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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 as 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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