused minds on the crucial differences in design between circular and linear economic systems, and clarified any confusion between sustainability and circular economy models in participants’ minds. One participant said he/she would “definitely use it in class” and many rated it highly. For the same reason, one teacher invariably chooses this activity as his starting point with students.

Participants at a Scottish teachers’ workshop also greatly valued the addition of a business case study exemplifying circular economy thinking (in this case, the Scottish Leather Group) to follow up the card game with its examples of a leaf versus a plastic bottle. Both of these facts seem to indicate the importance of concrete examples in introducing circular economy concepts.

Teardown Labs

The three Teardown Labs were attended by 84 teachers, along with 41 product designers, architects, engineers and educationalists. In these the participants work in

teams and disassemble an everyday products such as a camera, keyboard or phone. They are asked to identify the materials used and the quantities of each. From a circular perspective most of the products are disastrous – either almost impossible to take apart, or materials that are combined and thus not reusable. The participants are then asked to redesign the product for a circular economy. Afterwards, 83% of participants strongly agreed that the circular economy was of relevance to their future work; 78% strongly agreed that they felt stimulated by the afternoon’s learning, and virtually all intended to discuss the concepts learned with colleagues. One teacher participant commented:

A really different way to think when designing a product. Planning to get together with rest of department to discuss and share. I have already started putting a file together to help anyone with teaching it and started a discussion today with the Year 12s (16-17-year-olds) who were really interested, so I’m going to run a few teardown workshop type things with them.

The presence of designers from industry in the same discussion groups as teachers was particularly interesting. When making notes and design drawings, the designers automatically drew systems diagrams as opposed to technical product drawings – indicating that industry is already moving to a systems thinking approach, while teachers often teach ‘school design’ in a more restricted problem-solving and product-oriented ways.

The Labs generated so much interest that an accompanying short video ‘How to run your own Teardown Lab’ was developed to help teachers run similar activities in their own schools.

The Circular Economy Handling Collection

This collection is still in the process of development and a number of trainers have used it during training workshops with teachers. It is seen as an excellent stimulus for teaching circular economy concepts across a range of subjects, from Geography to Science to D&T and Engineering. As mentioned above, concrete examples are both inspiring and explanatory when introducing what can be challenging new concepts.

The tension in creating a handling collection of artefacts is to shape it into a coherent ‘story’ so as to communicate the key concepts, while allowing sufficient flexibility for individual educators to construct their own teaching units. One trainer reports that while teachers quite readily grasp the difference between products designed for a linear versus a circular economy, it is more difficult for them to address the wider ‘systems thinking’ dimensions without explicit guidance. This trainer suggests that each ‘Product for a Circular Economy’ included should be paired with a comparison product designed for a linear economy (e.g. a modular, upcycled and upcyclable dress could be contrasted by a conventional, linear item of clothing), to assist teachers who may be using the collection with little prior training in circular economy ideas.

INTRODUCING IDEAS OF A CIRCULAR ECONOMY

An additional question for the Foundation is how much information and complexity to include in the accompanying notes for each product. Much of the fascination of the products designed for a circular economy lies in the detail of the circular business models designed around them. Every teacher will use the collection differently, and it is important to ensure accessibility for lower ability students, as well as stretch and inspiration for those who quickly understand the concepts.

The authors anticipate that the Handling Collection's value will continue to be particularly great in Continuing Professional Development. The Foundation hopes to develop more extensive training opportunities, for example by making the collection available to networks of teacher trainers.

KEY THEMES FROM DATA

The following themes emerge strongly from the case study findings:

A Shift from Product Design to Design Economics

It is striking that what initially appears to be simply a set of new concepts can actually lead teachers to rethink completely how and why they teach D&T. The shift away from a focus predominantly on functional, aesthetic and ergonomic considerations, to the whole system in which products operate, is a broadening and exciting one - and appears to reflect how designers, as opposed to design teachers, increasingly design. As design for a circular economy spreads to the mainstream in our economy, those young people exposed to these concepts while still at school will be at an advantage both in their working lives and wider citizenship.

The Challenge of Moving 'Beyond Sustainability'

It has been challenging, at times, for trainers to help participants in teacher training events to draw a clear line between sustainability and behaviour change models on the one hand, and circular economy concepts on the other. Both teachers and students come to these workshops and resources with pre-existing mental models of sustainability, dominated by behaviour change-focused approaches such as the Eco-Schools award scheme www.eco-schools.org.uk/applyforanaward; some are inclined simply to overlay one set of concepts from another. As one Scottish workshop participant said, they needed help with:

Making the separation between 'cradle-to-cradle' and circular economy concepts with sustainability / re-cycling a little bit clearer as new concepts and current ones sometimes get a bit mixed together.

This also relates to a creative tension within the work of the Ellen MacArthur Foundation itself. Its priority has been to reach new audiences, both in business and education, with a novel approach based on design, systems thinking and

economics, rather than individual behaviour change. At the same time, its own educational philosophy too holds that teaching is not a matter of transmitting ideas but of providing a context for interdisciplinary, creative, critical thinking and joint production of knowledge. Thus, it would be unrealistic and wrong to seek to limit the scope of teaching on a circular economy to exclude ethical concerns of pressing concern to them and their students. Essentially, the Foundation's role is to provide resources and Continuing Professional Development, and then to encourage teachers to participate actively in the development of thinking and teaching in this area.

Age-Appropriateness and Intellectual Challenge

The Foundation's own position has been to avoid developing resources for primary level. In part this is because of the relative complexity of the concepts involved in circular economy thinking; it may also be difficult for teachers to distinguish sustainability from circular economy thinking at this level. However, 11-16-year-old students have been able to engage with many of the core concepts (e.g. biological vs technical cycles, design for disassembly), whilst 16-19-year-old students and teachers in training workshops have been quick and enthusiastic in grasping the wider systems thinking and economic dimensions.

The Role of Awarding Bodies

In England, some teachers have expressed difficulty in incorporating circular economy concepts into their teaching for exams at A level (aged 18) and, particularly, at GCSE (aged 16), because of restrictive curricula and examination specifications. The requirement that students at age 16 make what they design may be an obstacle to the introduction of higher-level concepts such as the circular economy. The situation in Scotland (see Learning and Teaching Scotland 2009), with its Curriculum for Excellence and emphasis on interdisciplinary learning (IDL), is more open, as demonstrated in the comments from Scottish workshop participants who outlined many opportunities to incorporate circular economy concepts in their teaching (e.g. Design and Manufacture courses, whole-school IDL initiatives, project work in various subjects). The same is true for the International Baccalaureate (IB) exams. The Foundation is working with awarding bodies in the UK and the IB to encourage thinking in this vital new area.

Systems Thinking as a Female-Friendly Approach to Design and Technology

An interesting theme to emerge from the case study data is that both women teachers and girl students have engaged readily and deeply with circular economy concepts. Whereas boys often excel in technical subjects such as product design, one teacher observed that his female students were particularly adept at systems thinking, the wider context of products and 'design economics'. Interestingly women teachers

have been drawn in large numbers to the Continuing Professional Development events run by the Foundation. This suggests some interesting areas for research.

CONCLUSION

The interest generated by circular economy thinking, with initiatives arising concurrently in business, education and government in many regions and countries as well as in supranational bodies such as the European Union and the World Economic Forum, is indicative of the beginning of the transition to a circular economy. As design, manufacturing, business models and reverse logistics infrastructures evolve as concomitant elements of this, it is important that design education in schools reflects the new paradigm. The learning resources developed by the Ellen MacArthur Foundation, and especially those for D&T, offer one vehicle for doing this. The lack of flexibility in many nations' school curricula and assessment systems, and the dominance of a 'do a bit less harm' approach to sustainability by teachers and their pupils, are obstacles to the exploration of circular economy thinking in schools. But overall it is our experience that the circular economy framework does reach parts of the student psyche that other mental models do not, and that it does so in a way that is positive, challenging and fun.

NOTE

- ¹ Ellen MacArthur Foundation (2012) and Ellen MacArthur Foundation (2013).

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17. “WE HAVE TO CREATE A WAY TO CATCH FLASHES IN ORDER TO GET ELECTRICITY”

*Creative Ideas in Children’s Perceptions of Climate Change:
An Innovation Potential for a Sustainable Future*

INTRODUCTION

The solution of the global environmental problem “climate change” is closely connected to the contemporary and future lives of humans. In this way the topic becomes an “exemplary key problem” (Klafki, 1992). In particular, today’s primary school students will be affected. For this reason institutions like the German Federal Ministry for the Environment and some publishers release materials for teaching and learning. However, until now, little has been known about children’s perceptions. As Educational strategies for supporting competencies for sustainable development “are best designed based on an appreciation of children’s preconceptions” (Boyes & Stanisstree 1993, p. 531) research was carried out to identify children’s ideas of climate change.

PREVIOUS RESEARCH ON YOUNG CHILDREN’S UNDERSTANDING OF CLIMATE CHANGE

Since Boyes & Stanisstree (1993) stated that little is known about children’s perceptions on climate change, there have been a lot of studies on secondary school and university students’ perceptions (e. g. Aydin, 2010; Boyes, Skamp & Stanisstree, 2009; Liarakou, Athanasiadis & Gayrilakis, 2011; McNeil & Vaughn, 2012; Niebert, 2010; Schuler, 2011; Shepardson, Choi, Niyogi & Charusombat, 2011, Shepardson, Niyogi, Choi & Charusombat, 2011; Sternäng & Lundholm, 2010; Taber & Taylor, 2009; Ekborg & Areskoug, 2006; Ikonomidis, Papanastasiouet, Melas & Aygoloupus, 2012; Parchmann, Pioch & Piosk, 1999). Results show that perceptions based on everyday experiences are different from scientific explanations of the phenomenon. Comparing the findings in the different countries indicates that students have similar perceptions, which seem particularly stable if they are consistently suitable with everyday analogies (Schuler 2005, p. 109). Thus one can find indications in all studies that students interpret the “green-house-analogy” as a barrier, similar to the roof of a green-house, where sun layers or warmth get trapped under. Furthermore, in all samples the problem of ozone layer was mixed up with the problem of climate change. This is a problem insofar as students’ concepts of causes and consequences have an effect on estimating their personal concern and capacity to act.

At the same time there have been no significant changes in the field of research concerning primary schools, which means that still little is known about the perceptions of children aged six to ten.

Hauenschild (2002) e.g. investigated children's control perceptions in situations referring to the context of sustainable development. That means she tried to find out to what extent children conceive opportunities of action in relation to certain environmental problems (internal control) and how they rather ascribe opportunities of action to other people (external control). A small part of Hauenschild's study deals with the topic of climate change. Since it concentrates on describing children's control perceptions there are only a few results concerning children's ideas of the phenomenon itself. The findings show that children have different ideas of how one could behave in an environmentally responsible way, but expect a low effect as long as the causers do not change their behaviour. Secondly, Hauenschild found that children seem to discern a correlation between local behaviour and global effects.

Pruneau, Liboiron, Vrain, Gavel, Bourque & Langis (2001) interviewed third-graders, aged eight - nine, as one small part of their sample. But still there are few results, since in 73% of the categories more than 80% of the children said "I don't know". They concluded that "in general, the climate change phenomenon is not well known to 8 or 9 year-old children" (Pruneau et al., 2001, p. 132).

RESEARCH DESIGN OF THIS STUDY

In order to find out more about children's perceptions of climate change twenty-nine third-graders (aged eight - ten) from three different schools in the north-west of Germany were interviewed using a semi-structured so-called "concept-mapping-interview" (Haerle, 2006). The children were selected by their teachers as being representatives of the class population. In the interview different stimuli (a concept cartoon and pictures) were used (Lüschen, 2011).

During the whole interview the children's responses were written down simultaneously. For this, a concept-mapping-software called VUE was used to create digital cards (concepts) with the children's answers displayed. The children had full visual access to the documentation of their answers as they sat next to the interviewer. In the end the reduced data was verbally validated with the interviewed child and arranged in a concept map (Lüschen, 2011).

For analysing the inter-individual perceptions the statements were combined in phenomenographic "categories of description" (Marton, 1988). A set of these categories consists of "terms of distinctly different categories that capture the essence of the variation" (Marton & Booth, 1997, p. 123) of expressed perceptions (figures 3 and 5). That means with these categories it is possible to describe qualitatively different ways, in which a phenomenon is experienced, understood or explained (Marton, 1981). These differing ways form a hierarchal structure. Thereby the variation of predictable perceptions can be presented and used for developing guidelines and materials for teaching and learning.

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Figure 1. Concept Cartoon 'Climate Change' (Lüschen, 2011)

In this case all mentioned perceptions of a specific aspect have been examined according to their differences and arranged regarding their complexity (see figure 2 and explanation underneath). The focus of the analysis not only lay in the complexity of the content, but also on the way certain aspects were connected. This is sensible insofar as correct knowledge is only *one* condition for ecological thinking or networked thinking (Kahlert 2007, p. 219; Doll, Rieck & Fischer 2007, p. 215), which is a competence that seems to be relevant for so-called 'shaping skills' (in German called: Gestaltungskompetenz). According to the German program 'Education for Sustainable Development' (short ESD; further information: www.bne-portal.de) shaping skills are key competencies for a sustainable future (Haan, 2008; 2009).

The section below shows, on the basis of several examples, to what extent the statements of the interviewed children (figure 2) vary qualitatively.

A closer look at the statements in figure 2 shows that Sophie's and Nele's perception differ in that Sophie precludes the influence of mankind on temperature, whereas Nele takes the view that the warming she had mentioned underlies anthropogenic causes. The higher quality of Lara's remark stands out due to the fact that she describes among causal processes also the regulative ones. Indeed, Lara does not describe how emissions cause the change. However, such a further explanation is found in Mathis' statement. Linus finally shows that he has developed a quite advanced understanding of the greenhouse effect. Moreover, he is the only interviewed child who uses the term greenhouse effect.

Sophie: It is not right that people cause it [temperature change]. (category 0)

Nele: People cause the change with the car. The cars and motorcycles have exhaust gases, then it gets warmer all over the world. (category 1 in figure 3)

Lara: It gets warmer all over the world, because people produce much CO₂. Big forests should not be cut down, to make paper or wood. The trees would filtrate CO₂.(category 2 in figure 3)

Mathis: Not people, but cars cause the change. They burn fuel and that mixes up with the clouds. The sun shines through [the clouds] but can't come out. (category 3B in figure 3)

Linus: driving cars, fireplaces of houses, coal and nuclear power plants produce CO₂ (carbon dioxide). We have an oxygen bubble in which the CO₂ remains and becomes thicker and thicker and won't let the sun rays get out any more. [This is called] greenhouse effect, that is why it is always warm in the greenhouse. (category 4 in figure 3)

Figure 2. Children's Perceptions of 'Causes of Climate Change' (exemplary quotations)

EXEMPLARY FINDINGS ON YOUNG CHILDREN'S PERCEPTIONS OF CLIMATE CHANGE

Third Grader's Perceptions of Causes of Global Warming

The results show that not every third-grader has ever heard of climate change as an environmental problem, but most of them connect the term with an idea of what might be meant by it. Those children, who thought of it as such a problem, had manifold ideas of what causes a change in global temperature. Figure 3 shows the differing categories.

Characteristic for categories 1 and 2 is that children name *one* reason for climate change but do not explain how the emissions cause the warming. The explanations are mono-causal (see figure 2 Lara and Nele). The qualitative difference between these categories is the *more complex connection* that is used in category 2 by explaining the influence of regulating processes. Characteristic for categories 3 and 4 is that reasons are anthropogenic *and* natural. The explanations are multi-causal (see figure 2 Mathis). The qualitative difference between these categories, again, is the *complexity of connections*: In category 3A natural and anthropogenic reasons are not connected but anthropogenic processes are connected with regulating natural processes. In category 3B: natural and anthropogenic reasons are connected linearly but regulating processes are not named. Category 4 is the most complex one, because natural and anthropogenic reasons are connected *and* feedback processes are considered (see figure 2 Linus).

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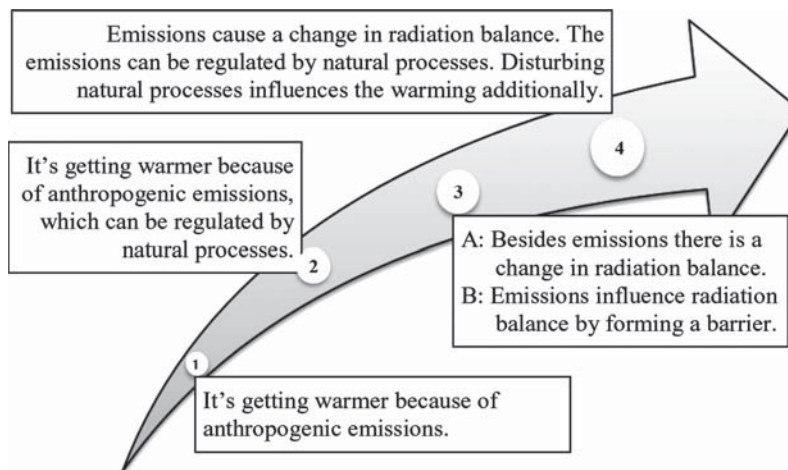


Figure 3. Set of categories 'Causes of Global Warming'

These categories demonstrate that young children can develop a quite deep understanding of the causing processes of climate change. Furthermore they illustrate that children of that age do not only show convergent thinking (Harms, Mayer, Hamann, Beyrhuber & Kattmann, 2004), but one can also find different dimensions of networked thinking in these children's perceptions like multi-causal explanations, the connection of natural and anthropogenic processes and/or complex relations (Lecher, 1997; Sommer & Lücken, 2010; Bertschy & Künzli David, 2011).

Third Grader's Perceptions of Children's Possibilities to Act

One part of the interview also focussed on children's perceptions of possible actions. They all had the opinion that something should be done against climate change and had a lot of ideas of what might be done (see figure 4).

The following set of categories (figure 5) refers to children's perceptions of their own possibilities to act:

Statements that were combined in category 1 are distinguished by the opinion that children have no possibility to do anything. In category 2 children think that they are able to act, but their actions are not concretized. Characteristic for category 3 is that children list different changes in behaviour like driving less by car. Categories 3 and 4 are distinguished by the perception that children have influence on other people or actions. While this influence is direct in category 3 it is indirect in category 4.

This set of categories is less manifold than the others. Children mainly see acting possibilities in the field of change in behaviour. Most of them stated that they could use the car less and/or that they can suggest this point to their parents. Only few see

Mathis: Children can't do anything. (category 1 in figure 5)

Toni: I think I can't do anything. (category 1 in figure 5)

Dirk: Some children think about what one could do against the climate change. (category 2 in figure 5)

Hannes: Children could more often go by bike, they shouldn't always be driven by car. (category 3 in figure 5)

Finn: Man can change something about fumes. Children could take care that their parents don't waste too much fumes.(category 4 in figure 5)

Toni: Man has to invent something new, how he could produce more electricity. Children could do a lot of researches with electricity at school and invent something which produces electricity. (category 4 in figure 5)

Lennart: Factories should be closed or shouldn't emit so much CO₂. Children could maybe do something, maybe could tell the politicians that they should close factories. (category 5 in figure 5)

Figure 4. Children's perceptions of 'Children's Possibilities to Act' (exemplary quotations)

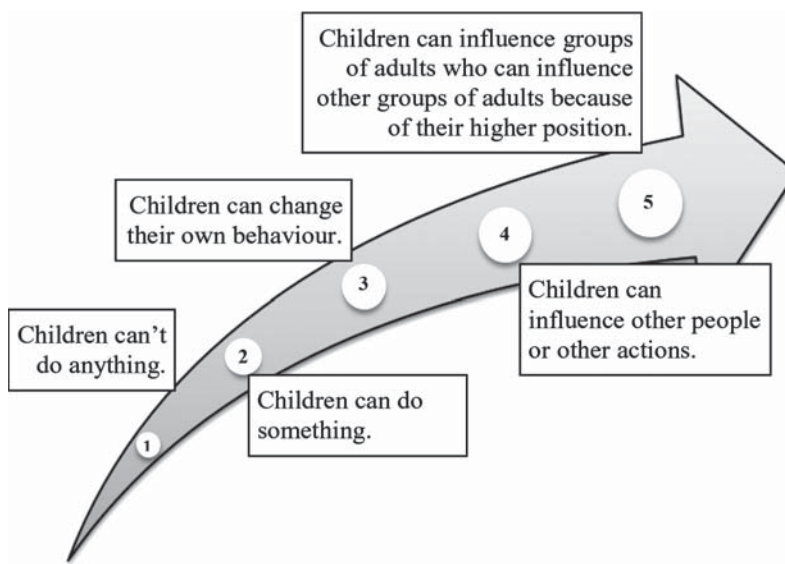


Figure 5. Set of categories 'Children's Possibilities to Act'

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their own innovative potential or possibilities of political participation. As both are seen as basic competencies for shaping skills (see above) one can identify a link for creating guidelines here, which contribute to a sustainable future.

CONCLUSIONS AND PROPOSALS

This study shows that not every third-grader has ever heard of climate change as an environmental problem. But it also illustrates that those who have already heard of it are interested in the topic, they have a lot of questions, and want to know answers. Consequently, teachers have a duty to consider children's interests and perceptions. Offering understandable learning materials which take account to children's perceptions is only one implication of this is. Children also need to be supported to release their fears, develop a “critical-constructive stance” and to create a positive Utopia (Bölts, 2002), by encouraging their innovative potential concerning the design of creative solutions.

According to the findings of this study the following aspects seem to be most important for teaching the topic of climate change at primary schools:

Helping children to express their perceptions and to come into discussion

“People have no influence on a change in temperature.”

Starting points should be impulses that allow children to express and discuss very heterogeneous perceptions. This study showed that concept cartoons (Keogh & Naylor, 2004) and/or pictures are suitable for this.

Helping children to judge the quality of information

“I know about climate change from books, television and from my parents.”

The results of the study show that the interviewed children learn mainly about climate change through different media and used them as sources of information. This has to be judged critically to the extent that reporting on environmental problems often involves exaggerations and misinterpretations (Haan, 2009, p. 21). Lessons on climate change should therefore always imply a critical examination of media.

Helping children to develop a critical-constructive stance

“We children could point out to adults that they don't waste so much CO₂.”

Children should be encouraged to develop their own ‘norms’ in order to provide a basis for a critical-constructive stance.

Ecological thinking and acting depend on a conglomerate of governing factors. Barriers which restrain mankind from acting can be conquered by pursuing different approaches. In the field of motivation to a behaviour and habit change, it became apparent that participation-oriented strategies are one sensible way particularly in organisations. These strategies develop their effects on account of the interaction of the group. In environmental psychology (Blöbaum, 2011; Matthies, 2000), this method is also suggested for schools. Blöbaum suggests the following approach. After deploying an actual condition analysis which observes climate-relevant behaviour (phase 1), a planning team (Climate-Team or C-Team) is established. This team should represent the whole school and therefore it should include students of each age group and persons of each status group. Firstly, during the planning phase, the “C-team” agrees independently on concrete measures. It then develops an implementation strategy and materials (phase 2). Due to an ideal matching between methods and institution, one achieves a positive effect for the participation. Moreover, the participants feel themselves to be autonomous and identify more closely with the objectives. A while after the strategy and materials were implemented (phase 3) the success of the strategy should be evaluated (phase 4), methods should be reconsidered and materials should be revised, if necessary (Blöbaum, 2011, p. 85).

Since the data of this study show that primary school children do not only reflect options for action which are within their own range of influence, but also those which are currently beyond their influence, they seem to have the necessary requirements for involvement and participation within such a C-team.

Helping children to develop creative ideas

“We have to create a way to catch flashes in order to get electricity.”

Use children’s creative potential to build-up a positive Utopia!

Development and innovation are significant not only for the context of ESD, but also for the options of action by the Intergovernmental Panel on Climate Change (IPCC): Stabilisation levels, for example, can be achieved by the development of technologies, which are either currently available or will be developed in the coming years. Energy supply and use and energy efficiency play a key role in this context (IPCC, 2008, p. 68). One principle of the German ESD-program is modernisation. It wants to reduce fears by focussing positively on reachable objectives that can be achieved by individuals or groups (Haan, 2009, p. 21; 2001, p. 198). In accordance with the wishes of a sustainable future, children should be supported to see and understand opportunities of change to then contribute actively, constructively and innovatively to the solving of problems, amongst other things, in the technology sector. Children have ideas (see above) and these partly utopian visions can progress to drafts. By linking creative acting and communication, concrete Utopias for a sustainable future can be established (Böls, 2002, p. 37 p.232, p. 257; Kaiser, 2006, p. 254).

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BEN CHAPPELL

18. SUSTAINABILITY + FUN = A CHANGE IN BEHAVIOUR

*How Much Fun Is There in the World? Is It Finite? So, Should We Be Using
More of It to Teach Students about Things That Are?*

INTRODUCTION

Something as simple as fun is the easiest way to change people's behaviour.
(Volkswagon, 2009)

This chapter is dedicated to the idea that fun is the easiest, cheapest and most sustainable way to change people's behaviour for the better. Fun is free; it doesn't run out and rarely becomes boring. Fun is not age, gender or race specific and is therefore the perfect vehicle to change a person's behaviour. Volkswagen believes this change can be evidenced in a number of ways (e.g. environmentally), as long as it is positive. Volkswagen used the power of fun to change people's behaviour in a recent viral campaign. They have called this process 'Fun Theory' (Volkswagon, 2009). The aim of this chapter is to see if Fun Theory can be used to change the way schools teach students about sustainability issues in Design and Technology (D&T).

In order to support this idea of using fun to change a person's behaviour it is key to make a change to the way sustainable issues are taught in schools. This change involves making sustainability issues central to learning, and to help D&T teachers to support a paradigm shift towards re-education about sustainability issues. The approach was to ensure these issues are an embedded part of the curriculum, rather than student regurgitation of teacher's 'truths', or as a tokenistic add-on during a project. Once this platform is set, Fun theory can be used to change people's behaviour for the better.

To illustrate how this process can be achieved a small scale case study is used. The case study shows how, through fun, students can engage in environmental, social and ethical issues, as well as developing their capabilities as designers, thus generating environmental capital within a school, community or wider society. The case study illustrates a model of learning that does not focus, specifically, on the acquisition of skills; rather, it develops students' capabilities as designers and activists, and enables them to make a positive contribution. This model of learning is structured to mimic

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the design process used by professional design studios and is based on Project H developed by Emily Pilloton (2010). It encourages students to question the issue of sustainability through active research and critical appraisal of real world problems. Through this, students take ownership of sustainability issues and produce designs intended to re-educate the rest of the school community about sustainability, all the while using fun as the vehicle of the change.

THE ISSUE OF SUSTAINABILITY

In 2000, Simmons questioned the idea that the Earth has unlimited or sufficient quantities of natural resources and has the capacity to allow humans to develop indiscriminately. He went on to say that exponential growth and consumption of natural resources without thought of repercussion are all naïve assumptions of the 20th century. This sort of attitude could be called being a “Future eater” Flannery (2002).

Instead, today’s culture is applying the brakes; it is a culture of rapid repair as the current human footprint exceeds the Earth’s bio capacity (WWF, 2008). The United Nations, Education, Scientific and Cultural Organisation (UNESCO) sees education as being essential to sustainable development and believes people need to learn to be sustainable as our current knowledge base does not contain the solutions to contemporary environmental problems (UNESCO, 2012). The case study presented in this chapter is one way to re-educate young people about sustainable development, using the English D&T National Curriculum.

Teaching sustainability issues is problematic as the terms ‘Sustainability’ and ‘Sustainable development’ are ill-defined and have been part of international discourse for the last twenty years (Pavlova, 2009). Finding a singular definition of the two terms is problematic (Pitt, 2009) due to it being an ambiguous term (Dale, 2001) or due to its complex and interdisciplinary nature (Elshof, 2003). For the purposes of this case study it was important to define what constitutes the term sustainability, as this will greatly affect the content of the teaching. A widely accepted definition for sustainable development or sustainability is “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland, 1987:37).

The UN conference (1992) endorsed the above definition and agreed upon Agenda 21 (UN 1992). This Agenda acknowledges the above definition but champions the importance of putting humans and education at the centre of sustainable development highlighting the need to integrate the values inherent in sustainable development into all aspects of learning to encourage changes in behaviour that allow for a more sustainable and just society for all.

The UN identified the need for a change in people’s behaviour in order to create a more sustainable society and identified that the only way to do this is by giving the teaching of sustainability issues a more central and prominent role in education.

This research intends to show how schools (in particular the D&T curriculum) have an important role to play in changing people's behaviour by making sustainable issues core to teaching and raising awareness in their community.

SUSTAINABILITY AND DESIGN EDUCATION

There are examples of learning environments in which sustainability issues are placed at the core of the learning. One example is Project H, a high school curriculum started by Emily Pilloton in 2009 in rural Bertie County, North Carolina. This project has raised awareness of sustainability and is generating creative capital in some of the poorest communities in America by engaging secondary students in real world design and build projects. Pilloton's students are taught in an environment where sustainability issues are central to their learning and the design process mimics professional practice. Students are encouraged to conduct their own research, design their own briefs and synthesise their own opinions all within the context of their local community. For example, REALM school, where Project H is based, required more classrooms, so they asked the project H students to come up with a solution. After conducting their research the students felt that upcycling three shipping containers and joining them with clear partitions would create a better environment to educate more students (ProjectHDesign 2012). Involving students in generating their own truths about sustainability can enable them to make positive changes to their community and learn key practical skills. Through design the students were learning industry relevant construction skills, building creative capital and, most importantly, developing citizenship skills necessary for the success and future of their communities.

What makes Project H special is that it makes the outcome relevant to the students; they can see the direct impact of their projects and as a result the students value the humanitarian issues placed at the core of the design. Pilloton shows why design is an excellent vehicle for social change and shows how the idea of activism is far more powerful when conducted on a micro level within a community.

If you start doing humanitarian work on a global scale you start to lose sight of people as individuals. (Pilloton, 2010)

In Project H the client is the local community and the design process is subdivided into the following categories 'Design, Engage, Build, & Transform' (Pilloton, 2010).

Through this process the learners take part in four distinct stages over the four terms in the year. The students' level of engagement is at its greatest during the Design, Engage and Transform stages, rather than the Build phase of the process. By doing this Pilloton redesigned the American education process to apply more critical thinking and synthesis of opinions to a subject that has traditionally been seen as a less academic or more vocational subject. The case study focused on in this chapter wanted to take the idea of humanitarian design, the generation of creative capital for a community and the small scale environmentalism and see how it could be applied to the English school subject D&T. The difficulty was in creating conditions in which change is possible.

THE CASE STUDY ‘PROJECT F’

My research used a similar process to Project H, but on a smaller scale in a school environment (Project H is based in a school but is involved in wider scale change including the local town). In this project the school was the wider community and the project was called ‘Project F’ (the F stands for fun). During the project the students passed through three phases ‘Learner’, ‘Expert’ and ‘Activist’ (similar to Pilloton’s stages; Design, Engage, Build, Transform). In the role of Learner, the student actively absorbed facts and information, not opinion. As an Expert the student critically evaluated facts and developed their own research and synthesised their own opinions based on facts and findings. Finally as a Teacher/Activist the student actively promoted findings through designs to re-educate the community. The activities at each stage are outlined in the figure below.

Learners	Experts	Teacher / Activist
Workshop: Big Picture, Design for short life & Over consumption Climate change	Activity: Evaluation of products from an social, environmental and economic view point	Activity: Interviewing and observing communities behaviours
Workshop: Social, Environmental & Economic issues	Activity: Synthesis of opinions about products and companies environmental credentials	Activity: Design and build a solution to re-educate, promote sustainable practice within the school based on research
Workshop: 6 R's - Recycle, Repair, Reuse Refuse, Rethink, Reduce	Activity: Analysis and evaluation of products from perspective of the 6R's Activity: Ethnographic research - identification of behaviours	Activity: Trial and evaluate effectiveness of the product in changing communities behaviour

Figure 1. Design process based on Project H

In the ‘Learner phase’ the students discovered sustainability issues within the school community through directed workshops. Each workshop focused on a different global issue; over consumption, the big picture and climate change for example. The students then took this knowledge and applied it in a new context, their school. This technique of providing students with facts and then allowing them to synthesise their own opinions in a context that is relevant and meaningful to them was very successful. Elshof (2003) describes this process of education as promoting “Active and responsible citizenship” by developing the necessary skills to investigate the “Full human and environmental context of any project and to reflect critically on its purpose and outcome” (Conway, 2002:260). By making the teaching of sustainability central to the curriculum and avoiding a tokenistic mentality where the learning is secondary to the doing (the completion of the practical outcome) the students engaged in proactive investigation of their community and used the facts and their own understanding to synthesise their own opinions. The process used reflected the concept put forward by Bonnett (2002) in which students engaged with environmentalism on both a sustainability level as well as a democratic level if the issues are central to the learning and relevant to them. Below are some images of student work from the ‘Learner phase’ of the case study.

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Once students were engaged with environmental issues on a sustainable and democratic level the next step was to transform the Learner from a passive recipient of information to an active learner, an opinion maker, someone capable of change. I wanted to avoid the students simply regurgitating teacher 'truths'. Rather I wanted the learners in the 'Expert' and 'Activist' stages to experience the learning through independent inquiry.

The case study was focused on developing students' design capability and literacy, with the intention of embedding sustainability issues at the core of their design thinking.

The nature of education for sustainable development is highly contested due to the concepts being difficult to implement in the current system Pitt & Luben (2009). Cortese (2003) suggests that there are "*several structural aspects of the current system contribute to the problem*" and there is no singular fix, suggesting that a shift toward re-education through active experimental, inquiry based learning and the solving real problems with an interdisciplinary approach is needed. This is what I tried to achieve through its three stages of the project. Kimbell & Perry's (2001) ideas have resonance with Cortese saying students must play an active role in learning if it is to be meaningful. Kimbell & Perry (2001:7) describe this process as "a move from receiving hand me down outcomes and truths to a situation in which we generate our own truths. The pupil is transformed from a passive recipient to active participant. Not so much studying technology as being a technologist."

The literature suggests that active engagement and promoting student inquiry into relevant issues, such as their direct community will allow the students to learn about sustainability issues through design in the most meaningful way possible. This literature does highlight some issues when teaching sustainability. Stables and Lawler (2008) found that a biased approach, too focused on the theory and not the application of sustainability, can have a negative effect. "Just don't go eco, eco, eco to them". (D&T student teacher) (Stables & Lawler, 2008:75). Therefore a balance of design capability and theoretical understanding was used in Project F to ensure that students were deriving their own meaning from the design process. Pavlova (2009) and Pitt and Lubben (2009) found that a further issue when teaching sustainability issues is the prevalence of consumer-orientated design and advertising applying pressure to young people when making consumer decisions.

To negate this sort of attitude Project F tackled environmentalism on a micro level, addressing issues on a small scale, issues relevant to the student so that they could see the worth in changing their behaviour. For example, getting students to not upgrade their phone every six months in order to stay current with the latest fashions is difficult. So Project F provided the students with facts about mobile phone production. The facts were based on a range of sources, including 'The Sustainability Handbook for Design and Technology Teacher' Capewell (2007). The information covered included; facts about the ore Columbite-Tantalite (CT) its necessity in mobile phone production, the effect mining it has on the Democratic Republic of Congo (DRC). The effect this has on various groups of people within

the DRC including women, farmers, children, miners and militia. Once the students had been provided the facts, they were given a part in a role play. This was to make the students empathise with the party assigned to them.

The students were then asked to create an argument for or against the use of CT in mobile phones and asked to explain the effect it was having on their character's life. By humanising the problem and asking the students *'What if this was happening to your family?'* it made a global problem very relevant to the students and made them see value in changing their attitudes.

The next stage was named 'Experts'. The reason for this was to empower the students, to remove the notion that the teacher was the fountain of all knowledge and to encourage the students to believe that they could re-educate the rest of the community. This was based upon the findings of Cortese (2003) and Kimbell and Perry (2001) who found that students engaged more deeply with sustainability issues if they played a more active role in the process. In the role of Expert, each synthesised opinions and conducted their own ethnographic research. The Experts then created designs to re-educate the school community, thereby generating creative capital in the same way Project H does.

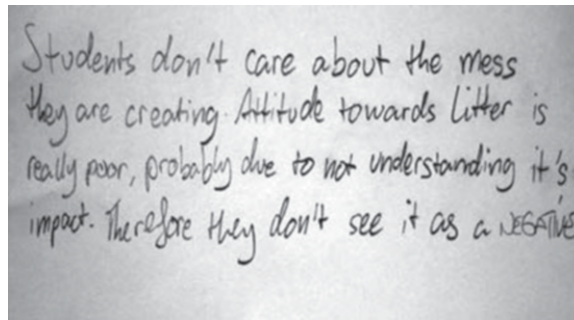


Figure 5. As experts the students empathised with the community and tried to establish the 'why' behind people's behaviour



Figure 6. Example of students using the six R's to analyse sustainable problems in their community

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The final stage of the project was to turn 'Experts' into 'Activists'- I wanted to promote the idea that the community can help itself. By making students produce a product, design or campaign the students engaged on a much deeper level than they normally would. It is at this stage that the students became empowered to make a change relevant to them. This led to community transformation through the students teaching/informing the rest of the community. Each stage in the design process built upon the last with the aim of spreading understanding of key issues throughout the school community. As students developed an understanding of the causes and consequences of unsustainable practice and the positives of sustainable practices, there were changes in the behaviour and attitude of the students. This was then translated at the 'Expert' phase into products to spread this understanding and change of behaviour. The final problem for the students was how to get the other members to change their attitude and behaviour. To do this we used fun as a reward.

THE FUN PART

Through this project I wanted to overhaul the methods of teaching sustainable issues to students in D&T. To do this I have made sustainable issues central to the curriculum and students have undertaken critical and creative inquiry based learning in a context that is relatable to them. They can physically see the changes they are making to their community and through doing this they are developing creative and environmental capital. In order for this process to be successful and to generate this capital the students must be able to change the behaviour of the other members of the community. In order to change behaviour, you need to offer an alternative to current behaviour. It was decided that the easiest, cheapest way to do this was to offer fun. Volkswagen and DDB Stockholm started a viral campaign and design competition with a series of experiments; captured on video, to find out if the world and people's behaviour can be changed by offering them fun. They called this concept 'Fun Theory' (Thefuntheory.com 2009). The viral campaign ran a number of experiments including turning a set of subway stairs into a real-life piano to encourage people to use the stairs rather than the escalator; a bottle bank which was turned into an arcade game with sound effects, lights and scoreboard; and a litter bin with a sound effect of a stone falling into a deep well when items were dropped into it. These examples were used as provocation for others to join in the campaign.

In order for a person to engage in a fun theory product there are three elements that the person must have in order for behaviour to occur. Fogg (2011) defines them as physical ability, motivation and a trigger. Assuming the physical ability is there, then the remaining factors are motivation and a trigger. In the case of the piano stair case the motivation is that the person needs to get to the top. They are physically capable, so why do they choose the escalator over the stairs. The escalator has a trigger - it is easier and therefore the user opts for that option. What fun theory should do is provide a trigger that should entice the user to change their normal

pattern of behaviour for the better. Once the user has changed their behaviour once it is possible to change their motivation permanently. Using the stairs as an example, the user's initial motivation is '*I need to get to the top of the stairs*', but offer them an alternative, a fun alternative and their motivation may change to '*I want to play on the piano stairs*', or '*I want to create a new tune on the piano stairs*'. Either way the user has changed their behaviour in a positive way.

The key to a fun theory product is to create an intervention in a product, something that causes people with the ability and the motivation to choose (trigger) a different way of responding to a need. Once they do this the reward for this change is fun!

This sort of design evokes an emotional response from the user; they are motivated to keep playing due to enjoyment. This is known as emotional or affective engagement (Lockton, 2004; Massachusetts Institute of Technology – Media lab, 1996). Affective engagement should avoid the product becoming 'gimmicky' or a one-off novelty item and should lead to a permanent change in behaviour. However, this is difficult to prove without a longitudinal study of the members of public who took part in the experiments. Volkswagen did conduct some small-scale observational studies on the three examples above. The bottle bank was used one hundred times in one night where as the nearest other bottle bank was used twice. The piano staircase was used 66% more than the escalator, but the time period for this data was not stated and the bottomless bin collected 72Kg of rubbish in one day, 41Kg more than the bins nearby. These findings indicate that fun can be used to change people's behaviour for the better; however a long term study would need to be conducted to see if the products made a lasting change on behaviour.

As Experts, the students in the case study created designs which incorporate Fun Theory and used this powerful idea to attempt to change the rest of the community's behaviour. Below are some examples of students' work. For each example the motivation and trigger identified by the student is outlined.

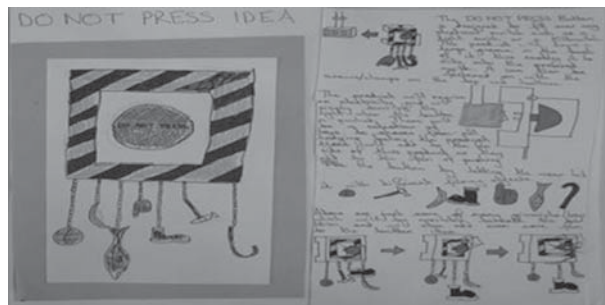


Figure 7. 'DO NOT TOUCH' light switch with tempting implements. The motivation is to turn off the lights and the trigger is the big red 'do not touch' sign and the variety of touching implements. The student's trialled a 'wet paint' model but the big red button proved the more widely used.

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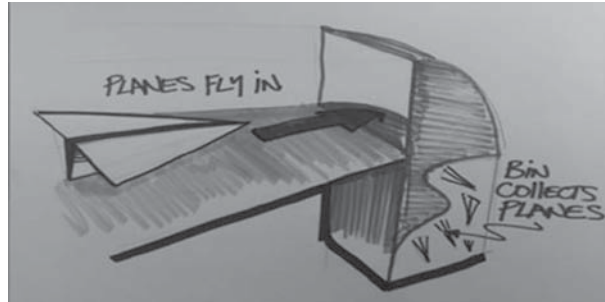


Figure 8. 'PAPER AEROPLANE LANDING BIN'. The motivation is to use the schools recycling bin. The trigger is the element of competition to land the waste paper aeroplanes in the bin

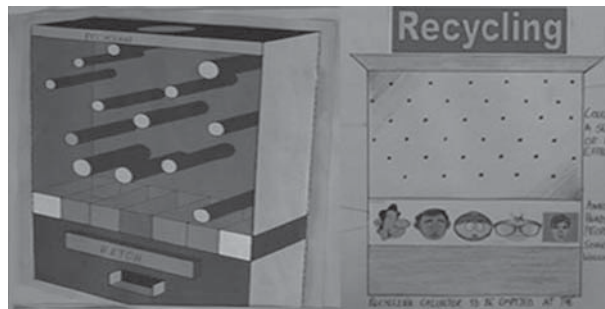


Figure 9. 'KERPLUNK RACE'. The motivation is to use the schools litter bins. The trigger is a 'kerplunk' style game where the users can move the rods in and out to allow the litter to fall into the sorting bins below

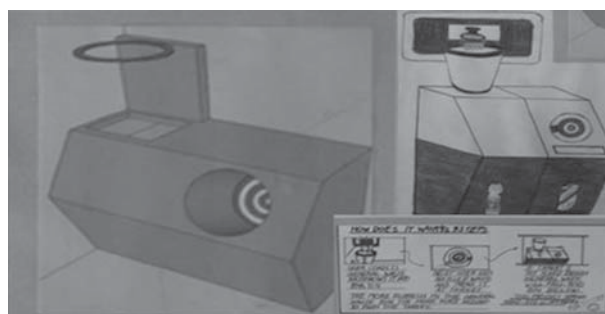


Figure 10. 'FAIR GROUND STYLE TARGET BIN'. The motivation is to use the schools litter bins. The trigger is to work in pairs to get the rubbish to drop into the bins. The left hand bin collects rubbish until the right hand target is hit releasing the contents.

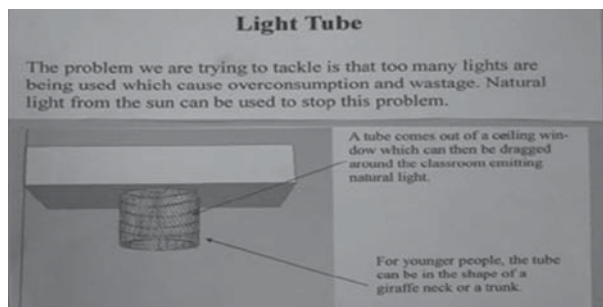


Figure 11. 'LIGHT TUBE'. The tubes are attached to the skylights and made with a reflective material. Motivation the school wastes energy lighting classrooms. The skylights in most classrooms are not used. The trigger is the novelty of having the light tubes, being able to pull them down to table level and work by natural light.

CONCLUSION

The objective of my research was to develop a curriculum resource which develops students' and the school's (as a community) capability to address sustainability issues by making them an embedded part of the curriculum. By making sustainability central to learning it is hoped that students will engage in design and lead community transformation in which their designs change/inform the behaviour/opinion of the whole school community using fun theory as the catalyst for the change.

Learner Phase

By introducing students to wider issues of environmentalism such as 'Over consumption', 'Design for short life' and 'Climate change' early in the project, the design process was used as a vehicle to encourage students to engage on a deeper level by promoting enquiry, evaluation, synthesising opinions and debating facts around each topic, students were no longer being active recipients of information, rather active participants. The following images illustrate students becoming what Kimbell & Perry (2001) termed '*technologists*'. The evidence shows students critiquing products and evaluating their full environmental and human impact as suggested by Conway (2002).

During this phase students conducted ethnographic research based on what they learnt in the learner phase. At this point the students were independent and deciding on their own direction. Students identified behaviours and analysed why the behaviours were occurring. The images below show how in-depth this analysis was.

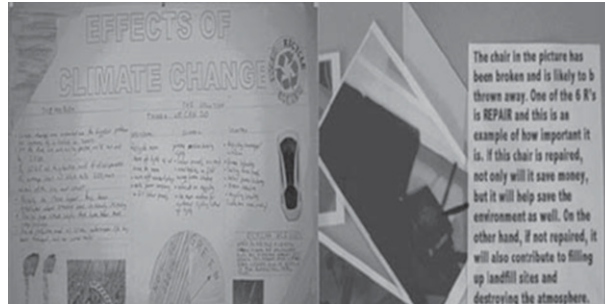


Figure 12. Evidence of students engaging on a deeper level by evaluating facts, synthesising opinions and debating facts around each topic. The right hand image shows students evaluating the school using the 6R's and identifying trades offs between contrasting environmental viewpoints. Expert phase

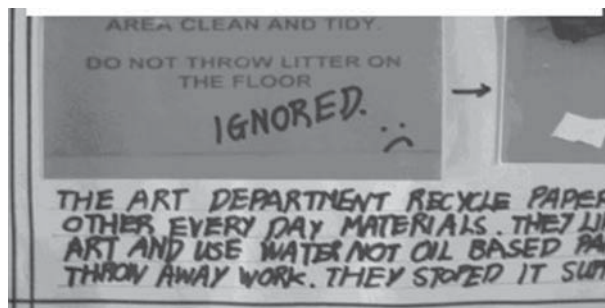


Figure 13. Evidence of higher level thinking and consideration of more complex social, moral and ethical elements of sustainability, rather than just recycling

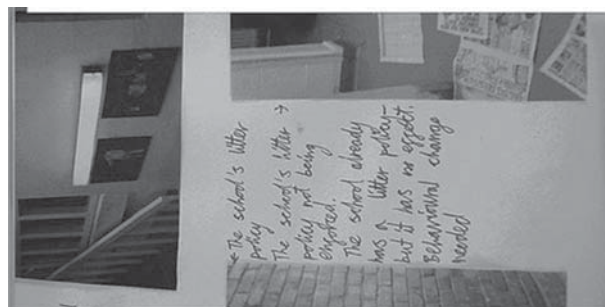


Figure 14. Evidence of students identifying current environmental schemes within the school, gathering evidence and evaluating why the current systems are not working

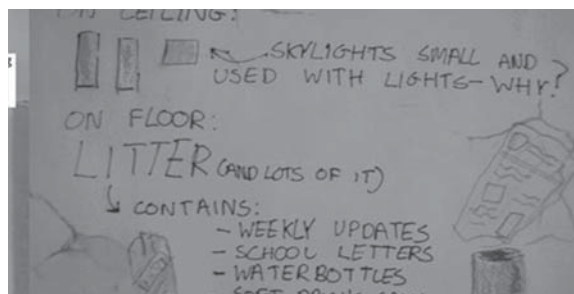


Figure 15. Evidence of students conducting ethnographic research and questioning current practices and hypothesising why this behaviour is occurring

The level of engagement from students was heightened for two reasons. Firstly students were operating independently in an active role as technologists (Kimbell & Perry 2001). Secondly the students were engaged as they knew as part of the end product they would have to ‘teach’ the rest of the community through their design. As a result there is no ‘hand me down truths’ students are deriving their own meanings for sustainability and applying it independently.

Teacher/Activist Phase

The aim of the products the students designed was to provide triggers for the community to engage in play and change their behaviour in a positive way. This change in behaviour should provoke the players to question their actions or change their motivation when approaching a sustainability issue. Thought provocation raises awareness and raised awareness was highlighted as a key feature of Agenda 21 (UN 1992) for changing behaviour and something Pilloton is utilised during Project H.

In summary it would appear that embedding sustainability into the curriculum and making it central to the learning has allowed D&T to be a vehicle for student exploration of a wide range of sustainability issues and has increased engagement through active participation. By encouraging the students follow a process of Learners, Experts, Teachers/Activists it helps them address sustainability issues within their community. The idea of Fun Theory was well received by all students and the outcomes indicate that it would help engage the community in design-led transformation. The findings would suggest that the designs have the power to change/inform the behaviour/opinion of the whole school community.

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19. OPENING UP THE FOUR WALLS

Reflections on Two South Australian ESD Projects

INTRODUCTION

The development of a dynamic, creative and relevant educational programme has been the cornerstone of my teaching practice throughout my career as an educator. Developing a constructivist approach to learning has made me focus on the individual as the key learner and has allowed me to target the kinds of qualities that are presented in the South Australian Curriculum Framework's (DETE, 2001) five Essential Learnings (Communication, Futures, Identity, Interdependence, and Thinking):

...understandings, dispositions and capabilities which are developed (across the curriculum) and form an integral part of children's and students' learning from birth to Year 12 and beyond. They are resources which are drawn upon throughout life and enable people to productively engage with changing times as thoughtful, active, responsive and committed local, national and global citizens. Engaging with these concepts is crucial to enhancing the learning culture within and beyond schools/sites. (DETE, 2001 p. 9)

My teaching philosophy is based on the belief that an educator's role is to provide and promote opportunities for all students to access a pathway to learning that best suits their needs, interests and styles. A strong commitment to life-long education and an ability to translate a comprehensive knowledge of current curriculum practice and learning theories underpin are key to effective classroom practice. Equally, teaching both adult and student learners in a variety of educational settings has allowed me opportunities to gain skills, expertise and insights into adapting to change, understanding a wide variety of different cultural and community backgrounds, and developing a clear understanding of the complexity involved in children's learning.

As society is rapidly changing, students need to develop and acquire from various sources knowledge, skills and dispositions that enable them to understand their world and play an active part in it. Information and communications technologies are an integral part of this development. They also need thinking skills that enable them to critically evaluate and challenge ideas. In all the programs I have delivered

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in a classroom setting or the courses that I have written and coordinated at primary, secondary or tertiary level, the students have needed to address changes in social relations in family life, employment, functions of the government, and the interaction of different races and cultures.

Since all learners learn differently and require specific experiences for them to express and excel in learning it is good to provide opportunities for them to use their preferred learning style which is often within a narrative and dialogic construct which embraces building relationships, circles of friends and collaboration. When the field of technology can often be male-dominated it is important to have high expectations that girls develop a strong sense of self-belief, resiliency and have full active participation in our ever-changing world. Learners from a young age begin to build a sense of who they are and it is imperative that they experience positive engagement in all roles in the community, validating that they can take on any role with confidence and independence.

THE STATE WE'RE IN – THE SOUTH AUSTRALIAN CONTEXT

“We live in the driest state on the driest continent” has been a catchphrase and core principle that has been a part of my South Australia upbringing. The environment, the climatic conditions, sustainability and a futures thinking approach have all been a necessary part of my professional psyche. These core principles have shaped and guided the purpose and intent of what I do as an educator and how we develop knowledge and understanding that strongly links issues and considerations for caring for our surrounding environment.

It has been good to see the South Australian curriculum framework carrying forward this thinking. Around twelve years ago it stated that ‘Learning through Design and Technology explores the interrelationship of people, technology and the environment through a range of contexts, and engages students in questioning the ethics and values inherent in any technology’ (DETE, 2001). Educational thinking in South Australian schools has been geared towards the environment for many years with many projects being developed and supported in schools. Examples include the Sustainable School focus, Green Education, Conservation and Sustainability projects, and Futures Education.

For success in educating learners for the future, we must as educators support the creation of a sense of optimism in all learners about their capabilities to critically reflect on, plan and take action to shape preferred futures. This includes assisting all learners to develop a sense of being connected with their worlds - being able to shape their local and global communities. As part of SACSA, the learning area of Design and Technology (D&T) encourages the teaching of students to develop abilities to critique, design and make quality products in an environment that promotes creativity, but also emphasises the importance of how to think and act holistically. Using these approaches links the key areas of sustainability and futures through Design and Technology education.

LEARNING, DESIGN AND TECHNOLOGY EDUCATION,
SUSTAINABILITY AND THE ENVIRONMENT

At the heart the two case study projects that are presented below, was the belief that learning how to learn, knowing which questions to ask and where to seek the appropriate information are important skills that need to be explicitly taught and nurtured through teaching programs, as is the capacity to learn from and with others. A measure of successful learning in the future will depend on one's ability to remain adaptable, be resilient, accept job and career changes and commit to life-long learning. Within education, being able to recognize that learning takes place both inside and outside the classroom - opening up the four walls - is an important critical view for both learners and educators as this understanding recognised the environment around the school as a learning tool.

Design and Technology acts as a vehicle so as to make ideas a reality in the classroom as well as to develop the thinking of the learners as our future decision-makers in society. D&T is centred on developing individuals and groups that can plan, design and critique intentions of products, systems and processes that they make or have been made by others. It satisfies a human need to make something, to create something better or to solve a problem. D&T promotes critical thinking skills in all learners to develop designers and makers who are skilled decision makers, environmentally sustainable thinkers, and innovative and enterprising operators. Where D&T really links strongly is the holistic way it brings together notions of the environment, sustainability, values and a futures thinking through its intended and implied pedagogy – one that involves thinking, analysing, decision-making, working in teams, material use and selection, techniques and skills, deconstruction, and critique of the purposes and intentions of ideas, designs and designing.

At the heart of teaching is the notion of change. We as educators seek to change the way learners think, feel and perceive the world and their place in it. We aim to create a learning environment that provides a reflection of the sort of direction in which that change might happen. Through relevant and contextualised learning D&T education can link learning to sustainability and the environment through meaningful educational activities.

COMMON UNDERPINNINGS OF THE TWO PROJECTS

The case study projects both promote opportunities for all students and teachers to access an educational pathway that best suits their needs, interests and learning styles. The projects have a common focus on D&T as the learning integrator by creating different futures-focused environments – a city in one instance and a sustainable garden in the other. Teachers having high expectations for all learners to develop a strong sense of self-belief, resiliency and to have full active participation in our ever-changing world adds depth to the learning experience and offers a direct link to futures perspectives.

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For the case study projects to be sustainable themselves certain understandings needed to be agreed upon by all, notably, that:

- learners have different experience, knowledge bases and established skills; that we each have our own individual approaches to learning; and that it's imperative to identify and nurture these and to allow time for thinking, adapting and challenging;
- learners learn best through an integrated approach to curriculum; this allows for the learning to be relevant and seen as a necessary part of the whole picture; and the learning environment must promote positiveness and foster a commitment to improving the skills and abilities of all; and
- a learning program should have a strong element of 'hands-on' to lead learners to experiment and risk-take; and their learning process should have strong elements of fun, enjoyment and achievement.

Case Study One: 'Creating a futures-focused sustainable community' A State government coeducational site in a rural setting; Reception to Year 7 (Ages 5yrs to 12 yrs.); 254 students

The school had as its core values Optimism, Caring, Respect and Achievement, and all programs and offerings were structured and designed to support and enhance these core values. As a school we wanted a unifying project that would foster these values, target the environment and sustainability, and bring the whole school (students, teachers, parents and the wider community) together. The school leaders decided cooperatively that all 'partners' (staffs and students) were '...to set upon a task of critiquing, designing and making a working model of a sustainable community that reflected an optimistic, preferable future as decided by the various groups of students from reception to year 7.'

All aspects of D&T were incorporated into the teaching and learning programs of all classes with discussions, peer mentoring and collaboration as key operating features. Student voice forums, which allowed for groups and cohorts of students to collectively discuss and decide on the direction and parameters of their input and production, were encouraged. The school's operational structure and strategies were in place to foster and support this process. The staff felt that this was a perfect opportunity to enhance both the involvement of students in a school-wide project, as well as to empower the students in their decision-making and choice-making about their preferred futures direction within the projects. Designing and making skills, a passion for the environment, and knowledge of our power as individuals and groups to shape the future were the project's three focal learning dimensions. The strong link with sustainability as a concept, as a method of operation and as the underlying focus of any designed solutions was directly attributed to the decision-making of the students.

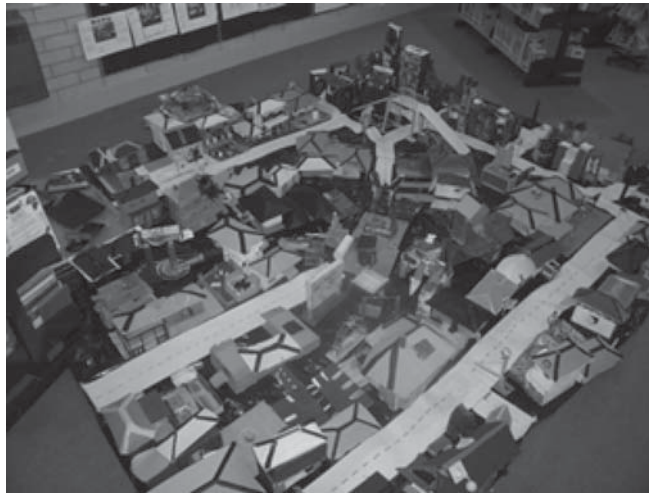
OPENING UP THE FOUR WALLS:

Futures thinking was encouraged through adopting the theories and practical strategies articulated by Richard Slaughter's (1995) four metashifts for Futures Education:

- quality outcomes rather than quantity of outputs;
- restoration of resources and sustainability rather than exploitation of environment;
- long-term planning solutions rather than short term reactions to perceived problems; and,
- values orientation rather than pure technologically-based operations.

Aligned with this was a clear intention 'to engage every child and student so that they achieve at the highest possible level of their learning and wellbeing through quality care and teaching'. All shared the aim and belief in developing key dispositions, skills and a body of knowledge that focussed on building: co-operation for a common purpose; excellence in endeavour; fairness in approach; integrity in self; respect for others and the world around us; and, a growth in personal responsibility for decisions about the future.

A sustainable model city was built that reflected these values. It was decided that each class would work cooperatively to develop and create the city. The city would occupy the learning space in the library and be used as teaching tool and interactive medium for the students to show each other what they had done and to communicate and engage with the wider community about their concerns and preferred futures ideals, such as living in harmony with the indigenous fauna and flora of the surrounding environment. The students were ensuring the adding of



The end result "The city" Crafers Primary School

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value and adopting a restorative approach to the environment that will support sustainability.

Reception to Year 1 Critiquing, design and making a ‘Cityscape model’ using recycled materials to be a hub of the new community development. The R-1 students were keen to design and make a city that was friendly, encouraged harmony, and was warm and inviting – not only for the people, but the indigenous animals to live and dwell amongst the citizens. Making the city environmentally sustainable was a focus.

Year 2 and Year 3 Critiquing, designing and making a ‘futures-focused centre’ for the community. This was to be futures-focused: in relation to the use and application of resources used in the centre’s construction; in the design and shape of the centre; and in the sustainable method of energy saving ideas for heating and cooling. The underlying educational power of this section was the thoughts, values and ideals of the school learners as a whole.

Year 4 and Year 5 Critiquing, designing and making living spaces for the community, for example houses, housing blocks, shared dwellings etc with a focus on sustainable living, linking with the environment around them, the indigenous fauna and flora, and the local community. The students were really keen to have value adding impact as a focal point in their constructions for the environment that would make their houses /shelter sustainable.

Year 6 and Year 7 Focus on transport and providing electricity to the community with long-term planning solutions that would add value and have a restorative approach toward the surrounding environment. The students’ focus was on sustainable development including housing lighting, commuter control lights, signage, and transit pathways around the community.

To ensure that the project was successful for learning in sustainability through D&T across the school, the key areas of focus were designing and making skills, a passion for the environment, and knowledge of our power as individuals and groups on the future needed to be identified and consistency in approach and understanding had to be maintained and monitored throughout the project. This was not as a ‘big stick’ approach, but as a supporting, nurturing and encouraging method of progress. Keeping to a timeline was an imperative as a clear end-point of a community presentation night was a factor. The D&T learning in this project gave validation to the school’s core values across all curriculum areas as well as giving common understanding of the learning outcomes achieved and creating a meaningful mode of operation to target sustainability, the environment and futures.

*Case Study Two: 'A Sustainable Community Garden' Catholic all-boys school
R-12; ages 5 – 18 years; 1100 boys. Project focus: Junior School, R-6; ages 5 - 11
years; 223 boys*

The aim of the Sustainable Community Garden Program was to increase understanding and awareness of sound environmentally sustainable practices along with the positive food education for the boys. The underlying belief was that by introducing an holistic approach we have a chance to positively influence children's food choices in ways that have not been tried before. The Sustainable Community Garden was created to provide edible, aromatic and beautiful resources for a kitchen. The creation and care of such a garden teaches children about the natural world, about its beauty and how to care for it, how best to use the resources we have, and gives an appreciation for how easy it is to bring joy and wellbeing into one's life through growing, harvesting, preparing and sharing fresh, seasonal produce.

The College leadership wanted to implement a change in learning focus in the junior school to heighten the use and application of D&T learning approaches and to link with sustainability issues in relation to futures perspectives. This intent formed the basis and process development for rigour and accountability in the provision of support structures and leadership. The Sustainable Community Garden was to be so much more than just growing some vegetables. It was to be a place where the soil is full of life and the plants are bursting with nutrients and minerals to teach the children how to create healthy soils and grow healthy food. The students were to eat the food from this garden - real food.



Garden area Rostrevor College Junior School

Also, the project was an ideal catalyst and perfect teaching and learning focus to complement the extensive sustainable learning approaches already established

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within the school: water watch; air watch; frog watch; Our patch rejuvenation program; land care; fauna and flora conservational programs; Indigenous perspective environmental program; butterfly garden development and maintenance program; recycling and worm farm; seed propagation and planting; integrated individual classroom based environmental programs; and, an environmental captain leadership program for students.

Working with teachers and other staff e.g. groundsman and support staff from across the school campus, parent groups, and volunteers from our local community to incorporate new approaches and promote the intended outcomes in the classroom meant that ‘collaboration work’ was a first priority. Working individually with some teachers while mentoring others to conduct research and data collection and analysis on learners’ prior knowledge on sustainability was of primary importance. Equally, research into teachers’ own understandings and knowledge of D&T as a learning area was essential too. All the gathered data was used to support our program and acted as a starting point for the development of the project itself. This research also had the added bonus of being a component of the continual review process into teachers’ own current professional practice.

The Sustainable Community Garden was constructed in an area of the Junior School campus that was considered to be an untapped resource. Coincidentally, we entered into a partnership with University of South Australia (UniSA) through a program which saw Design and Technology education pre-service teachers working with the boys to critique, design and then construct parts of a sustainable garden. The foundation ideals of the partnership were to engage the boys from Reception to Year 6 with the UniSA students in all facets and stages of the design and construction; to raise the awareness of D&T as a learning area; and to address and incorporate sustainable practices and futures perspective thinking at all activities.



The excavation begins Rostrevor College Junior School

The preparation of the garden site took most of the first term and required much earth moving and negotiation with various building professionals especially the groundsmen of the College. The Environmental Education Coordinator was a driving force behind the project and his enthusiasm, skill and ambition in shaping the project ensured that the impetus was established and maintained. All the boys were involved in hands-on activities of removing soil, cutting down overgrown bush and levelling the site. At this early stage they were also all involved in critiquing the suitability of the site, to develop design ideas for the development and undertaking a propagating plants process. The project included the incorporation of native and indigenous flora as the school was located next to a national park. The students were to critique the local flora and to be involved in a propagation process from seeds to seedlings for edible food.

Term Two saw the construction of raised garden beds and the laying of gravel paths. This phase involved all students from the Reception to year 6 and involved some great fun playing with dirt whilst mixing the correct soil composition. The next stage of construction involved the establishment of a Chicken Run and erecting the Chook House. Surrounding the Chook house a Citrus Grove was planted with lemon, lime, orange and grapefruit trees. The next strategic move was the placing of eight half wine barrels (easily accessed from South Australia's huge wine-growing industry) and the planting of a variety of dwarf fruit trees including peach, nectarine, apple, pear and apricot. A group of indigenous Year 11 students designed and made a large Cubby House, as a part of a community project, this Cubby House provided a play space for Junior Primary Students when they were not directly involved in gardening activities.

Term Three saw the planting of the first crops that included tomatoes, strawberries, carrots, beans and watermelon. Along with the fruits and vegetables, rows of lavender and poppies were planted to ensure that bees and insects were attracted to the garden for pollination purposes. The garden beds were also mulched and three new compost bins were brought in to take care of any green waste. With the introduction of four Silky Bantam hens and many newly purchased garden tools the project was beginning to come to fruition.

Further developments continue to occur. Each year level has an allotment that is for their year-round use. Classes have grown a wide variety of vegetables and herbs that have since been incorporated into healthy eating and cooking programs. A group of year 11 and 12 Indigenous students have also incorporated a Bush Tucker Trail into the garden area and have started growing plants that will produce fruits and berries that can be included in the cooking programs. These students also assist with any large-scale maintenance of the garden including brush-cutting and tree-trimming. Building the partnership with UniSA, a different group of Design and Technology students from the University expanded the program to include Healthy living and life skills development through the integration of a cooking program and a fabrics and design 'scarecrow construction' program using recycled materials.

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The sustainable garden takes shape Rostrevor College Junior School



The plantings begin Sustainable Garden Rostrevor College Junior school

OPENING UP THE FOUR WALLS:

Through discussion and review the students all focused on the sustainable future of the garden and were concerned about water. Being in the driest state in the driest continent, water supply is paramount and the groups completed the Rainwater Harvesting stage and plumbed in two large tanks that aim to provide enough rain water for most the year. These two tanks are connected to a digital flow meter which records water usage on a daily basis and keeps track of all water use for each month and year.

THE EDUCATIONAL BENEFITS OF THE SUSTAINABLE COMMUNITY GARDEN

In parallel with all the activities, Sustainable Gardening units were developed by all Junior School class teachers and a variety of unique educational programs was produced. Foci included units on *Lifecycles, Healthy Eating, Biodiversity, Composting, Worm Farming, Pollination, Plant Science, Plant and Animal Interdependence, and Medicinal benefits of Herbs*. Amongst other outcomes the following give a picture of the benefits achieved:

- developing new skills in the kitchen and garden to lead lives that are not dependent on processed foods;
- modelling new ways to connect with parents/family in discussing what happens in the Sustainable Community Garden Program and applying what is learnt (growing things, cooking things) at home;
- developing understanding of how time is needed for important things to happen e.g. grow food to harvest, bread dough to rise;
- developing better understanding of the relationship between the garden and the table;
- introducing new foods, new flavours, new textures, and developing appreciation of fresh seasonal food;
- developing, using and recording specific vocabulary to describe some of the textures, tastes and sights that they experience. Reading and understanding technical instructions, expanding vocabulary and exploring language;
- listening, speaking, working in teams, working cooperatively and problem solving;
- developing confidence and self esteem;
- engaging in hands-on activity and physical exercise;
- understanding the link between good food choices and optimum health;
- developing social skills at the table e.g. sharing a meal, conversation;
- developing deeper understandings and tolerance of cultural difference by exposure to other culinary traditions;
- developing strong relationships with adults other than class teacher or parent e.g. volunteers; and,
- developing practical understanding of environmental sustainability issues such as soil health, water management, waste management, seed-saving, organic pest control, and the importance of plant diversity.

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Design and technology skill development was evident in the decisions made in the garden each week. Students acquired many strategies for thinking, related to investigation, enquiring, processing information, problem solving, using reason, evaluation and reflection. Health/Wellness and Physical Education developed through physical activity in the garden and was a great way to enhance Fine and Gross Motor Skills Programs. The Science, Environment and Sustainability focus was further addressed through issues such as climate and climate change, water management, plant cycles and plant diversity, soil health, and the avoidance of chemicals. The real-life application of Mathematics skills such as measurement, calculation, estimation and comparison in the kitchen garden context were also enhanced.

The project created excitement within the school community and helped raise the children's and the broader community's awareness of the local natural environment and how we relate to it. It did so using a range of perspectives such as environmental, social, ethical and health and an understanding of the links across past, present and future. Students could better see that they are connected to their local natural environment and to the broader community and that their actions can have positive or negative impacts on the environment, their community and themselves. The Sustainable Community Garden Program supported students' capacities to manage themselves, to build good relationships with others, to make sense of the world in which they live and participate and to recognise how our future is dependent on building mutually responsible and sustainable patterns of living.

Most importantly, the pleasure gained from growing, harvesting, preparing and sharing can be a life-long pleasure, and will affect how our children live as individuals and as members of local and global communities. Creating an environment that allowed the boys to explore and nurture their senses - a sensory garden - allows them to become connected with their natural environment. Also, for students with sensory integration difficulties the garden can be both a calm place as well as one offering opportunities to do physical work – both of which can help alleviate moments of anxiety and overload. The Sustainable Garden program also enhanced the boys' development of social-emotional learning skills and created a Meeting Place for volunteers, parents and friends to enjoy and become involved in areas of the garden that interested them.

CONCLUSION

In the two projects presented in this chapter, changes in both focus and practice were achieved. This is the real power of D&T educational theory and practice in action and what makes the teaching of D&T a passion for me as an educator.

The successes for teaching and learning are that:

- leadership – students are provided opportunities to demonstrate their leadership ability through articulating their passion for sustainability;
- teamwork – students appreciate the power, value and contribution of everyone in the team;

OPENING UP THE FOUR WALLS:

- values – students are given the opportunities to demonstrate a values-orientated approach to sustainability and the environment;
- problem solving – students are given scenarios and opportunities to problem-solve and think creatively to achieve a preferred outcome;
- resourcefulness – students are encouraged and supported in adopting enterprising approaches in achieving tasks; and,
- communication – students are encouraged and supported to articulate their beliefs and futures perspectives on issues of sustainability and the environment.

By adopting this approach the students connected the environmental, social and ethical effects of their creations. Learners used futures thinking as a means to become critical thinkers to critique in order to redesign, remodel and make better.

To return to the SACSA Curriculum framework, we can see that the projects articulate and cement into the teaching and learning programs the three critical and powerful dimensions of technological literacy as expressed through Design and Technology. First, the operational - in which learners develop skills and competencies at a technical level so as to use materials and equipment in order to make products and systems (they learn to use and do). Second, the cultural - in which learners contextualize their learning in the world of designed and made products processes and systems. They recognize the interdependence of technologies with people, applying their technological learning in practical ways to realize designs and solve practical problems (they learn through technology) and, finally, the critical dimension – that empowers learners to become critical citizens living in a technological society, being able to make refined judgments about the worth, intentions and consequences of technological products, systems and processes on themselves and others (they learn about and to be with technology).

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