Leonie Rowan · Chris Bigum *Editors*

Transformative Approaches to New Technologies and Student Diversity in Futures Oriented Classrooms

Future Proofing Education

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Part I
Towards Transformative Approaches to New Technologies and Student Diversity

Chapter 1
Transformative Approaches to New Technologies and Student Diversity in Futures-Oriented Classrooms

Leonie Rowan

Introduction

This is a book about educational futures: about the ways in which schools and educational agencies throughout the world previously have, practically can and creatively might best seek to respond to contemporary social and technological contexts, and the role that computers and communication technologies have to play in this response.

While the influence that computers and communication technologies might have on contemporary schools is one of our key concerns, the book goes beyond much of the usual "computers in schools" literature with its exhortations to embrace new technologies and the accompanying range of "how to" check-lists. Instead, it seeks to examine and re-examine the traditional relationship between schools and technology, between schools and diverse learners, and between schools, children, technologies and knowledge. The book makes the case that schools, students and teachers have long been positioned in a passive relationship to knowledge—as the consumers of materials largely written, determined or authorised by other people. This widely critiqued approach to education within which all students are expected to "consume information fed to them by a professor and be able to memorize and store it" (Hooks 1994, p.14) remains the default position of many contemporary schooling frameworks which appear all but obsessed with measuring the amount of content that students can recall at certain points in their education. The dramatically changing social context challenges all those working in the fields of education to consider alternative ways to conceptualise school: to consider what it really means to prepare diverse kids for unknowable futures.

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The book begins with an acknowledgement that much, indeed, has changed in the past 5, 10 or even 50 years. Social analyst Arjun Appadurai (1990) has provided a useful set of concepts for describing the ways in which the environment currently negotiated by children is different to that of previous eras. He describes developments across five key "scapes." There is a *finanscape* where we witness not only rapid flows of money, but also a re-conceptualisation of business practices associated with economic rationalism. These financial changes are fundamentally connected to developments across the *technoscape* where new technologies emerge even before the old are out of warranty. These change the way we communicate and entertain ourselves, as well as how (and where) businesses are conducted and, by extension, how and where people are (or are not) employed. The dramatically increased interconnectivity between financial institutions (where, almost literally, every institution is connected to every other around the world) has been brought to the fore recently with the much-analysed global financial crisis. The prospect of even greater connectivity via a peer-to-peer economy (Stalnaker 2008) is indicative of the direction this development may well take.

Intertwined with the technoscape are developments on the *mediascape* which, in its contemporary pervasiveness, has collapsed traditional notions of time and space allowing many of us instant access to information throughout the world, and exposure to ideas from dramatically different personal and political perspectives. An important adjustment of the mediascape is the shift from a situation in which the few control access to publishing and broadcast, the era of mass media, to one in which publishing and broadcasting is available to all who have access to the internet: a phenomenon which has helped to produce attention (Goldhaber 1997) as one the scarcest of all contemporary commodities.

All of the changes across all of these scapes contribute, in turn, to a reworking of the *ideoscape*: Appaduri's metaphor for the increasingly diverse set of world views, opinions and belief systems which we see battling for inclusion and legitimacy in both local and global contexts. The proliferation of easy-to-use publishing software, found on sites like YouTube, Blogger, Flickr, Twitter etc., has allowed greater participation in the sharing and contestation of ideas whilst also supporting social networking of various kinds. In multiple online forums individuals and groups are engaged in various sorts of battles about which sets of knowledge should have supremacy in particular contexts, with some of the more extreme forms of these battles generating widespread social unrest and anxiety.[1]

Even cursory attention to developments on each of these scapes makes it clear that the world of 2011 is much changed from the world of 30 years ago. In this context, Douglas Rushkoff once made the claim that:

> Today's 'screenager'—the child born into a culture mediated by the television and computer—is interacting with his world in at least as dramatically altered a fashion from his grandfather as the first sighted creature did from his blind ancestors, or a winged one from his

[1] Google offers a mapping of issues as they rise and fall across regions of the planet: http://www.google.com/insights

> earthbound forebears…what we need to adapt to, more than any particular change, is the fact that we are changing so rapidly. We must learn to accept change as a constant. Novelty is the new status quo. (Rushkoff 1997, p.3)

Rushkoff's comment was made more than a decade ago. Since then his oft referenced 'screenager' has been usurped in popular meaning making by debates about what it means to be generation y, generation next or a millennial learner. Discussions (even lamentations) about the key and apparently intractable differences between so-called digital immigrants and digital natives, digital insiders or digital outsiders popularised by authors as diverse as John Perry Barlow (1996), Douglas Rushkoff (1999) and Marc Prensky (2010) dominate many educational forums. As attempts to categorise and thus to "know" the "nature" of "youth" go on—in what has been described as an academic form of "moral panic" (Bennett et al. 2008)—we continue to see more and more significant and pervasive changes in the form and content of technologically mediated societies. While many adults can remember the wonder of fax machines and the startling introduction of email and the internet, there are children in schools who have never lived in a world without YouTube and Google. Kids take iPads to school and sit in restaurants playing, not with colouring-in pens and paper, but iPhones, iPods and Nintendos.

This book is not focused on debating, bemoaning or reifying these patterns of technological interaction. We are concerned, rather, with a different issue. In the context of ubiquitous change it would seem reasonable to expect that the functions and forms of the education system would also have undergone radical transformations. It would also seem possible to suppose that this radical change would be seen in the areas where change has most commonly been hard to find: in the participation rates, achievement patterns, and graduate successes of the full range of the student population. This is not the case.

There have, of course, been significant changes in some of the ways schools operate. The "typical" classroom probably looks quite different to the classroom of 50 years ago. In many of the over-developed countries of the world interactive white boards, laptops, and personal computers are standard environmental accessories. So, too, has the composition of classrooms changed with school demographics reflecting increasing diversity of the wider population: a diversity enabled by speed of movement from place to place and increasing political commitments to ensure that individuals are able to live harmoniously with diverse others. It is also easy to recognise the influence of seemingly endless reviews of curriculum, on-going quests to find the magic solution to complex educational problems, and increasingly hysterical attempts to manufacture at least the appearance of educational quality through the introduction of high-stakes, unimaginative, bland testing regimes. Underpinning much of this business, however, are assumptions about schooling, knowledge and learning that are eerily familiar.

This book is based upon recognition of the fact that whilst some aspects of schooling have changed quite dramatically over the last three decades, *in regards to two key performance indicators schools remain largely and persistently unchanged.* Specifically, when we consider, first, *school-based responses to the computer and communication technologies* that underpin much social change, and, secondly,

school-based responses to student diversity it becomes clear that schools have not yet been able to respond in any sustained or significant way to the most fundamental challenges posed by the external world within which they are located and which they ostensibly exist to support.

A great deal of time and attention has been devoted to consideration of both of these challenges. Since the advent of the first micro-computers schools have embraced particular computing and communication technologies in order to signal variously their engagement with the "real world" or the "innovative" nature of their practices. The effort that has gone into finding a role for computers to play in school is widely documented (see Chap. 2 for more discussion). Unfortunately, in this context, computers have become a synonym for technology more broadly and many are deployed within schools as little more than symbols of educational innovation: proxies for the real thing. This results in what might be labelled a cyber-tooth curriculum: a traditional set of skills augmented by new literacies loosely associated with "doing computing in schools" which bear little resemblance to the kinds of operational, cultural and critical literacies that students will need beyond the confines of the school walls. And yet technologically mediated innovations consume vast amounts of educational resources (including the time, energy, "good will" and hope of teachers, students and care givers). Schools have not been transformed by technology. Nor have patterns of educational success and failure.

This leads to the second area of schooling where it is possible to map a startling *lack* of change. Despite three decades of equity-based school reforms (often supported by all manner of technologically mediated educational innovations), schools have made relatively little progress when it comes to addressing serious, persistent, consequential social patterns including (but not limited to) sexism, racism, homophobia, poverty and geographical isolation. Although awareness of the diverse forms that discrimination and alienation can take has undoubtedly improved and overt forms of harassment and discrimination may have decreased, (at least in some environments), there is much still to be concerned about. Debates about the responsibilities and challenges, as well as the opportunities and boundaries and barriers associated with education for diverse students are long standing and well rehearsed, and the potential for schools to alienate particular children and families from the very earliest days of schooling is well documented within social justice literature (Considine and Zappalà 2002; National Economic and Social Development Office 2009). So, too, is the disturbing lack of progress that has occurred during the past 20 years (Harding et al. 2001; Heymann 2000). Schissel and Wotherspoon (2001) cite data from the Organisation for Economic Co-operation and Development that estimates that between 15% and 30% of children and youth in its member nations are at risk of failing to complete school and experiencing subsequent problems of integration into labour markets and adult life.

This suggests that the same patterns of educational success and failure that were identified within schools in the 1970s years remain present today. Factors relating to socio-economics, cultural identity, Indigeneity, language, disability, gender, religion and family form continue to impact upon educational pathways and achievements.

Socio-economic status, for instance, is increasingly identified as one of the key predictors of educational success or failure. There is no escaping from data which indicates, for example, that while approximately 77% of Australians in high-socio-economic brackets completed secondary schooling between the years 1997 and 2008, only 58% of students in low-socio-economic areas achieved the same feat (Holmes et al. 2003). Statistics from the United States paint a similar picture where the high-school dropout rate among persons 16–24 years old was highest in low-income families (16.7%) as compared to high-income families (3.2%) (National Center for Education Statistics 2002).

Indigenous children throughout the world are also recognised as being educationally vulnerable. Brought into schooling systems which often celebrate very narrow, European ways of being a student, Indigenous students experience both overt and covert forms of discrimination, even within systems designed to "include" and "support" them (Auwartera and Arugueteb 2010; Cherubini et al. 2010). These range from overt instances of racism and processes of active exclusion, through to less obvious, but equally damaging, scenarios within which schools demonstrate such things as: a lack of cultural awareness; a disinterest in Indigenous histories or perspectives; paternalistic "we-know-what-is-best-for-you" attitudes; and lowering of expectations. All of these factors impact upon the likelihood that an Indigenous student will attend school and complete post-compulsory education. This, of course, has life-long and life-wide consequences. A recent enquiry into Indigenous issues in Australia notes:

> Evidence indicates that young Australians who do not complete year 12 are less likely to have the same opportunities as those who do. In 2006, year 12 completions for Indigenous Australians were 45.3%, compared to 86.3% for non-Indigenous. Based on current trends, the gap between Indigenous and non-Indigenous is widening. (Commonwealth Government of Australia 2009)

For Indigenous people this gap is seen, not just in statistical data, but in long-term and concrete ways relating to their access to economic and social rewards.

Gender, too, continues to impact upon children's expectations of themselves and of their peers. International research continues to show that gender impacts upon the length of time that students spend at school; high-school completion rates; and post-school destinations (including areas of employment and fields of further study). By extension: gender influences both the nature and duration of employment and, of course, remuneration. A report commissioned by the International Trade Union Confederation in 2008 indicated that across 63 countries surveyed, there was an average gender pay gap of 15.6% (Abjorensen 2010).

The impact of gender is also seen in frightening statistics relating to general health and well being. Having been repeated so often and for so long, some of this data has lost its impact. All those working in any educational context, however, should continue to be alarmed by evidence that reminds us that the life expectancy for men continues to be less than that for women; that men are far less likely than women to seek regular medical advice; that women are far more likely than men to be denied access to even basic education and to lack foundational literacy skills; that men in over-developed countries commit suicide at three times the rate of women;

that women in the same countries account for 90% of eating disorders; and that men throughout the world are over represented in high-risk use of drugs and alcohol and, of course, criminal activity (Bergman and Scott 2001). The list could go on and on. The key point to be made, however, is that differences amongst us do not exist in isolation. Nor do we live in a world where all differences are treated equally. Factors relating to gender, socio-economics and cultural background influence the expectations we have of our selves and each other. Issues of cultural diversity, language, ability, sexuality and religion also influence the way kids are positioned within, by and for education. They also shape the extent to which students feel themselves to be natural, normal, valued participants in the worlds produced by school systems.

Terms such as "alienated," "disengaged," "disenfranchised" and "marginalised" are now widely used to describe an easily recognised trend in school which sees "at risk learners" differentiated from "ideal" learners almost from the first day of school (Schissel and Wotherspoon 2001). The middle class, able bodied, heterosexual child from a nuclear family who conforms to cultural stereotypes about what it means to be a boy or a girl remains the ideal learner within many school systems and for many school teachers, while those who depart from this mythical norm are routinely seen as other than normal: experiencing at best tolerance or acceptance and at worst, alienation and hostility.

There is, therefore, a real tension between the need to respond to dramatic forms of technologically mediated change and equally dramatic—if rather less "exciting" or marketable—lack of change. This tension is captured in William Gibson's eloquent comment provided at the start of this chapter: "the future is here. It's just unevenly distributed."

In the context of both what has changed (the context of schooling), and what has not changed (the outcomes of schooling), this book argues that the focus of contemporary educational debate needs to shift away from discussion of the ways in which schools can "respond to" or incorporate aspects of the new world into their existing practices towards a more rigorous debate about the role and potential of classrooms. In a world that is, on the one hand, much changed by computers and associated technologies but on the other hand, stubbornly unchanged in the ways in which factors such as gender, economics, cultural identity, disability and location continue to impact upon educational success or failure.

Such a rethinking takes nothing as a given, and adopts a blue skies, clean slate, "if only" perspective, whilst remaining mindful of the conditions under which educators now work. This includes recognising that teaching remains one of the most highly scrutinised professions in the world. Responsibility for all manner of national, social, economic and medical problems is routinely directed at schools. Teachers in this environment are asked not only to produce clever kids but social and economic capital: graduates who are active, healthy, mentally stable, socially aware, environmentally responsible, economically savvy and capable of making a long and productive contribution to an increasingly globalised workforce. Schools (along with parents and caregivers) have become the "go to" villain of choice in mediated contexts which thrive on the identification of crises and the establishment of responsibility. Childhood obesity? Blame it on schools. Anti-social behaviour?

Blame it on schools. Online bullying? Alcohol abuse? Teen violence? Schools. Schools. Schools.

Whilst we would never deny that schools have a vital role to play in circulating and normalising social values, a culture of blame coupled with an ever expanding portfolio of expectations can lead all too easily to a situation where teachers develop a "play it safe" mentality. Choosing to stick with familiar routines is a clearly understandable response when every move or change can be subjected, not only to scrutiny and criticism, but to scrutiny and criticism plastered all over the internet. Mistakes are rarely private and experiments always risk being interpreted in negative ways.

Yet without risk taking, experimentation and innovation, schools will surely always struggle to move beyond the patterns of success and failure that have become at once so well known and so naturalised as to be rendered almost invisible. The need to embrace imagination and experimentation underpins the chapters that follow. Many texts focused on education and technology embrace particular technological products—iPads for example—as though they are themselves the carriers of imagination; the magic keys to unlock hitherto unimagined vistas. In this book we argue that imagination resides not in any object or product, but in the relationships that are established, sustained, naturalised and celebrated through imaginative educational practices.

Martin Espade (2000, p.16) has argued that:

> Any progressive social change must be imagined first, and that vision must find its most eloquent possible expression to move from vision to reality. Any oppressive social condition, before it can be changed, must be named and condemned in words that persuade by stirring the emotions, awakening the senses. (as cited in Singer 2006, p.1)

Responding to Espada's stirring words Jessica Singer (2006) writes:

> If individuals are to change conditions they disagree with, then they must use imagination to invent and shape the kind of world they want to live in. I also believe that it takes models and practice to learn to take risks or to step outside of common expectations. (p.1)

The spirit of Singer's (2006) words here informs the work undertaken by this book that seeks to offer an optimistic, aspirational but modestly ambitious agenda for schooling illustrated through diverse models and examples that take risks and step beyond common expectations. The modest nature of the agenda we pursue is a position that stands counter to the default position of much educational and social policy making. In a world which is crisis rich and time poor—where every idea competes with a million others for the attention and commitment of governments, policy makers, teachers and community members—modest claims are under threat. Politicians are more likely to embrace an activity that supports an "education revolution" than one that reflects more humble aspiration. This kind of aspiration, however, is not to be mistaken for a framework that lacks passion, power or vision.

Modest aspiration, we argue, is far more powerful as a mindset for shaping and sustaining educational reform than the now *de rigour* over-stated "up-sized" agendas that saturate policy documents, vision statements and strategic plans. It is through the day-to-day work of teachers with modest ambition—ambition that is

humble but in no sense unexceptional—that students are brought into sustained and sustaining positive relationships with their community, their peers, and, indeed, with knowledge itself.

Modest ambition as an agenda acknowledges and respects the widely recognised power of teachers. It also respects the pressure that teachers are under. Parker Palmer makes the important point that "reform will never be achieved by renewing appropriations, restructuring schools, rewriting curriculum, and revising texts if we continue to demean and dishearten the human resource called the teacher on whom so much depends" (Palmer 1998, p.3). Respectful of multiple pressures on teachers and supportive of the value of small instances of transformation, this book seeks to explore the role that teachers and schools have/can/should seek to prepare diverse learners for these diverse futures.

In recognition of the high profile and large amounts of financial and human resources that are directed at educational technologies every year, the book takes computing and communication technologies as a key focus, but presents this as one set of issues upon which to reflect. Technology is always connected to other issues. As such, the book seeks primarily to illustrate what might happen if teachers are able to re-imagine the relationship between schools and technology, between schools and diverse learners, and between schools, children and knowledge. In foregrounding the concept of relationships we commit to looking at the ways technologies can support new relationships but also the ways teachers can transgress the boundaries that are so easily and routinely reinforced between some groups and education.

In the chapters that follow the book looks at the way schools—teachers—are able to move beyond limited, stereotypical or tokenistic responses to the diversity of the student group in order to establish robust understandings of what it means to be a learner, a citizen, a worker in these changed and changing times. Central to this project is the belief that preparing kids for the future necessitates not only preparing them to be good at doing school, but rather to be good at doing life. In recognition of this key distinction we put forward, here, an educational agenda characterised by the label "future proofing." We use this term to indicate a commitment to educational agendas which look beyond the boundaries of schools to think about how every single educational moment is working (or not working) to provide diverse kids with the attitudes, dispositions and self belief that will serve them well in a future that no-one is in any real position to describe. It is a concept—and idea—that signals, not a naïve belief in the transformative power of the individual teacher or the particular school, but rather a particular kind of a mindset: a disposition or commitment to re-thinking the purposes, content and processes of schooling with a view to ensuring that all children, from all backgrounds are prepared by their education to cope, engage with and actively shape the futures that could be ahead of them.

The future-proofing agenda is best thought of as a series of questions that can be directed at any educational initiative, environment or practice to reflect upon the extent to which it is helping children get good at doing school, or, more importantly, helping kids get good at doing life. Indeed, we would like to make it clear from the start that this is not a book of answers. Rather it is a book of questions: To what extent, and in what ways, is it possible to future proof children for a largely unknown

and unknowable world? What would future-proofing curriculum, pedagogy or assessment actually look like in practice? What kinds of relationships underpin this future-proofing project? What role can educational technologies play in a broader project designed to change students' relationships with knowledge?

In exploring these questions, the book outlines some of the ways in which a future-proofing focus, and the imaginative (multiple) practices this demands, can help educators in diverse contexts and disciplines move beyond a largely descriptive (and often pessimistic) acknowledgement of changed and changing circumstances towards a more optimistic, pro-active conceptualisation of educational programs that maximise opportunities for students to cope productively with a future in which change is constant and novelty is the status quo.

The book is divided into two sections. In the first we acknowledge the range of challenges that the contemporary environment poses for educators and the dominant ways in which schools have sought to demonstrate their response to the technological dimension of this change. This is followed by an exploration of the challenges that patterns of educational success and failure pose for educators in a range of contexts. Reflecting upon significant developments in scholarship focused on technology in schools and social justice within education we then put forward the concepts of educated hope and modest ambition as useful frameworks for imagining and sustaining technologically mediated educational interventions.

In the second half of the book educators from diverse backgrounds operating in very different cultural and educational settings explore a range of analytical and conceptual devices to discuss key sites within which contemporary educators can make use of *diverse* forms of technology—some computer based, some not—whilst working towards bigger educational and justice agendas predicated on commitment to developing education which seeks to change relationships between kids and knowledge, kids and school, and kids and communities.

The centrality of relationships to the overarching future-proofing agenda is introduced in the chapter by Carmel McGrath and Leonie Rowan who explore the ways schools, students and teachers can be brought into different relationships with both knowledge and community through an educational initiative known as knowledge-producing schools. A key idea for this chapter is the ability of particular approaches to school to allow even the most "at risk" learner to see themselves as having skills that are recognised by, and valued within, *diverse* social and educational contexts.

Jan van Aalst and Carol Chan pick up on this commitment to skill sets that are valuable well beyond the confines of an immediate classroom in their exploration of the concept of knowledge building in the Hong Kong context. They make the point that as a community-oriented practice, knowledge building takes advantage of the diversity of interests, knowledge, and abilities within classrooms. There are opportunities for all students to make valuable contributions, learn from others, and develop their interests. In this transformative framework the learning environment becomes more *community oriented*, the learning goals become *emergent* and *authentic* to the students, and agency over the educational process is substantially turned over to the students. Engagement is enhanced and traditional patterns of access and exclusion are challenged.

A similar commitment to disrupting traditional understandings of school, schooling and school children is seen in Helena Gillespie and Rob Walker's investigation of the impact of space and place upon student learning in diverse schools in the United Kingdom. After acknowledging the uncomfortable reality that schools are not easy places to change the authors go on to paint a picture about the ways in which particular teachers have taken up particular technologies to support an overall agenda of reform: and capture in the process stories about lively and optimistic children working with good teachers in positive ways. Indeed, this chapter picks up on the idea of optimism introduced above: optimism in the face of stories we are constantly told about the loss of childhood, the corrosive impact of technologically mediated practices on relationships and social norms, and the inability of schools to change. Their data—like that explored by van Aalst and Chan—speaks to the importance of meta-skills: skills that help children understand their world, and the power they have within that world.

A similar focus characterises the exploration of schooling and an approach to educational reform outlined by Pam Hook. Focusing on diverse learners in the context provided by New Zealand, Hook (1994) argues that the schools are at their most valuable when they actively focus on helping children develop skills, capacities and dispositions that allow them to understand, and contribute productively to, the complex environment of which they are part. As she writes:

> Living well with socially and culturally diverse others requires people who can make good choices around participation and who can offer good actions when it comes to contribution. To make good choices requires cognitive skills in synthesising and integrating information; to take good actions requires social skills.

From this basis Hook provides examples of how children of different ages and from different backgrounds can achieve excellent results when they see themselves as good at *learning*, not simply good at doing school.

Hook's chapter explores the important point that the pursuit of educational equity does not necessitate a lowering of standards. This idea is further explored in the chapter by Margaret Marshman and Peter Grootenboer which also calls into question many assumptions about technology and student engagement. Working with the subject matter of high-school mathematics (a curriculum area long associated with alienation and dis-engagement), Marshman and Grootenboer outline the ways in which at-risk and marginalised learners were brought into a positive relationship with genuine and authentic mathematical knowledge via the use and exploration of old-world technologies. They remind us that innovation lies not in the computer power we bring to a classroom but, rather, in how we work with what we have to help students develop a positive sense of themselves as learners. The chapter is a valuable reminder that keeping educational goals at the forefront of our mind helps us make better choices about how and why we will choose technologies with which to work: choices that reflect much more than an unfounded belief in "technology" as cure for all educational ailments.

While Marshman and Grootenboer explore the creative use of old-world technologies, Craig Smith investigates the pedagogical potential of new and emerging online resources. His chapter examines the ways in which digital

resources were used to connect diverse students to what are literally old-world artistic practices. In his exploration of an arts-based project called *Floating World* Smith raises excellent questions about what counts as an innovation in the contemporary context and points to the ways in which modest ambition can make a significant contribution to the outcomes of schooling. He explores conditions that support the development of the kind of twenty-first-century knowledge flows that are able to interrupt and (at least temporarily) transform very traditional nineteenth-century institutions, such as the public art gallery and the classroom. The physical and logistical constraints imposed by geography and time are challenged by frameworks and technologies that allow students to become publishers of their own work, online, to a potential global audience.

The notion of boundaries and limits is also central to the chapter contributed by Mary Ulicsak and Keri Facer which asks the key question "Whose educational future are we discussing?" As we think, plan and hope to create educational environments to future proof our students it is important for us to return continuously, relentlessly, to questions about who exactly we are focusing on, and how, exactly, that is decided. Ulicsak and Facer take up the challenge of widening debates about the purposes, contexts and risks of education and outline powerful ways of using digital technologies to incorporate more people in the kinds of debates that have historically privileged the voices of small sections of society.

Finally Rune Krumsvik looks beyond the boundaries of schooling to reflect upon challenges associating with continuing to engage diverse learners in university environments dominated by pedagogical environments—such as large-scale plenary lectures—that have not historically responded well to the challenge of engaging students in their learning.

Together these case-based chapters outline mindsets that underpin new ways of thinking about the purposes and processes of schooling. They provide insights into a diverse range of modestly ambitious practices that reflect a commitment to positioning students as active producers of knowledge that is meaningful to and for them in their present and their futures. Case-based chapters also make use of diverse technologies as they pursue aspirational agendas that go well beyond the acquisition, employment or integration of computers into schools.

As the basis for the case studies that follow, the next three chapters explore in more detail the multi-faceted nature of the challenges facing today's educators. We look at the ways in which previous and dominant discourses about technology in schools, and a long history of equity-based school reform, can impact upon what is seen, imagined or read as "innovative" and the ways in which it is possible for all educators to be involved in re-constructing understandings of the good, natural and successful learner. Central to this process is the ability to step back and critically reflect upon where "we" are at with regards to computers in schools, and blind spots we may have learned to ignore. To this end we turn now, in Chap. 2, to a discussion of patterns concerning schools' traditional relationship with computer and communication technologies and explore the particular kinds of patterns that can be seen within a long-standing—but not all that it seems—digital romance.

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Chapter 2
Schools and Computers: Tales of a Digital Romance

Chris Bigum

This chapter is concerned with the way schools and school systems in the over-developed world have come to terms with computers and related technologies and, particularly, recurring patterns in terms of how schools' relationships with computers are considered and evaluated. The patterns I will describe are quite remarkable in that they have repeated over the past 30 years, and, as I will argue, will likely continue into the future. They are essentially patterns of *response*: response to whatever the producers of digital products for educational purposes place in front of schools; response to anxiety about keeping up with the schools-next-door and, ironically, response to concerns that, left unchecked, technologies could disrupt the patterns of schooling and, by extension, student learning. Even though the nature of the pro-offered products (and the associated technologies) has changed greatly since the early 1980s, the ways in which schools and school systems have responded to "the new" and "the latest" remains largely unchanged. I explore the way these patterns constrain debates about underlying technologies (which I prefer to call computing and communication technologies[1]) and the value of taking a fresh look at the school/computer relationships.

[1] I prefer the term "computing," which is what these machines actually do, over "information." Information connotes more than data. As Bateson (1999) suggests, information is the difference that makes a difference. But given the ubiquity of the acronym IT and ICT I will use these terms here.

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Background

On August the 4th 2010, the CEO of Google, Eric Schmidt, told the audience of the Techonomy Conference in Lake Tahoe that the world now produces *every two days* more information than had been produced *in total* from the origin of the species to 2003: that is, some five exabytes[2] of data every 48 h.[3] These kinds of (mind numbing) statistics reflect an extraordinary pace of change in terms of ICTs as well as enormous growth in the number of users of the internet.

Thirty years ago, the volume of digital data was nothing like it is today. The Internet was in its infancy as it emerged from various military and research networks[4] and to speak of a "digital world" would have seemed odd or at least overly boosterish. This was the time when some computer software and data were stored on audio tapes—a step up from mark sense cards, punched cards and paper tape—and where educational institutions were, relative to the world outside, computer rich: the opposite of what we find today. Schools, indeed, were important sites for the fledgling microcomputer industry[5] which worked hard to find markets across a broad range of social institutions and organisations. In those early years, there was a good deal of optimism about the potential of computers to transform, perhaps even revolutionise, the processes and outcomes of schooling. Looking at the history of computers in schools, it is hard to suggest that anything even remotely revolutionary has actually taken place. This is not to suggest, of course, that computers have not interrupted or changed some schooling practices. There were, indeed, obvious disruptions to the work of schools when computers were first taken in. Space had to be found in the curriculum to teach about them. Physical space had to be allocated to them in classrooms or classrooms had to be converted into computer laboratories. Resources both human and material had to be found to maintain them, to manage them and to keep them up to date. But once schools adjusted to these initial perturbations, schooling continued on much as it always had. More than this, schools learnt how to *domesticate* new technologies (Bigum 2002), or as Tyack and Cuban (1995, p. 126) put it, "computers meet classrooms, classrooms win."

So in this chapter I will examine the recurring patterns of school responses to ICTs in some detail. I will look, firstly, at the circumstances which helped to make possible schools' initial investment in computers; secondly at the most common

[2] An exabyte is a billion gigabytes. A gigabyte is 1,000 megabytes. A small book is roughly 1.5 megabytes. This makes a gigabyte about 600–700 books and an exabyte 600–700 billion books.

[3] A study by IDC (Gantz et al. 2007) provides a detailed analysis of growth patterns and the methodology for doing the calculation.

[4] A useful history can be found at: http://www.davesite.com/webstation/net-history.shtml. The tight association between the interests of the US military and the educational use of ICTs continues to this day (Noble 1991).

[5] The term "microcomputer" reflected not only the physical size of the computer but also, relative to what were then called mainframe computers, their computing power. As computer power has increased significantly these terms have become obsolete and we are left with two broad classes: computers and super computers.

arguments used to justify ongoing investment in ICTs and finally at patterns relating to "what happens next": that is to say, what has tended to happen once a new technology has been acquired. In this process I will identify the way schools have consistently attempted to make sense of "new" technologies by locating them within the logics and ways of doing things with which schools were familiar.

What follows draws on my own long-standing research and teaching interest in computer use in schools. I have worked with and carried out research with teachers, schools and school systems since the early 1980s (Bigum 2011). Neither before nor after the widespread use of the Internet allowed for the easy sharing of ideas in education have ICTs been experienced the same way across the world. As William Gibson puts it,[6] "the future is here it is just not evenly distributed yet." There have always been variations between countries concerning the hardware that was available to schools, the assumptions made about educational purposes ICTs could be put to, and the relative importance attached to expenditure on hardware, software and warmware. Between and within countries there are also considerable differences in the quality and quantity of ICT resources and access to them (Organisation for Economic Co-operation and Development 2006); a point that has been widely and thoroughly documented (Becker 1984; Bigum et al. 1987; Bubenko et al. 2005; Coley et al. 1997; Cuban 1986, 2001; Fitzgerald et al. 1986; Impagliazzo and International Federation for Information Processing 2006; Impagliazzo and Lee 2004; Molnar 1997; Reiser 2001; Schifter 2008; Sutton 1991; Tatnall and Davey 2004; Zammit 1992).

Despite the well recognised differences in terms of how much access different countries have to ICTs there are also some remarkable similarities in terms of the way schools and schooling systems internationally have sought to make sense—and make use—of computers in school contexts. The patterns of engagement by schools with ICTs that I describe are broadly consistent with the reported experiences in most of the over-developed countries of the world.

A Budding Romance

Computers were, of course, found in schools before the late 1970s or early 1980s, however, it was the availability and relative affordability of 8-bit microcomputers from the 1980s onwards that led to them becoming a more or less routine fixture in schools. Up till that time, schools generally had a long-distance relationship with computers, and made use of remote computers typically by sending mark sense cards to a computer centre, most often at a university, for processing. The arrival of the microcomputer was a significant shift. The computer moved from something that was locked away in air-conditioned comfort—unseen by its users and tended

[6]The quote is attributed to Gibson but the specifics are uncertain, see, e.g. http://www.brianstorms.com/archives/000461.html for a history of the web publication of the quote.

by humans who fed it data and programs on cards and magnetic tape—to a much smaller device that sat on a desk and demanded attention. It had a screen and keyboard, allowing for direct interaction by a user.

These early microcomputers, while puny in terms of computational power compared to the machines to which we have access today were, nevertheless, able to perform useful computations and display their results on screens rather than on paper, which was the output format for the larger time-shared and mainframe computers of the time. Having a screen made them seem somewhat similar to the then popular programmable calculators which also had screens, albeit tiny ones, that were used to display the output of calculations. In many ways this similarity helped pave the way for computers into schools, as schools had been exploring the use of these calculators for teaching and administrative purposes since the mid 1970s[7]: The similarities allowed teachers to imagine how to use the new technologies in ways consistent with the old.

Indeed, as is the case for most new technologies (Franklin 1990), the arrival of computers in schools was most powerfully enabled by enthusiasts and hobbyists who, in this case, also happened to be teachers. These were the people who would bring their own computer to school to try it out in their class or to use it to carry out some administrative work. They were the first to do for computers in schools what Franklin calls unpaid product development engineering. In those early days, as is, again, the case for any new technology, you needed a tinkering hand to keep the technology working and maintained. This was certainly the case with the early microcomputers.[8]

With a foot in the door so to speak, these machines then had to find (or be found) acceptable educational uses. At this point two sets of interests came together. In simple terms, for a technology to find acceptance it has to generate uses.[9] Here, enthusiasts continued to play a valuable role. They began writing software to support their teaching or administrative work. Simulations were popular, particularly in the sciences where you could represent a variety of processes using, more often than not, a programming language called BASIC that often came supplied with each computer. At the same time, computer vendors were keen to open up new markets for their products and schools were identified as important sites which might lead eventually to the home. Vendors courted schools and brought to the relationship

[7]The calculator proved to be something of a harbinger of the debates about computer use in the classroom. The calculator was then at the centre of a debate in the teaching of mathematics in schools. The use of calculators in schools, and in the teaching of mathematics, has an interesting history (see for example, Ellington 2003; Fey 1989) that points to an important idea—the delegation of work to a machine—to which I will return in a later chapter.

[8]I recall with the early Apples that, on occasion, they would malfunction when they were in use for a time. The heat from the circuitry would sometimes cause the chips to rise from their seats on the motherboard. Switching off and gently pressing the computer chips down into the mother board would often solve the problem. In warmer parts of the country, teachers would explain how they kept modems in the refrigerator before use.

[9]Ursula Franklin (1990) has a detailed account of this process for a number of contemporary technologies.

claims that what might look like a hobby or a diversion was actually an unavoidable part of the educational landscape of the future. This ability to "sell" the potential of computers was central to the early stages of the relationship. It is possible to argue that if computers and computer companies had relied solely on the enthusiasm of the teachers who brought computers into schools and lobbied for their acquisition then their history in schools would resemble that of devices brought into the classroom in earlier times, things like television, radio and video players (Cuban 1986). These technologies can still be found in schools and enjoy intermittent use but no longer are positioned as the educational panaceas they once were.

Unlike these technologies, the computer was enjoying widespread and rapid take up across most sectors of society. It was promoted as the solution for a broad range of problems in industry, business and government, all of which made more and more use of them and, as a consequence, became increasingly dependent on them. Of course, the "good things" that occurred in spheres outside school always came at a cost, often of certain types of jobs, as new ways of doing things, ushered in by ICTs, were rolled out. There is a substantial literature concerned with unintended outcomes from the implementation of new ways of doing things that extends beyond computing and related technologies, as Edward Tenner (1996) and others have documented. Nevertheless, widespread claims linking computers to improvement supported a marriage of convenience between computers and education: a marriage that was consolidated by a broader social/economic context that increasingly began to link ICTs with such seemingly desirable characteristics as "improvement," "efficiency" and, by extension, educational status. These were in many ways the off-spring of the original marriage.

Claims about improvement and efficiency were, at first, easily demonstrated. For things like calculations, for example, computers soon become well known for their ability to do them more quickly than other means of calculation. The important point here is their consequent framing[10] as "a good." The celebration of the computer's potential was clearly illustrated in 1982 when the computer was named by *Time Magazine* as machine of the year in place of its usual person of the year. This recognition marked the increased visibility of computers and their growing importance in so many aspects of everyday life. Even though computers had been around for decades they were removed from most people's daily experience. The proliferation of affordable, and eventually powerful, computers marked the beginning of the widespread take up of these devices in the wealthy countries of the world. Its public promotion and association with notions of modernisation and progress (Nisbet 1994) made it a powerful symbol of the future.

The growing deployment of computers across a broad range of human activity in the 1980s made it clear that ICTs *might* be improving the way things were done but were *definitely* changing the way things were done. With this change routinely linked to the catch cries of "improvement" and "advancement," computers became

[10]Framing was a notion developed by Erving Goffman (1974). It has been popularised more recently by the work of George Lakoff (1987, 1993, 2002, 2004).

symbols that schools could ill afford to be without. Thus, from being a novelty at the start of the decade, the computer became a must-have for most schools by the mid 1980s. I recall a visit to a wealthy private school in Melbourne in the early 1980s. I was working at a teacher education college at the time and we had just scraped together sufficient funds to acquire our first time-shared computer, a VAX 11/780. As I walked into the foyer of the computer facility of the school, there sat, in air-conditioned comfort, a VAX that was more powerful than the one the college had acquired. I was impressed. In discussions with staff however, it turned out that this machine spent most of its time counting how idle it was. It was virtually unused. The computer, like swimming pools, gymnasiums, rifle ranges or equestrian facilities, had become a means of promoting the merits of wealthy schools. An evaluation study carried out in Australia in the mid 1980s documents views expressed in some schools of the importance of being ahead of other schools when it came to computing resources (Bigum et al. 1987). All this underlines what Lipkin (cited in Zakariya 1984) wrote almost 30 years ago:

> Them that has, gets.... if a particular race, sex or economic group occupies an inferior position in society, you only have to be able to add one and one to see that technology will compound the problem. (p.29)

Evidence of the successful use of computers for various applications outside of schooling has often provided a kind of "evidence surrogate" for schools, that is, if ICTs are doing so much for banking, newspapers, or the military, it stands to reason that they are or can do good things in schooling. As the amount and size of the investment in computers continued to grow, so, too, did attempts to measure claims that computers did, indeed, improve things. As each wave of ICTs has been taken up in formal education settings it has been followed by a raft of studies that set out to examine improvements and effects. A recent example is the large number of studies concerned with comparing electronic white boards with other modes of classroom communication. This is akin to comparing the riding of a horse as a means of transportation to the use of a motor vehicle. It's like comparing oranges with orangutans. No doubt, given the recent popularity of things like the iPad, there will be a spate of comparison studies about this particular technology also.

At the base of these studies is the ever present rationale, introduced above, that ICTs are, somehow, automatically and universally, about *improving things* and that because of this link schools with more computer activity are better than schools with less. However, despite the oft-cited "schools + computers = improvement" claim, what computers are used for in schools is always constrained by dominant beliefs about how schools should work.

Domestic Harmony

Coming to terms with each new ICT has become part of the routine of schools. An important part of that work is reading each new technology in terms of existing or previous schooling practices. This is a process I describe as domestication: the taming

of something which, in its "natural" environment, might function quite unpredictably. Domestication works only if the new can be translated into the familiar. The more a new technology can be seen as part of the normal routine the easier it will be to find a place for it in the classroom. Seeing new things in terms of what we know is how humans initially make sense of the new. When cars first appeared they were talked about as horseless carriages. The first motion pictures were made by filming actors on a stage and so on.[11] Stephen Hill (1988) tells a story which underlines this habit of mind. It is a story about a native of Papua New Guinea who returned to his village after hearing a radio account of the first moonwalk:

> In the tradition of the people, he presented a masterful oratory on rockets and space capsules, and on men journeying through the skies to land on the moon that the people could see above the skyline of their jungle habitat… The orator was heard in complete silence … At the end the people asked him two questions. The first was 'Why did they go?—was it for pigs or women?' The second was 'Who were they?—Roman Catholics or Seventh Day Adventists'. (p.44)

This illustrates powerfully the ways in which people attempt to explain the new in terms of the old. We routinely transfer our assumptions from one context to another. This is also seen in the way people make decisions about how to respond to particular technologies and which ones to allow into schools. It is obviously the case that not all new ICTs end up in schools. A judgment has to be made (by teachers or principals or policy makers) about whether or not a new technology can be successfully domesticated or schooled, that is to say: able to be engineered into the existing routines and structures of a school. If it cannot then the usual practice is to ban it (Bigum and Rowan 2008). Popularity with students is often a good predictor of what ends up being banned. Schools are clearly aware of the trends and fashions that spin up around each new wave of digital product if only because students will bring them into the classroom and decisions have to be made about whether the device or software is allowed to be used while at school. The more popular a particular technology is with students the greater the chance it will be banned. The almost universal ban placed on mobile phones is an example of this logic.

This approach is, of course, somewhat ironic given that schools are now technologically poor when compared to non-school environments. This was recently illustrated by an audit of computing and related technology in a primary classroom in NSW (Finger and Lee 2010). The study also surveyed the homes of the children in the class. For the class of 30 children the total home expenditure for computing and related technologies was $438,200. The expenditure for the classroom was $24,680. Even allowing for the sharing in families, the difference between the two locations is clearly significant. Further, the often limited access students have to web sites in the classroom due to access limitations, costs and/or risks of accessing undesirable material contrasts with internet access in the home (Australian Communications and Media Authority 2008). Moving from home to school must for many students be like stepping back in time. It is difficult to see this 30-year trend reversing.

[11] Carolyn Marvin (1988) has an excellent account of early technologies in the US.

The point to be made here is that although schools often begin to engage with computers and related technologies in the belief that they will improve something about schooling, schools often use those technologies in old and familiar ways: integrating them into existing routines, deploying them to meet existing goals and, generally, failing to engage with technologies in ways consistent with the world beyond the classroom.

Summarising the Pattern

To summarise, schools have ended up in a loop that looks something like this:

1. A new ICT appears on the market.
2. Arguments are made concerning the *improvements* the technology will make to existing teaching/learning practices. This is an important and necessary step in terms of recruiting support. The technology has to be positioned so it appears as a solution to a particular problem. So the initial story has to be constructed around current practices. It would make little sense to claim an outcome that was unfamiliar or that was impossible to foresee. Its only justification can be in terms of what is already known, and importantly it has to be in terms of a current problem of some kind or other. This is what Sproull and Kiesler call first-level effects—"the planned efficiency gains or productivity gains that justify an investment in new technology" (Sproull and Kiesler 1991, p. 4).
3. The case made to justify the acquisition of the new ICT is successful and the new technology is put in place.[12]

At this point, typically, one of two things tends to happen. One possibility is that the ICT is successfully domesticated. It is made to fit into existing school routines. In this scenario, the fact that the technology is being used at all is typically sufficient evidence that the claims made for it have been met.

Not long after this, a new technology appears or an upgrade is required and new efforts go into making a new case for its acquisition. Of course, when schools first embarked on the acquisition of computers it was with little sense that they were entering into an arrangement that would require them to replace machines that they had acquired not many years earlier. While the notion of upgrading hardware and software is now well understood, this notion was not a consideration in the early 1980s. The mainstay logic for keeping the acquisition cycle going is the ongoing framing of ICTs as educational goods. This framing is sustained by the long-standing claims outlined above that ICTs improve things, which, in education, is usually translated to mean learning, employment opportunities and access to information. Today, these claims are more implicit than they were 30 years ago but they nevertheless remain as the pillars that support the ongoing cycles of acquisition in schools.

[12]This is no simple matter. More unpaid product development engineering is required for each new ICT.

Investing in the "next" and "newest" technology, then, is the equivalent of a renewal of one's wedding vows: an ongoing statement that schools are in their relationship with computers for better or worse.

Thus many schools find themselves caught up in a cycle of identifying, buying, and domesticating the "new best thing" driven largely by claims that the process is ultimately improving learning. And, as the amount of time and energy and resources that is invested in the cycle increases, more and more attempts are made to measure the resultant improvement, with things that don't seem to be measurable being swept under the carpet.

Given all the difficulties[13] I have mapped so far, you'd wonder why on earth schools or teachers continue to play the game. Part of the reason, of course, is that the world continues to report and celebrate important developments and improvements that are underpinned by ICTs. So for schools, it continues to be logical that they too should enjoy something similar, perhaps not with the kind of impact that is reported in other settings but you would expect at least some benefits. It is also important to acknowledge the large amount of unpaid product development engineering undertaken by hard-working teachers who have tried to achieve changes that are comparable to what has happened in other fields and practices. But it is fair to observe that the aspirations that have long been held for ICTs in classrooms are yet to be met, particularly on the scale that is imagined by proponents. In lieu of that, what schools have become very good at however is the *form*. The form of computers in schools is as perfect as that of the Cargo Cult people. Richard Feynman (1974) in an account of what he termed "cargo cult science" describes the practices of the Cargo Cult in this way:

> In the South Seas there is a Cargo Cult of people. During the war they saw airplanes land with lots of good materials, and they want the same thing to happen now. So they've arranged to make things like runways, to put fires along the sides of the runways, to make a wooden hut for a man to sit in, with two wooden pieces on his head like headphones and bars of bamboo sticking out like antennas--he's the controller--and they wait for the airplanes to land. They're doing everything right. The form is perfect. It looks exactly the way it looked before. But it doesn't work. No airplanes land. (p. 11)

Schrage (2006) describes a similar phenomenon in some ICT implementations in business as process pantomime. You can find similar patterns in universities in which ICTs are used to promote and symbolise contemporary practice. I recently worked at a university which mandated that all students should do at least one course wholly online "to prepare them for the world in which they would work." The claim, like other of this ilk, does not bear close scrutiny.

There are, however, other ways of looking at this relationship. Let us return to step 3 above: where the case made to justify the acquisition of the new ICT is successful and the new technology is put in place. I have argued above that much of schooling

[13] As Perelman (1992) noted, putting computers into classrooms is akin to putting an internal combustion engine in a horse.

works to simultaneously domesticate technology (i.e., stop it from doing what it might have done in any other environment), and try to measure the way it improves "things". This reduces much debate about computers in schools to the level of right/wrong; good/bad; improved/not improved.

I want to argue here that looking for evidence of improvement is a distraction. Similarly, focusing on processes to support domestication is a mistake. Both obsessions miss the most obvious, and fruitful, point: ICTs change things. In the process of adoption, interesting things happen that may bear little relationship to what was imagined: These are what Sproull and Kiesler call second-level effects, "…people pay attention to different things, have contact with different people, and depend on one another differently" (Sproull and Kiesler 1991, p. 4). Their research clearly demonstrates that when you introduce a technology, a new way of doing things into a setting, things change and that seeking to "assess" the change or compare the new way of doing things with the old makes little sense. In a similar vein, Seymour Papert (1972) parodied the application of the scientific model to the evaluation of computer-based learning. He suggested that the failure to find significant differences in favour of computer-based approaches was like the failure of a nineteenth century engineer who failed to show that engines were better than horses.

> This he did by hitching a 1/8 HP motor in parallel with his four strong stallions. After a year of statistical research he announced a significant difference. However it was thought that there was a Hawthorne effect on the horses … the purring of the motor made them pull harder.

From this perspective there is little point or interest in evaluating the original claims because what is most interesting is the resultant effect. The entire history of computers in schools, however, is a history of attempting to prove that computers have improved things whilst also being successfully incorporated or captured by the existing structures of schooling. If we let go of that obsession—and step off the digital merry go round—we can look at the second-level effects that occur. We can also focus on the way a technology may change patterns that have nothing much to do with learning the official curriculum. A similar point is made by Franklin (1990) who posits that technology needs to be seen as *practice*, the way things are done—not as a separate, stand-alone "thing" that either does or does not make learning better. From this holistic approach to understanding technologies—one in which the social and technological are not seen as separate—attention shifts from looking at what is improved, to identifying *what has changed*. These changes may have very little to do with what was hoped for or imagined.

This book is premised on the belief that it is the exploration of changing relationships, disruptions, and second-level effects which have the most to offer those seeking to interrogate the practices and purposes of schooling. This works to challenge the two more prominent mindsets that currently inform debates and current practices.

The first mindset is one that continues to pursue the promise of using computing and related technologies in the classroom. It is supported by (and supportive of) research that continues to look for improvements, often by conducting comparison

studies. The major task in this mindset is to integrate ICTs into the classroom. Change is typically informed by the "diffusion of innovation" theory of Rogers (2003), which is commonly flagged by the use of terms like "early adopters," "change agents" and "laggards". In this mindset, schools are doing a good job in preparing the young for the future that lies ahead. The curriculum tends to be one in which getting the correct answer is important. The emphasis in teaching is on "the how". The complexities of teaching with ICTs is represented by things like technological pedagogical content knowledge (Mishra and Koehler 2006). This mindset pays limited attention to what is happening outside schools *vis-á-vis* computing and related technologies.

There is a second mindset which draws attention to the slow disintegration of a number of the social institutions (Shirky 2009) which are based upon what might be called a "broadcast logic". What is suggested (Heng 2006; Lankshear and Knobel 2007) is that the recent shift from a web that was largely read only to one that is now a read/write web, one in which anyone can publish almost anything, has strong parallels with what followed the invention of movable type by Johannes Gutenberg in Europe in the fifteenth century (Eisenstein 1979). As Weston (1997) presciently wrote:

> It is well understood that all social institutions have their relative certainties made possible by the centralising power of the technologies of mass communication. The relative certainties that accompany attenuated access to the means of symbolic production are welded into the fabric of all institutional policies and practices. Assuming, then, that access to the means of cultural expression will be increasingly distributed, it follows that all of the institutions of modern society will be threatened or at least inconvenienced by this development. (p. 197)

This mindset has resonances with the de-schooling movement of the 1960s and 1970s. Schooling is, in this view, a social institution dependent upon a broadcast logic. It then is only a matter of time, in this view, before formal schooling begins to experience the difficulties that the newspaper industry is currently experiencing and with which the music industry has been dealing for some time. From this point of view, trying to improve schooling with ICTs is a wasted effort: as Russell Ackoff (2004) argues:

> The righter we do the wrong thing, the wronger we become. When we make a mistake doing the wrong thing and correct it, we become wronger. When we make a mistake doing the right thing and correct it, we become righter. Therefore, it is better to do the right thing wrong than the wrong thing right. This is very significant because almost every problem confronting our society is a result of the fact that our public policy makers are doing the wrong things and are trying to do them righter. (p.2)

Mindsets one and two are characterised by a similar level of stubborn commitment: to embracing technology to improve schools on the one hand, or to an acceptance that schools cannot be improved (certainly not by ICTs) on the other.

There is a third mindset which, broadly speaking, is where the focus of this book lies. It is a view that is neither naïve nor nihilistic; a view which is acutely aware of the changed and changing circumstances of the world as a raft of various technologies are deployed across most aspects of human existence. This view argues that given the real challenges that those currently in school will face, there is a real

warrant for thinking about doing school differently. It is a mindset that is seeking not to replace the existing single solution with another but rather to encourage a proliferation of thinking about and doing school differently.

It is a mindset which recognises that focusing on change but not measurement, on the social, and not simply the technical, allows us to identify the ways technologies may help disrupt traditional relationships: between schools and knowledge; knowledge and children; children and teachers; and learners and communities. This mindset acknowledges that many wonderful innovations in schools and technologies are tenuous. Indeed, the fragility of ICT-based change in classrooms and schools is found over and over again in the literature (Lankshear et al. 1997). But even this fragility is not necessarily a cause for despair: for still it points to the possibilities of change—the scope for modest ambition—and the value of continuing to look for the small-scale disruptions that can occur.

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Chapter 3
Edges, Exponentials and Education: Disenthralling the Digital

Chris Bigum

Thinking Holistically About Technologies

Technology is a key term in this book. How the term is used and understood matters. Usually, technology is thought of as material stuff, the physical artefact that is a printer or a mobile phone or an automobile. While this usage is convenient as a shorthand for talking about things, it is only when technologies are used to do things that it becomes less clear just what is or is not technology, i.e. where does it start and end; what are its boundaries? There is a significant literature that talks about technology more holistically for instance as hybrids/cyborgs (Haraway 1990, 1991, 1997), or as intimates (Turkle 2011), or as a global whole (Kelly 2010). Whenever a technology is in use there are always many other things that are present if not always visible and which, particularly in education, we tend to ignore (Sørensen 2009). So I want to extend the notion of thinking about technology holistically that I gestured to in the previous chapter and draw on sensibilities from actor-network theory or ANT to further examine schools, computing technologies and the patterns which were mapped in an earlier chapter.

Much can be said about ANT and there are now a large set of resources and publications that illustrate the way these ideas have been deployed to explore and examine everything from scallop fishing (Callon 1986), electrical vehicles (Latour 1996), atherosclerosis (Mol 2001), financial markets (Knorr-Cetina and Preda 2005), the law (Jasanoff 2007) and studying organizations (Jensen 2001). There are also a number of ANT informed studies in education (for example, Gorur 2008; Fenwick and Edwards 2010; Sørensen 2009; Rowan and Bigum 2011; Bigum and Rowan 2009).

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Briefly, ANT offers a relational approach to thinking about technologies and schooling, as John Law (2008, p. 141) explains:

> Actor-network theory is a disparate family of material-semiotic tools, sensibilities and methods of analysis that treat everything in the social and natural worlds as a continuously generated effect of the webs of relations within which they are located. It assumes that nothing has reality or form outside the enactment of those relations. Its studies explore and characterise the webs and the practices that carry them. Like other material-semiotic approaches, the actor-network approach thus describes the enactment of materially and discursively heterogeneous relations that produce and reshuffle all kinds of actors including objects, subjects, human beings, machines, animals, 'nature', ideas, organisations, inequalities, scale and sizes, and geographical arrangements.

Realities, like schooling then, are enacted into being. But they are not enacted from nothing. Schools and schooling have a long history and practices that persist over time even after the origins of the practice are long forgotten. What is of interest are the persistent patterns of relations that are performed in schooling, what John Law calls the hinterland. As he puts it (Law 2004, pp. 33–34):

> The hinterland produces specific and more or less routinised realities and statements about those realities… The hinterland also defines an overall geography—a topography of reality-possibilities. Some classes of possibilities are made thinkable and real. Some are made less thinkable and less real. And yet others are rendered completely unthinkable and completely unreal.

I have traced some of the patterns of thinkables and unthinkables vis-à-vis computing technologies in the previous chapter. For computers to be 'real' in schools, they need to "draw on—and perhaps contribute to—an appropriate hinterland" (Law 2004, p. 28, 34). This means fitting in with the quotidian practices of schooling: classrooms, timetables, curricula, assessment logics and so on. So, in this way, it is perfectly thinkable to use computers to analyse data in a science experiment in class but in assessment, particularly high stakes assessments, it is unthinkable to obtain help from a machine. The influence of decisions taken in the past to allow and disallow actions in the present is not often drawn upon when we think about computers and schooling. Yet the impact that past ways of doing things have upon what is done and also what can be *imagined* is significant.

An example away from schools illustrates well the longevity of choices and decisions made in the past. Kevin Kelly (2010, p. 179–180) recounts the story of the influence of Roman carts on roads and rail through time. Since the carts followed in the ruts of the war chariots the carts were built to the same specifications. The chariots were built to allow two warhorses to pull them side-by-side. In time, as the English began to use carriages, they too were built to fit the existing ruts which had become roads of similar width. When railways were built, the horseless carriages were also built with the same width of almost 5 ft. Labourers from England built the first American railway tracks and because their tools were designed to build the British tracks the end result was that rail tracks in the US also ended up being a little under 5 ft. More recently, the rockets which launch the space shuttle were brought via rail to Florida. They had to pass through a tunnel not much wider than the 5 ft wide track, so their diameter could not be much greater

than that same measure. Kelly quotes the conclusion of one wag who commented that: "So, a major design feature of what is arguably the world's most advanced transportation system was determined over 2,000 years ago by the width of two horses' arse".

So too with computers in schools, the 'tracks' that have been laid down a long time ago continue to frame and shape what can run on them. Computer use which fits these tracks or long standing patterns in the classroom will be relatively easy to keep in place.[1] Practices that do not will require constant effort, most often from enthusiastic teachers, to be kept in place. To extend the analogy, it virtually means having to build your own, different tracks. Importantly, the places and spaces in which practices which are less constrained by the disciplining effects of the 'tracks' or the hinterland of schooling are always found at the edges, those spaces and practices that are deemed to be not sufficiently important or a part of 'real' schooling. It also means that for mainstream schooling, achieving anything other than a series of domestications, one for each new technology as it comes onto the market, is highly unlikely.

Does it matter if schools keep on dealing with these technologies as they have done for the past 30 years? Clearly, under the current cycle of doing computer related things in schools most people are happy. The vendors are happy. Schools are no longer the market key they once were but, in aggregate, schools still spend a significant amount on these technologies and the educational aura of each shiny new piece of computer equipment is in tact. The romance continues. Teachers are more or less happy. The enthusiasts keep getting their hands on the latest products and doing things with them in their classrooms.[2] The less than enthusiastic can either avoid them or find odd things for them to do in their classes. They remain a good, if expensive, reward to send students to for finishing their work early. The students are happy. They have adapted well to having a schooled experience of ICTs that is bizarrely different to what they have outside. Principals are happy. They have managed to find enough funds to keep up the symbolic work these technologies do for schools. Parents are happy. Their school has a lot of the latest 'what evers' so they must be doing good things with them. Governments seem happy as they find funds to build elaborate, locked down intranets that make the experience of the Internet even less like the Internet outside schools. So even though, as some critics might argue, this is a costly state of affairs, changing things does not appear to be an important matter to most of those involved. I want to disagree however and argue that maintaining such a position is not just unprofessional and wasteful but, in the broad scheme of things, dangerous.

As the previous chapters have already illustrated schools now operate in a world that is much changed to that of a decade or two earlier. The nature and size

[1]There is an interesting parallel here with what Christensen et al. (2011) term sustaining innovation.

[2]The current enthusiasm in schools for tablet computers like the iPad is a good contemporary illustration.

of the shifts that have occurred as the read/write web has played out is only a *tiny* indication of what will flow from computing and related technologies in future. The significant interest in and debates around the notion of education for the twenty-first Century is a key focus for this book, i.e. how do you future proof diverse groups of kids for what is (possibly) to come? The challenges go far beyond how to deal with various computing technologies in the classroom, they go to the role and purpose of schooling particularly when we consider the failure of long standing educational traditions to offer quality education to such large numbers of the population. To me, education now needs to be thought about in terms of two other E's: exponentials and edges.

Exponentials

If the current and future challenges posed by ICTs is not enough of a challenge for schools, there are other clusters of technologies that will powerfully shape the world in which the young of today will live. In particular, current developments in what Kelly (2010, p. 260) calls GRIN technologies, G for geno, R for robo, I for info and N for nano technologies,[3] point to significant challenges for future generations that will be orders of magnitude more disruptive than developments in computing and related technologies have been to date. How schools engage with such developments will be crucial if they are to retain any credibility as an essential element in the preparation of the young for a challenging and complex future. What is worrying about schools and schools systems is that the domestication habits they have developed in relation to ICTs are not good habits to have in the face of what is to come.[4] Maintaining the digital romance, enacting domestication after domestication in an era of accelerating change becomes neither sustainable, sensible nor ethical.

To most, the notion of an exponential is something that belongs in a mathematic's classroom or perhaps may somehow be related to home loan repayments.[5] Exponential change is not something with which we have had to become familiar, despite the fact of Moore's Law and other Laws that map the growth of various digital technologies and which tell us that the price of various digital technologies is halving roughly every 18 months to 2 years and that their performance is doubling on about the same time scale. For example, a measure of the computational power

[3]The least familiar of the quartet, nanotechnology is concerned with engineering things at the scale of the atom. The properties of materials so engineered are like nothing we have seen till now. As Stevenson (2011, p. 110) puts it, "Nanotechnology is to matter what a phone booth is to Superman".

[4]Ray Kurzweil (2001) argues that we won't experience 100 years of progress in the twenty-first century – it will be more like 20,000 years of progress (at today's rate).

[5]To illustrate exponential growth let's imagine that we take a step and it is a metre of ground we cover. Then let's imagine that each step we take is double the last one. After nine steps we have covered a kilometre. In our 28th step we will have passed the moon. Step 34 takes us past the sun.

of the chips used in the manufacture of various computers is MIPS which is the acronym for millions of instructions per second. And while there are lots of qualifications of a measure like this, it is often used as a rough guide of computing power. This is doubling every 21 months (Kelly 2010, p. 167). The chip in the laptop I am using to write this, an Intel Core 2 duo which was released in 2008, is rated at ~50,000 MIPS. In 2011, the most recent Intel chip is rated at 160,000 MIPS. These numbers are often difficult to relate to the experience of using a computer or related technology apart from a sense that newer computers seem to be faster. More controversially, but in my view, a useful measure that compares the rate of change of digital technologies in a less abstract manner, is to compare the calculations per second that the human brain carries out with that of computers now and into the future. Kurzweil (1999) argues that the human brain carries out about 20 million billion calculations per second. He estimates that around the year 2023 you will be able to purchase a $1,000 computer with that computational power. By 2037, the same computer will cost about a cent. In 2049, he argues, that you will be able to buy a $1,000 computer that has the computational power (measured in instructions per second) of the entire human race. In 2059, he predicts that the price of this computer will be about one cent.

These extrapolations may appear to be science fiction. If we had made similar projections at the time of the first moon landing they too would have seemed like fiction. It is a fiction I am using to write this book chapter. The fact is that the various digital technologies that end up in laptop computers, mobile phones, and an increasing number of things that we tend not to associate with computers, are still doubling their performance and halving their cost in fixed time periods, i.e. we are seeing exponential growth.

There is much controversy about what all of this might mean, but for the purposes of this chapter I don't want to open the debates about Kurzweil's argument about the technological evolutionary point he calls the singularity (Kurzweil 1990), I simply point to a fast approaching world in which not just computing and related technologies are improving exponentially but a world in which the other three of the GRIN quartet[6] enjoy similar growth characteristics.[7] An important feature of this growth is that each technology draws on what has gone before. This is both limiting, as I have just argued, but it also means that you do not have to start from scratch to take the next step, i.e. in order to build a nuclear reactor you do not have to begin with a stone axe. Kurzweil's (2001) law of accelerating returns elaborates this point in some detail.

Another important property of all four groups or clusters of technologies is self-replication, that is the ability to make perfect copies of themselves or to improve subsequent versions. This is not a new idea. We have known about the replication

[6] A readable account of the current state of these and other technologies is provided by Stevenson (2011).

[7] George Church, a prominent molecular geneticist points out that the cost of DNA sequencing has been halving every 4 months over the past 5 years (Stevenson 2011, p. 51).

of genes for a long time. What is new is the prospect of self-duplication in robotics and in nanotechnology: robots that build robots that build robots and which work to improve each successive generation; and nano factories, that build nano factories that build nano factories.[8] Taken together and without attempting to anticipate how any of these technologies will play out, it is nevertheless patently clear that doing school the way school has always been done or tweaking it around the edges will not prepare young people who will grow up in this world. And more importantly, school has always been, will continue to reproduce the patterns of disadvantage described in other chapters of this book.

This take on the challenges facing the young can easily lead to a kind of paralysis of the imagination and a loss of hope that things can be different. That is, we keep doing what we have always been doing because that is the only thing we have some control over, and, because the tracks are there it is easier to work within them than build new ones. Alternatively, we can work to explore or develop the mindsets that allow us to explore possibilities for schools and young people, some of which are mapped in this book. Experiments in doing school differently have become more common as the limitations of the mainstream system become more and more apparent. But even when we look to these sites and the inspiring folk who do this work, often against the odds, there remain heavy traces of the ideas, assumptions, practices and beliefs to which those who work in education are in thrall, the stuff of the hinterland of education. Ken Robinson, speaking at the 2010 TED conference drew attention to a word that Abraham Lincoln used in an 1862 speech to Congress in which he (Lincoln 1953, p. 537) said:

> The dogmas of the quiet past, are inadequate to the stormy present. The occasion is piled high with difficulty, and we must risee—with the occasion. As our case is new, so we must think anew, and act anew. We must disenthrall ourselves, and then we shall save our country.

Disenthralling ourselves is a lot easier said than done. Nevertheless, getting past the horseless carriage thinking that still characterises the way we think about computing technologies in education is an urgent first step. The term horseless carriage was used in the early days of the automobile to help smooth the transition from horse-based transport to one in which a horse was no longer required.[9] In education, thinking about computers as educational technologies, as tutors, as learning aids and so on is based upon a similar logic. Horseless carriage thinking is however a *kind* assessment. What has happened in schools more closely resembles horsey horseless carriage thinking. The horsey horseless carriage was a design in which at the front of the vehicle there was a carved wooden head and neck of a horse (Neil and Time 2007). It was argued that this vehicle would be less disruptive to horses

[8] An early, large scale version of this kind of manufacturing is provided by the development of what is called 3D printing, or additive technology (http://en.wikipedia.org/wiki/3D_printing).

[9] Carolyn Marvin (1988) makes a similar argument in her accounts of the introduction of technologies like the telephone and electricity in America.

with whom it shared the roads. So too in computing in schools, computers have to be domesticated so they don't disrupt the smooth running routines of the classroom and school. These are things to be preserved at all cost!

Disruption is never easy (a point made well by authors such as Gillespie, Walker, and Smith through this volume), particularly in the main stream of any set of practices and schooling is no exception. When we look for disruptions, because of the massively conservative nature of main stream schooling, we have to look to the edges, the fringes, the places and spaces that may not even be recognisable as school even though the educational outcomes from these sites are often more significant than that of a 'normal' school.

The disruptions I will briefly illustrate below (and others that are described in the next chapters of the book), are always accompanied by a disenthralling of some of the foundational ideas of schooling. Disenthralling ourselves of the ideas of formal schooling may seem like a return to the romantic days of deschooling (Illich 1973) in the 1960s and 1970s. The challenge we face is neither romantic nor old. We have a very simple choice. We can either continue to prepare the young for a world that no longer exists or we can take seriously the huge challenges that will emerge as the GRIN technologies play into every aspect of human activity.

Edges

The edge is a way to talk about the places and spaces that are not mainstream. It is a label used to describe the boundary of things. In current debates about new economies, new ways of doing business and innovation generally, the edge is both a descriptor for and a symbol of things that are not mainstream. It is also a way to talk about the limits of what we know, what we can do and what we can think. It is a crude but useful distinction that, at the very least provides a marker for thinking differently about change in education.

To put it bluntly, edges are where novel stuff happens. The various systems that operate within the mainstream be they business models, governance structures, or accountability regimes, all serve to constrain what is possible. These things support what is more or less able to be anticipated and serves the interests of the organisation or business. This makes it nigh on impossible for innovations that could upset or disrupt the status quo to be allowed or even noticed. In actor-network terms, the hinterlands of well established organisations and businesses determine what can and cannot be thought, what can add to things and what can't.

To further develop this idea, I draw on what to some in education see as the 'dark side', that is the world of business. I take the view however, that with the changed and changing nature of the world that teaching and learning, in the broadest sense have become everyone's business, and particularly for those in business. If we use the notion of the emerging world characterised by exponential growth of the GRIN technologies as a kind of underground mine – it is dark. It is hard to tell what the next excavation will reveal and so on. Then business, because it has tougher metrics

for success than do formal educational settings, can operate a bit like a canary[10] for education miners. That is, business will make mistakes faster and adapt quicker to the changed and changing circumstances they encounter. I am not advocating that education simply mimics the engagement business has with rapidly emerging technologies but that formal education needs to pay a lot more attention to what happens in this sphere. This, I need to add, is not a new idea. Doug Noble (1991) documented 20 years ago the influence of the US military in shaping most of the technologies dubbed educational in use in the average classroom.

Clayton Christensen has been interested in canaries also. He does not write in these terms but he was curious about why some businesses that were operating well and were thought to be in control of their markets, failed. His curiosity led him to develop, with others (Christensen 1997; Bower and Christensen 1995) a model of disruptive technologies, later to be renamed disruptive innovations. In this model he makes a distinction between sustaining and disruptive innovations. Sustaining innovations improve existing products and services, ways of doing things, while disruptive innovations change the nature of the business. Computers in schools can then be seen as sustaining innovations, added to improve things; that this claim is still a matter of considerable dispute (see for example, Cuban 2001) has not altered the persistence of the idea of a computer as an improver of things in education.

Sustaining innovations are deployed to improve market share, for instance, the embellishments that are commonly associated with wealthy private schools like swimming pools, rifle ranges and expensive computer equipment fall into this category. They are all intended to improve the product and hence, market share. Disruptive innovations always come from the edge or fringe, from places and spaces which dominant or mainstream businesses do not look at or if they do, do not recognise the innovation as a threat. They are not seen as a threat because initially they are often a lower quality or crude product or service and are not attractive to the existing users of the product or service. Thus for example, as Christensen documents (2003), telephone companies did not see the mobile phone as a threat. It was outside of the way they saw the world. It was also the case for the manufacturers of minicomputers like DEC when the first microcomputers appeared.[11]

Typically, a disruptive innovation is simpler to use, costs less and attracts nonusers of the technologies it will eventually compete against. It is also initially not as good as the technologies it eventually will disrupt. Those who can recall the early mobile phones which were often referred to as bricks because of their large size, is a good illustration. If Christensen's model can be applied to schooling, and he, Michael Horne and Curtis Johnson believe it can (2011), the current patterns of computer use will never achieve the kinds of revolutionary changes that some advocates have suggested. Moreover, an examination of educational practices that might be deemed to be at the edges may offer insights into how better prepare the young.

[10]In the early days of coal mining, miners would carry a canary in a cage with them to monitor the quality of the air. If the canary fell off its perch the miners were warned of the presence of poisonous gases.

[11]Christensen's theory is not without its critics (see for example Danneels 2004).

Doing School Differently, Education at the Edges, Twenty-First Century Schooling

Peter Senge (2007) once asked the question would we know what twenty-first Century schooling looks like. He argued that we would not given that we have had such a long involvement with mainstream schooling. What follows here then are not just examples of doing school differently but ideas that offer opportunities to think differently about what future proofing might entail.

What is on or at the edge will of course depend upon your vantage point. Whether some of what follows even registers as school will be an indication of how blinkered the debates about what it means to prepare the young for a future of exponential change have become. The examples included here are not intended to be a comprehensive list of all or most educational practices operating at the edge of mainstream education but rather are an indicative sampling. They are brief, at face value accounts and to which the characteristics of a disruptive innovation are lightly mapped. I am not arguing that the kind of rapid change seen in the business examples Christensen studied will spring from one or more of these, rather, I am interested in what can be learned from these approaches in thinking about future proofing the young.

A recently publicised[12] series of experiments involving the placement of computers in holes in walls in India, Cambodia and Africa, Sugata Mitra (2006, 2003) has demonstrated that groups of children can learn to use a computer and the Internet to answer a broad range of questions. Mirroring what happens when children work together to play various video and online games (see for example Gee 2003, 2005), Mitra has documented evidence of peer tutoring, inquiry learning and a capacity to talk about the pedagogy used to help their peers. He argues that in terms of formal curriculum, only one portion of any given curriculum actually requires a teacher and that his model illustrates the key role of peer teaching and modest expertise to support the learning of novices. Importantly, the learning that he observed taking place was driven by questions. Not the kinds of questions asked in normal classrooms where the knowledge authority knows the answers but questions that lead to better questions in the pursuit of a goal (Thomas and Brown 2011). While his work is referenced to mainstream schooling, in terms of a disruptive innovation, his model taps a huge number of non-users of formal schooling. To supply the missing third part of support that his model suggests, he has enlisted large numbers of volunteer mentor/tutors, his so-called 'granny cloud' which provide an hour a week of support to each self-organising cluster of students via Skype.

826 Valencia[13] is a project in the United States in which school age children work with writers after school hours on their writing. Help for writing ranges from help with homework through to writing and publishing books, novels, and newspapers, real tasks. The children have access to the mature insider forms of practice of actual writers, people who write for a living, something they can't get in a classroom.

[12] http://www.ted.com/talks/sugata_mitra_the_child_driven_education.html

[13] http://826valencia.org/

Computers are used for writing and publishing, i.e. to do work that matters to the children and to the audiences for whom they write. These children also are non-users, non-users of an educational service that gives them access to cutting edge expertise. Access to expertise is a consistent feature in all of these examples.

The Lumiar schools in Brazil arose from the interest Ricardo Semler (of *Managing without Managers* fame) (1989, 1993) has in education. His philosophy of running businesses has been hugely successful. In his critique of the way businesses normally operate, he likened them to schools. So it is perhaps not surprising that he wondered about shifting his ideas into formal education settings. His schools offer a similar freedom to that which he gave his workers, a freedom uncommon in most mainstream schools. There are no classrooms, homework or playtime. While there are features which may resonate with some aspects of mainstream schools, the basic thrust of the schools is to reinvent schooling so that it better meets the developmental needs of children and has none of the trappings of what is seen as industrial age schooling. The children work in multi-age groups led by a tutor or mentor. There are no teachers in the mainstream sense of the word. Masters come to the school as experts or subject matter experts to provide expertise that is driven by student interest.

The Khan academy[14] is not a school. It is a large collection of screen casts made by Salman Khan. It began when he was tutoring his cousin in mathematics using online notepad software. Friends and neighbours heard of it and to manage the demands on his time (he worked in the finance industry) he began to put them out as screen casts – short videos of him sketching on a computer screen while talking about the way he was tackling the problem. There are now over 2,000 of these screen casts covering mathematics, history, finance, physics, chemistry, biology, astronomy, and economics from elementary ideas through to ideas taught at the lower end of university. I have used a number of them. They are excellent. Probably the best of this genre I have seen. Khan has since quit his job and with the support of the Gates foundation works full-time for the Academy. The content is free. Many would probably say it is not as good as a face-to-face experience. It is, in terms of mainstream schooling, the stuff of mainstream schooling. The interesting point of this example is that it is providing the service that usually occurs in a classroom. For the poor in the world the Khan Academy provides an excellent teacher in places where there is not one,[15] for the home schoolers it provides high quality materials at no cost and for schools, apart from providing auxiliary help for students, it poses interesting challenges for teachers and their content-based expertise.

There are many other examples of schools which might be categorised as having the potential to be disruptive to main stream schooling. The MET schools movement, now under the umbrella of Big Picture Learning,[16] the Buck Institute's[17]

[14] http://www.khanacademy.org/. Currently over a million students a month are being supported by these materials.

[15] This is one of Mitra's motivations also.

[16] http://www.bigpicture.org/

[17] http://www.bie.org/

promotion of project-based learning, High Tech High's[18] emphasis on students producing work for real audiences, the KaosPilot schools[19] of Denmark are just a few examples of the many experiments occurring around the world in doing school differently. All of these 'experiments'[20] in doing school differently make for a messiness in the education landscape. It's a robust messiness as each project in its own way aims to cater for diversity, difference and the desires of the young. In every case, there is a measure of disenthralling going on. Not all of the tracks of schooling have been relaid, replaced or removed but there are signs in all of these sites at the edges that the needs and interests of the young are not being assumed, that preparation for the future is not the straightforward task that main stream schooling implies and that new kinds of knowledge work are not only possible but are a key part of future proofing the young.

GRINning at Education

It is clearly the case that mainstream schooling will be with us for some time to come. However schools change, diversify or morph into something else there are a number of considerations that need to be at the front of any practice that is associated with preparing the young for the future. These considerations derive from taking the challenges of the GRIN technologies seriously. They might be thought of as two opportunities to become disenthralled with some long standing educational ideas.

In a world in which the growth in the numbers of computers and their inter connection grows rapidly, there will necessarily be an ongoing delegation of work to these machines. As Robert Constable (2007, np) argues: "Digital information, now measured in petabytes, is expanding rapidly; already most of it will never be examined by any human."

We have become used to having machines help us do things or do things completely for us not only in the material world where our existence has become almost totally dependent upon an array of machines which we tend not to notice until they stop doing their work, but also in digital space where we can duplicate files with the click of a mouse, Google a word or phrase to determine its meaning, analyse a huge data set via a graphical interface, or have our phone record an incoming voice message. In all of the myriad tasks in which machines have a role there is a distribution of competences between the human and non-humans (Latour 1992, p. 158). The distribution is, as Winner argued a long time ago, always political (Winner 1985). That is, that delegation of certain tasks to machines in particular ways can discriminate against

[18] http://www.hightechhigh.org/schools/HTH/

[19] http://www.kaospilot.dk/

[20] Mainstream schooling also needs to be seen as experiment, a very long standing one that has inappropriate metrics and a misguided notion of accountability.

particular groups of humans. As I have argued in the past, consideration needs to be given to the distribution and to identify those complementary skills that humans now are assumed to have. To take a simple example, a hand calculator is a device in which the arithmetic work of a calculation is delegated to the machine. For calculations with large numbers involved, being able to estimate very roughly what the answer should be is an example of a complementary skill. For some calculations knowing about significant figures or perhaps how the processor rounds up or down could also be important. In effect, the calculator can discriminate against people without those skills. Computer use in schools is devoid of these kinds of considerations. I suggest that developing a keen sensibility about the delegation of work to machines and assumptions about complementary skills ought to be a key element in any future proofing agenda.

Complementarity is a broad principle that can usefully be deployed when thinking about what is done in schools and elsewhere. As the spread and use of various technologies occurs apace outside schools, asking how these patterns might be complemented inside schools rather than should we domesticate or not would allow schools to play a much more proactive role in terms of issues like access and role. More importantly, as the rest of the GRIN quartet begin to play out, complementarity provides a robust basis for thinking about and acting on issues of difference and disadvantage.

The second consideration is linked to the first and can be stated as a question: why do we teach children to do things that machines are good at or soon will be? Schools have had an unhappy history about allowing students to use machines to do some of the routine work of schools. The long running debates about being able to use calculators[21] in mathematics, the concern that Mum or Dad were writing essays when students turned in word processed assignments, or the anxiety about students using Wikipedia as a reference source underline the difficulty schools have had in coming to terms with the role of computing technologies. There has been little interrogation of curricula in terms of what machines can now do and what they will be capable of in the near future.

Douglas Thomas and John Seely Brown (2011, p. 92) describe an experiment Thomas conducted following the publication of a report in 2006 that found that 63% of Americans aged between 18 and 24 could not find Iraq on a map. Thomas gave a group of students a computer instead of a map and asked them to find Iraq. They all could, but offered a great deal more options of how the country might be viewed – aerial, satellite, conventional map etc. The shift from ‘what’ to ‘where’ as Brown and Thomas suggest is an important characteristic of working with machines.

I am not arguing here that simply because a computer can do a task that it ought to do that task (Weizenbaum 1984) but that in a world in which there is a delegation to computers on such a massive scale that clinging to old curriculum and assessment practices is galactically stupid.

[21] Which distracted the debate from the more important question of complementary skills in calculator use.

This second consideration underlines the shift that is occurring in the way that knowledge is produced, preserved and disseminated. The intimate association of the disciplines with computing technologies was underlined by a recent report on the state of 'computational thinking' (Committee for the Workshops on Computational Thinking 2011) which, among other things, details examples of the role that computers have played in solving problems in fields as diverse as criminology, archeology, psychology, astronomy and proof construction in mathematics. In schools there is still an ongoing emphasis on doing the 'grunt' work in problem solving rather than encouraging students to develop problem formulating skills. The recent exhortation of Douglas Rushkoff (2010) is apt here: program or be programmed.

The current world already favours those quickest to adapt. Managing the fine balance of what machines do and what humans do will not be simple but it cannot continue to be ignored and needs to be a crucial component in any education that claims to future proof the young. To do this we cannot continue with the mainstays of conventional schooling. It is a matter of letting go, of becoming disenthralled. As Thomas and Brown (2011, p. 81) suggest:

> We propose reversing the order of things. What if, for example, questions were more important than answers? What if the key to learning were not the application of techniques but their invention? What if students were asking questions about things that really mattered to them?

The chapters that follow provide a range of examples of educators asking questions about what they are doing in order to allow students to ask questions themselves. In the following chapter Rowan explores the ways in which this kind of thinking can be accompanied by a commitment to educational justice characterised by both robust hope and modest ambition.

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Chapter 4
Educated Hope, Modest Ambition and School-Based Equity Reforms: Possibilities and Perspectives for Change

Leonie Rowan

Introduction

The previous chapters have outlined challenges that schools and teachers have faced when attempting to respond in meaningful, sustainable ways to technological developments that have taken place in both the "real" world contexts of industry and homes and in the more technologically domesticated environments associated with schools and education. Focusing on the patterns that have become naturalised and drawing attention to the transformative opportunities that exist on the edges of legitimate, routine, safe educational practices, the chapters have highlighted the kinds of mindsets that function as either barriers to or gateways towards innovative approaches to technology. Central to these discussions is the recognition that particular mindsets—such as those which link computers automatically to "learning" or which concentrate on trying to measure what technology does, or does not, actually improve—can work to reproduce, rather than interrupt, traditional relationships between schools and technologies: relationships which have, to this point, actually achieved very little in terms of the "revolution" technology is so often seen to promise.

ICTs, of course, are not the only area or sphere of analysis where it is possible to identify the persistence of particular, narrow and restricting patterns of behaviour linked to specific, familiar mindsets and beliefs. This chapter focuses on the patterns concerning the ways schools deal with issues relating to student diversity and highlights why this remains an issue for educators already under pressure to respond to numerous (often competing) sets of demands. In bringing together perspectives on equity with perspectives on ICTs our goal is to generate an interdisciplinary and

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cross-domain conversation that allows for a new beginning, or a fresh start, in thinking about ways to deal with topics that are well worn, familiar and somewhat tired.

To this end we are motivated by the work of authors such as Ayers et al. (2009) who introduce a recent handbook focused on Social Justice in Education with the following point:

> Perhaps we've lost sight of the largest purposes of education in a democracy. Perhaps—as a society, as a citizenry—we've been temporarily blinded. If so, we should be forgiven—our blindness is in large measure understandable.
>
> The dizzying dash to reform schools—the bump and run, the hoot and holler, the endless high-pitched clamour—can, after all, be exhausting. The thousands of consultants with their millions of concrete fixes for every perceived problem can be debilitating. And the steady drumbeat of criticism—often ideologically driven—falling on the heads of educators and parents and kids mostly can become deadening. And so if we've momentarily forgotten to focus upon those transcendent goals underlying the entire enterprise, perhaps we can forgive, even as we move now to right ourselves xiii (2009, xiii)

They go on to argue that:

> Education invites us to know more and to be more, to see, to understand, to become more capable and more powerful, more courageous and more propulsive in the service of greater participation and more effective engagement in our work, our society, our lives. (2009, xii)

This chapter—indeed this entire book—shares a belief in the importance of "righting" our educational enterprise and re-focusing on our specific destination: even if that destination is to the margins or edges of education explored in Chap. 3. To take the metaphor further, I would suggest that if schools are conceptualised as ships on a voyage then their focus can easily become too narrow: looking more at the mechanics of the journey—speed, for instance, or distance travelled per fuel allocation—rather than at the choice of destination or the actual *purpose* of the journey in the first place. I explore this point in the next section of the chapter. From that basis I go on to outline some of the different mindsets that help to guide various journeys through education/equity discussions. Finally, I put forward the concept of educated hope as a framework for conceptualising the kinds of goals that are so crucial to ongoing equity-based educational reform that is linked to innovations in technology. My aim throughout is to argue the benefit of educators developing frameworks for thinking about the work of twenty-first-century educators that are neither nihilistic nor naïve: frameworks which allow them to work within a transformative agenda that is both anchored and aspirational: to be aware (and to beware) of what currently "is" but to be motivated by what might be: possibilities that exist, in the words of Bigum, on the edges and at the fringe of familiar school practices.

From Destination to Journey

Looking around at the world today, it is easy to see societies much changed by technological developments which have impacted upon all aspects of life, shaping not only the flow of information, news and entertainment but also people, products

and ideologies. The ubiquitous nature of technology and technologically mediated practice appears to demand widespread and far-reaching change in terms of the process, content and pedagogy associated with all levels of education indicating, as it does, an almost unimaginable future world in which students will live, work and, hopefully, prosper. Some of the ways in which this concern about technologically mediated change has played out in schooling—and some of the recurring themes, patterns, assumptions and, indeed, silences and absences—have been outlined in the previous chapters.

Equally significant is literature that reminds us that whilst much of the world lives, communicates, travels and works in an environment significantly different to that of the 1970s or 1980s, there are some key features of life that are eerily—horribly—familiar. The children at risk of educational alienation and failure in 2011 are the same groups of children at risk more than four decades ago: kids from rural and isolated areas, indigenous communities, language backgrounds other than English. Kids from low-socioeconomic families, single parent households. Kids with physical and intellectual disabilities. Kids who don't match their world's "mythical norm" (Lorde 1990). Issues of class and culture interact with factors such as gender and religion to produce what might be thought of as an intensification of risk. For example, on measures of literacy and numeracy achievement working-class boys generally struggle more than working-class girls. Similarly, indigenous children living in remote or isolated communities are at greater risk of educational alienation and failure than those who live in metropolitan centres. Once again, however, socioeconomic status plays a key and, some would argue, defining role in educational pathways (Teese 2000; Teese and Polesel 2003).

In this dual context of change and lack-of-change, educators face a particular kind of dilemma: How should we direct our attention? The demands of technologically supported changes are powerful and immediate. Few, it seems, (certainly few governments) want to be left behind (or seen as behind) in any digital, information or communication revolution. Indeed, the very notion that we need an education revolution (a key feature of much contemporary government policy) suggests that some aspects of schooling have failed to keep pace with change in other areas of society. This gives educators (and consultants) a clear mandate to focus on issues relating to technology in the design and delivery of a curriculum into/from and for this twenty-first century. One common theme within the resultant or connecting curriculum documents is that "technology" possesses some almost magical power to "engage" and "motivate" even the most disaffected of students. This provides even more ammunition for those wishing to focus their scarce time and energy on deploying technologies in classrooms.

By contrast, those who focus their attention on matters associated with social justice face a tougher battle, in terms of both finding the time and resources to sustain any systemic innovations and asserting the legitimacy and value of this work. It is true, of course, that educators with a social justice perspective are able to draw upon an established and rich body of knowledge to shape their thinking and their actions. Literally thousands of people have documented and analysed the diverse processes through which factors such as gender, cultural identity, first

language, ability/disability, sexuality, geographical location, socioeconomic status and so on shape educational success and post-school pathways. The close relationship between schooling, employment, income, social connectedness, and mental and physical health is similarly well documented (Chiswick et al. 2003; Considine and Zappalà 2002).

This same scholarship has long offered advice upon how schools should conceptualise and implement projects of reform designed to improve educational outcomes for diverse learners. There is a rich set of resources targeted at particular "high needs," "special interest," "at risk," "disadvantaged," "marginal," and alienated learners. Even the most cursory search for resources focused, for example, on the needs of refugee learners, produces a wealth of advice and possible directions. This literature has been—and continues to be—an important resource for educators facing the reality of heterogeneity in classrooms and cultures (Alton-Lee 2003).

However the value one might ascribe to this rich and diverse scholarship is potentially—and perversely—undermined by the knowledge that despite all we have learnt, despite all the time and emotion and money invested in the analysis of educational equity, children from dominant cultural, language and economic groups *still* experience far higher rates of success than do those on the margins of educational and social life (Teese 2000). This awareness begs the obvious question: Is there really any point in battling against the inevitable? Are there, perhaps, some groups who are really not destined for significant social or academic success? And (shameful thought) isn't it perhaps time we just thought about something else instead?

Whether uttered out loud or under our breath these and similar questions nevertheless occur at various times—with varying degrees of remorse—to large numbers in the education professions. For those who hold right-wing or conservative beliefs they are another way of expressing doubt about the value, wisdom and benefit of trying to offer the same quality of education to all regardless of their background. To many others, however, the questions are based not upon a denial of human rights, or principles of justice, or a sustained commitment to the pursuit of social transformation but on a genuine and often painful confusion about whether the problems of educational inequity can ever be overcome.

This confusion is confounded by the sheer weight of expectation that is directed at schooling. We live in a world which is crisis rich and time poor (de Graf 2003). There is, quite literally, not enough time to worry about every issue that is placed before us, and for every crisis that society faces—from childhood obesity, to school yard bullying, to drunk driving and anti-social behaviour—schools are handed their fair share of blame. In this context it is hardly surprising that educators may prefer to invest their limited resources in areas that appear to be achievable such as upgrading their computer labs and bringing electronic whiteboards under their control.

This brings me back to the question of educational destinations and purposeful educational journeys. Whilst aware of, and respectful towards, those who have been either discouraged by too little achievement in too many areas of education or distracted by any one of the multiple challenges educators are asked to deal with on

a day-to-day basis, this book proceeds from the belief that educators throughout the world share a collective responsibility for continuing to demand better, more equitable, outcomes from our education systems. This means we need to stay focused on the idea of a destination in which all children—regardless of background—have an equal chance to see themselves as successful learners, and active citizens. All the decisions we make along our voyage remain guided by that commitment. If that means rethinking the purposes of schooling, or embracing the fact that we may be sailing into unfamiliar, unchartered and unsafe waters than so be it. For a commitment to the pursuit of change is linked, from my perspective, to an equally strong belief that change *is* possible; that we are not doomed to follow always in the tracks of those who went before us (a pattern outlined by Bigum in Chap. 3); but that we can trace new pathways and we can reach new destinations.

The key question to emerge, then, is: How can we invigorate and sustain this belief? My response to this question structures the rest of this chapter, which is divided into two parts. In the first I discuss in more detail both the possibilities and the obstacles associated with decades of what can be thought of (if somewhat ironically) as "mainstream" equity-based educational reform. I will provide a brief overview of some of the major mindsets relating to the how and what of equity driven change and point to some of the contextual factors that make work in this area increasingly complex.

In the second I explore the concept of educated hope as both a philosophical and analytical framework for reflecting upon contemporary educational practices and processes that are motivated by an ongoing desire to interrupt, challenge or counter long-standing patterns of education.

Perspectives on Equity-Based Educational Reform

Theories about the best way to respond to evidence of uneven student achievement have developed significantly over the past century. While new perspectives have continued to emerge many of the older explanatory frameworks still have a great deal of influence. Thus both newer and older ways of conceptualising and accounting for patterns of educational/social successes and failures continue to impact upon how individual teachers think about the challenges in their classrooms, and the ways in which they might best approach the design of quality, meaningful education experience for diverse students. As a basis for outlining the approach to equity that informs the work of this book it is worth providing a brief overview of some of the most influential frameworks for thinking about educational inequity and reform.

There are four key perspectives that it is useful to review. Each one has played a role in shaping up what schools, teachers, and policy makers do, and do not do, when faced with evidence that some children are achieving at different rate, and in different ways, to others. The first, highly influential, position can be loosely described as an *essentialist* perspective. This is based upon a belief that there are some fundamental—essential—differences between individuals and groups that

inevitably result in differences relating to patterns of participation and achievement (Dillabough 2003; Griffin 1996). Historically, this position has linked observable differences between individuals or groups—such as differences in interests and abilities for example—to factors such as gender, cultural background or disability. Within this broadly deterministic logic, physical or biological differences are commonly used to account for differences in behaviour and to set limits around what it is reasonable to expect from different groups. Essentialist frameworks work on oppositions such as male/female and represent behaviours as natural when performed by one kind of body, and unnatural when performed by another (Bacchi 1990).

Critiques of essentialist mindsets have often focused on the limits of representing men and women as opposites. A similar logic, however, underpins much wider sets of educational arguments and so-called essential differences have then been used to justify excluding some groups from some experiences; tailoring schools to cater for the "reality" of differences (such as providing entirely different curricula to some groups); responding to the "real interests" of particular groups by re-designing the content and delivery of particular programs to respond to "natural" differences. This means that biologically or deterministic perspectives can be used aggressively and with deliberate intent to exclude particular groups or experiences from certain spaces (such as legislation which prevented girls or indigenous Australians from certain kinds of work spaces or active "streaming" of kids from working-class families into vocational education and training program without regard to their interest or abilities).

Related perspectives however can be used in what appear at the outset to be friendlier moves to "accommodate" differences by teaching topics in student-friendly ways. This might mean, for instance, drawing upon widespread essentialist stories about Maori culture and then allowing all the Maori children in a classroom to work in groups because of a widely held belief that Maoris are fundamentally communal in how they work. Or it could mean teaching boys about newspaper reporting by having them concentrate solely on reporting the games of the Soccer World Cup: a perspective which believes that all boys in the group will be engaged with and motivated by such a focus purely on the basis of their "boyness."

In either case, the fundamental assumptions about what boys/girls/diverse students are "really" and "naturally" like are, at best, unchallenged and, at worst, given increasing legitimacy (Rowan 2002). Groups are treated as homogenous entities and the real and powerful differences between children who may, on the surface, appear to have much in common, tend to be glossed over, trivialised or ignored. At the same time, these "boys will be boys" or "celebrating Indigenous culture" initiatives—which may be very superficial—also fuel arguments that differences *are* being recognised and that they *are* being catered for in the best ways possible. This allows schools to celebrate projects that respond to simplistic representations of groups of people as fundamentally homogenous: representations which argue, for instance, that all boys learn best in competitive environments, or when focused on science and technology, or when allowed to investigate themes connected to violence, conflict and war (Rowan et al. 2007). The child who does not match this model is thus doubly betrayed: first by a society which validates

narrow versions of masculinity, and second by a school system which says "but look, we are helping you—why aren't you engaged?"

A second, equally influential, perspective on equity-based educational reform rejects the idea that any individual is automatically or naturally "limited" as a result of their biological make up and focuses attention, instead, on identifying barriers to full and equitable participation. This is sometimes described as the access perspective on equity: a perspective that takes a liberal approach to the definition of social justice and argues for the provision of so-called "equal opportunities" (Allard et al. 1995). Within this framework emphasis is on the removal of institutional barriers—be they legislative or organisational—that might limit the possibility of "freedom of choice." This access-equals-equity model basically argues that if people are provided with access to the same opportunities/resources/spaces (that is, if barriers are removed) then any difference in terms of the results that they achieve can subsequently be attributed to factors such as intelligence, effort, commitment and so on. This reflects a belief in society as a meritocracy: a world where those with sufficient skills and determination can be whatever they choose (Alloway and Curriculum Corporation Australia 1995).

Alternatively, the phenomenon of personal interest can be put forward to account for and justify differences in the participation patterns of particular groups. It is common to argue, for instance, that boys just are not interested in programs of study that involve communication, relationships, or attention to detail and that girls just do not care about the demands imposed by mathematics, physics or computer programming. Clearly people have personalities. Equally clearly these personalities are often accompanied by distinct preferences for ways of working and modes of learning. The mistake that is often made, however, is to conflate personality with biologically determined aptitudes. There may well be lots of boys who prefer to play soccer as opposed to netball. This doesn't reflect any essential level of ability.

This way of thinking about equity draws important attention to both formal and informal barriers to participation. Laws forbidding women to vote, for example, are obvious formal barriers to full participation in society. A lack of kindergarten places in a remote part of Scotland obviously impacts upon the opportunities children in those areas have to take advantage of what early learning environments can offer. Access is also impacted upon by other less deliberate decisions. For instance, a plan to hold consultations with parents about a new curriculum direction that is scheduled for 11 a.m. excludes the participation of working parents. Similarly, a decision to hold a meeting at 8 p.m. limits the attendance choices of single parent families without childcare.

In other words, every context is characterised by often unwritten assumptions about the kind of people who belong. Workplaces organise crucial meetings at breakfast time: when many employees are involved in the business of feeding and caring for children. Some private schools offer excellent educational pathways but demand, in return, large financial investments from their students. Access is not truly equal. Focusing on issues of access—and the multiple ways in which access is limited—is thus an important part of any reform agenda. It draws attention to both the deliberate and accidental ways through which we shape who can participate in

particular places and spaces, and highlights, too, the multiple ways in which decisions about who the natural inhabitants of particular environments—a maths class, an early childhood staffroom, a physical lab—have often been assumed to be.

Clearly, though, access is only part of the puzzle. Women and men in most westernised countries have equal access to the full range of higher education specialisations (Siann and Callaghan 2001). The numbers of women choosing to study information technology or engineering, however, remains very low indeed. Similarly, the percentages of men choosing to move into nursing, early childhood education, or other historically feminised professions have experienced only minimal movement. This draws attention to the point that factors other than access shape the choices people make (Lynch 2007).

This leads to a third and highly influential framework for reflecting on the causes of, and best responses to, educational diversity: the socialisation perspective. This literature argues that it is not what children "are" (how they are born) that is the problem, nor the opportunities they have access to, but rather what they are made into (how they are taught to think, act, feel) which narrows and limits life choices and educational pathways (Booher-Jennings 2008). This can have a similarly demonising tendency to rampant essentialist thought by arguing that some groups are trained from birth to be lazy, anti-social, violent and so on. In this case the cause is social, not biological, but the social is seen as so pervasive and powerful that there is little hope for its effects to be interrupted. More positive readings of socialisation argue that in order to improve student outcomes or to change students' self perceptions we simply need to change how they are socialised: that is, we need to attend to the messages circulated by various agents of socialisation—schools, families, religious institutions, peer groups, the media and so on. This involves thinking about how we speak to and about particular individuals and groups: How do we engage them, what opportunities are they provided with? Strategies for reform, in this context, are based primarily on asserting the notion of choice: assuring children that they do not have to be limited by what society expects and that they have infinite options and possibilities ahead of them.

This plays out in multiple ways: We remove formal and informal barriers; we provide students with "positive role models" that demonstrate the multiple ways in which people "like them" are able to live and work. This is seen in everything from poster campaigns which argue that "girls can do anything" through to responsible drinking initiatives endorsed by high profile sports stars through to "real men say no to violence against women" programs. We encourage them to identify the existence and circulation of stereotypes which tell them how to behave and to display their ability to make choices.

Indeed, although socialisation frameworks emphasise the impact of diverse agents of socialisation on patterns and preferences they also emphasise the point that individuals have the agency to resist or reject the perspectives endorsed by these key structures. Although socialisation perspectives are often seen as more robust or sophisticated in terms of the issues with which they engage than liberal approaches that emphasise issues of access, there are certain similarities between the two. This is particularly clearly illustrated by the ways in which both frameworks can be used

to reduce complex decision-making processes down to the issue of so-called free choice. Socialisation perspective on equity argues for the importance of educating students explicitly about their right to choose (as opposed to the rather less pro-active access stand point which concentrates more on removing barriers than on educating folk about the lack of barriers) and supporting them when they do make their decisions. This choice-based framework can easily lead to teachers feeling that despite their best efforts students continue to follow traditional pathways. This can lead, in turn, to feelings of hopelessness and powerlessness. Ultimately, it can also lead to the belief that perhaps, after all, differences in interests, skills or preferences run deeper than we might have thought.

Indeed, although socialisation and deterministic frameworks are often represented in an either/or relationship to each other they frequently overlap, particularly where interventions have been introduced without noticeable success. I have recently worked on a research project which investigated the reasons why girls in Australian secondary schools were continuing to avoid enrolling in the study of information technology in the post-compulsory years of their education. In accounting for the low numbers of girls entering these fields of study (numbers that have hovered around 25% with-out much change for close to 30 years), participants in the program moved easily and effortlessly between essentialist, biologically based explanations—"I think it's just how their brains work," socialisation perspectives—"our parents told us there are no jobs so we don't do it," the assertion that students have free choice—"it is just personal taste…personal preference," and an acknowledgement that students who do choose to follow non-traditional pathways could expect at least some form of consequences: be it an awareness that their peers might deign to tolerate their choice, or exposure to forms of bullying and intimidation (for fuller discussion see Rowan and Lynch 2011). Socialisation perspectives place great emphasis on the individual. Access perspectives place great emphasis on structures. But both structures and agency are shaped at the intersection of multiple and competing discourses about what it means to "be" a particular kind of person (boy, girl, Irish, African-American) and what it means to "belong" to a particular group.

The socialisation framework, therefore, emphasises, at heart, the power of choice, and the possibility of free will. From this standpoint it is possible to make the argument that, provided overt barriers and obstacles are removed (i.e., if we remove any policy prohibiting full or equal participation, if we attend to any informal barriers (such as the timetabling of maths at the same time as drama), if we are alert and responsive to instances of overt or covert discrimination, and actively promote the legitimacy of diverse choices) then what is left is "student choice" and "individual preference." There is obviously an important element of truth in this. Left to our own devices or given "free time" most of us have clear ideas about what we would choose to do, and what we would prefer to avoid. Preferences, however, do not develop in a vacuum. Nor do the choices we make occur in any kind of fundamentally neutral environment (Arnot 2002).

Consider the simple case of Keyshawn, a 7-year-old boy in a combined year 3 and year 4 classroom. Having completed his prescribed narrative writing task he is allowed to choose a book of his own choice from the classroom library. The first

three times that Keyshawn has this opportunity he opts for a book in the popular *Rainbow Magic* series. The books in the series feature fairies, goblins and the villainous Jack Frost who is constantly outwitted by the intervention of the central characters. Keyshawn is obsessed with magic and loves reading about the Goblins. It is a series he has easy access to at home because his sister, Shae, has read them all and has more than 80 of the books. His parents are happy to see him reading anything because they know the importance of early literacy development to long term educational success. Keyshawn's choices, however, are met with raised eye brows by his teacher and by some laughs from the children on the reading mat. No-one says anything directly but the message is clear: Keyshawn is reading a girl's book. The fourth time he is given free time Keyshawn chooses a Goosebumps book which is both too hard for him, and too frightening. He doesn't really engage with the book at all. The time spent on independent reading is no longer fun. It is a chore to be endured.

Situations like this occur every day in classrooms around the world. Although we ostensibly live in a world that celebrates diversity and offers freedom of choice, that same world circulates, naturalises and, indeed, polices, very narrow and specific understandings of what is natural and normal for particular individuals and particular contexts (Rowan 2001; Rowan et al. 2007). Individuals who adhere to social norms have (at least potential) access to different kinds of experiences than those who depart from them (Dillabough 2003) and what is valued in one context may not be valued in another (Groundwater-Smith et al. 2006). The boy reading "boy" books may not experience explicit rewards but he is at least somewhat less likely to experience implicit or explicit criticism. The boy choosing the fairy books, by contrast, often does so in an environment which signals to him that his choice is actively wrong, or something that might be tolerated rather than seen as natural or normal.

The same kind of point is powerfully made by a 14-year-old boy who responded to claims that we now lived in a world characterised by diverse opportunities and free choice by saying "sure be what you want, do what you want, and spend your life in the emergency room getting stitched up." This vivid acknowledgement that choices come with consequences points to the complex range of factors that shape students' sense of themselves as individuals, as members of a group, and as learners. Differences, of course, interact with each other to produce quite individual experiences for children who ostensibly have much in common. Not all boys are treated the same way. An Indian boy from a working-class family who chooses to study ballet, for instance, may have a different experience to the white, middle-class boy in the same ballet class. Or he may not. Similarly, the overweight girl who enters a school talent contest may sing as well as the model-thin, cover girl who enters with her but will not necessarily be received in the same way.

In other words, although there are multiple ways to be a girl or a boy, to be an Australian, or Canadian, a student and a learner, not all the possibilities on offer have equal status or equal legitimacy (Epstein 1998). We might have choice, but the choices come with consequences in terms of how safe we feel, how validated we are, and how rewarded we might be.

This insight has informed a great deal of writing and analysis that draws upon the resources of cultural and post-structural theorists: the fourth framework for conceptualising educational justice explored in this chapter. This diverse branch of scholarship focuses on highlighting, in Gayatri Spivak's words, "the way in which cultural explanations are generated" (Sipiora and Atwill 1990). Authors within this space commonly argue that to fully understand the process through which individuals are positioned in particular cultural contexts we need to analyse the relationship between the individual and the social while paying close attention to the operation of power (Rowan and Lynch 2011). Thus attention is not focused solely on structural barriers and issues of access. Nor is the so-called free will or "agency" of the individual over emphasised. Rather, this framework attends to processes involved in constructing, circulating, naturalising or contesting meanings and the power of the various meanings in particular contexts. These resources generally understand seemingly "natural" behaviours not as fixed or biologically determined but as the result of "an ongoing social production…negotiated in many places across the social landscape" (McCaughtry 2004, p. 402).

The language associated with post-structural explorations of cultural norms has been critiqued for being obscure, overly complicated and difficult to "sell" or explain to non-expert readers. There is certainly an element of truth to these claims. However, as with most bodies of scholarship there is enormous variation in terms of the intended audience. Some scholars do not write for the broader education community, but some most certainly do. From these people we gain the following insights into post-structural perspectives on equity discussed in more detail elsewhere (Rowan 2001).

First: the meanings that circulate so widely in our world—what it means to be a good mother, a good learner, a good citizen—are *produced* and not natural. Thus, although members of one community might see and describe some behaviours as inherently masculine—reason, logic, aggression—these meanings do not exist in any *a priori* reality but have rather been constructed and naturalised for so long that they start to appear as natural.

This leads to the second key principle: meanings are produced in contexts (historical and social). Looking at the ways in which the concept of beauty is represented differently across time periods and across cultures makes it clear that highly influential beliefs—such as who should be regarded as beautiful—are not truths, but productions (McCaughtry 2004). Tastes change and vary from context to context. This reminds us that the things we may today see as normal could just as easily have been otherwise. Today, for example, girls with tattoos are often represented as attractive or sexy or independent. Twenty years ago a tattoo on a woman's body had a narrower set of meanings.

Here is the related third point: not all meanings in the same context have the same status, value or power. Australia represents itself as a land of diversity and a place that celebrates multiculturalism. The dominant imagery of Australian identity however—and the story telling about what it means to be "an aussie"—continues to privilege quite narrow and specific kinds of Australians with white, European, able bodied, Christian, financially secure sporting types being routinely celebrated more than those from indigenous, working class, or non-Christian backgrounds.

In other words, meanings about difference—about gender, class, culture—are connected to widely rehearsed and regularly repeated assertions about the way things "really are" and what things "really mean." The concept of masculinity, for instance, is produced through a network of related communication patterns—movies, songs and works of fiction; school assessment tasks and the curriculum of schooling; sports stories and advertisements; workplace cultures; jokes; playground bullying—that send messages about what it means to be masculine. No single message by itself—a single conversation, a single joke—is responsible for naturalising particular ideologies. Rather it is through a process of continual repetition that certain beliefs start to appear as natural, logical, truthful stories about the world and how it really is.

All of the points above combine to generate awareness of a fourth claim: If meanings are made, then meanings can change. One need only think about the huge shift in understandings about what a president or prime minister would naturally look like or be like that has occurred around the world in the past 100 years to recognise this point. This leads to perhaps the most powerful but commonly overlooked dimension of particular post-structural perspectives: the recognition that if meanings are produced then all of us—individuals and communities—have a role to play in naturalising or challenging particular meanings or particular perspectives about the world and the associated belief in the power of repetition (Rowan 2001).

Post-structural perspectives, then, enable the mapping of multiple and competing discourses about what it means to be male, female, Indigenous, European, beautiful, clever, responsible, moral, ethical and so on. However, they also remind us of a crucial fifth point: that changing meanings is never a simple matter of introducing a new version: The old stories and new stories almost always continue to compete for the attention and legitimacy of the population. In this context the story with the longest string of associations—the greater history of repetition—tends to appear more familiar, more reasonable, more logical. It is, by extension, often more powerful than newer perspectives.

There is, then, a strong educative function to every transformative agenda, as change is predicated not only on the introduction of new images of learners, but on the critique and contestation of what might have historically passed for "the truth." This process has been powerfully illustrated in various reform movements through the last century including the suffragette movements at the start of the twentieth century, the civil rights movements through the 1960s and the second wave of feminism. In each instance change was effected not only by asserting the right of individuals to free choice, but by showing the consequences and problematic nature of assumptions and practices that had long been seen as natural rather than produced.

The various perspectives on equity explored here point to the importance of adopting a multi-dimensional approach to educational reform: an approach that involves attending to issues of access and ensuring the removal of formal and informal barriers; introducing and legitimating multiple understandings of what it means to be a member of any particular social/cultural/political category—a girl, a boy, a learner and so on; whilst also ensuring that students are provided with skills that allow them to see how meanings are produced, how norms are policed, and that they are able to resist, challenge and transgress the roles they may be assigned.

This book is premised on the belief that all of these goals can be achieved via an approach to education that is centred on changing relationships between students, knowledge and their community. Transformative images of learners link the idea of a "good" or "successful" or "happy" learner to the identities of those often marginalised by these discourses. So projects may work to connect individual boys to literacy achievement; or to make links between indigenous students and mathematics; or to demonstrate ways in which students can combine areas that are often kept apart—such as science and English—in "meaningful" assessment activities. These new images of learners and learning (and the relationships they work to legitimise) do not come about as a simple result of the good will and personal strength of an individual teacher. Rather, diversity is legitimated through the daily, ceaseless repetition and celebration of diverse ways of being a good learner.

Everything discussed to this point, then, comes together to suggest not one, single, universally accepted way of conceptualising or enacting educational reform, but rather the value of particular kinds of dispositions: dispositions characterised by a suspicion of essentialist or essentialising claims; a recognition of the multiple ways through which seemingly natural meanings are actually produced and policed; and appreciation that things could always be other than the way they are in any social, historical and cultural context. This combination of beliefs characterises educators who are neither naïve nor nihilistic: people who understand the complicated issues with which they must engage, but who remain willing to have a go at working transformatively. This brings me to the final point to be made in this chapter: the importance (foreshadowed in the introduction) of an optimistic, but modestly ambitious, agenda.

Working Hopefully

The agenda for change outlined above has a large amount of optimism at its core. Understandings about the ways in which educators, schools and wider social systems can address long-standing and emergent patterns of educational and social disadvantage have developed significantly through the last century. These understandings have informed an enormous number of projects—big and small—in all manner of countries and contexts. It has also produced significant amounts of change. However, there exists an equally large volume of scholarship suggesting that an increased understanding of the complexity of the problem has not yet produced a corresponding reduction in instances of social and cultural alienation. Kids continue to fail. Schools continue to fail kids.

This leads to the inevitable point of how to continue to desire and work for change. And brings us to the important concept of educated hope: a belief that whilst a knowledge of what is going wrong is vital to any project of reform, a positive, future-looking disposition is just as (if not more) important. The concept of educated hope comes from the work of influential theorist Henry Giroux who claims that "educated hope provides a vocabulary for challenging the presupposition that

there are no alternatives to the existing social order" (Giroux 2003, np). He describes it as a language:

> of resistance and possibility, a language that embraces a militant utopianism while constantly being attentive to those forces that seek to turn such hope into a new slogan or punish and dismiss those who dare look beyond the horizon of the given. Hope as a form of militant utopianism is one of the preconditions for individual and social struggle, the ongoing practice of critical education in a wide variety of sites—the attempt to make a difference by being able to imagine otherwise in order to act in other ways.

Giroux goes on to make the point that:

> Educated hope also demands a certain amount of courage on the part of intellectuals in that it demands from them the necessity to articulate social possibilities, mediate the experience of injustice as part of a broader attempt to contest the workings of oppressive power, undermine various forms of domination, and fight for alternative ways to imagine the future. (Giroux 2003)

A similar sentiment is found in Stephen Hartnett's recent advocacy of the role that "joyful commitment" can play for those committed to social justice. Hartnett uses the term to describe an approach to social justice that asks us to be: "both radical in our demands and gentle in our demeanor, both outraged by inequality and oppression and joyous in our commitments to end them" (2010, p. 71).

In exploring this concept Hartnett (2010) makes the important point that "even as we tackle the day's pressing problems, we also need to find ways to not become consumed by those struggles. Indeed, we have all learned that the haggard activist, angry and enflamed, accusing others of their transgressions while embodying anxiety, achieves little, alienates many, and often succumbs to despair". For Hartnett the perspective of joyful commitment offers many benefits. It makes scholars more effective advocates by:

> enabling us to turn away from scholarship as critique and rejection toward scholarship as affirmation and empowerment; it protects us against burnout by enabling us to turn away from activism as anger and confrontation toward activism as fulfillment and solidarity; and it makes us better teachers by enabling us to bring into our classes frontline experiences that enrich traditional learning materials. (2010, p. 86)

Taken together, both Giroux and Hartnett remind us that commitment to social justice requires the capacity to not only critically analyse the world around us but also to re-imagine the role that schools can, might, should play in a changed, but unchanging, context. It draws attention to the need for educators to operate on multiple fronts: identifying the operation of power and the role that school plays in this; undermining various forms of domination; and identifying alternative ways to imagine the future: working, in Bigum's terms, on the edges and at the fringe.

There is an important additional point to be made here. Over the past few decades, issues relating to social justice have increasingly been associated with particular kinds of educators holding particular kinds of political (left wing? extreme?) views. Social justice debates have also become something of a minefield with people frightened of upsetting either the "mainstream" or the "minority." The common, damning, cry of "political correctness run amok," which is all too often directed at initiatives that attempt to respond to the diversity of a particular group, has fostered

a certain degree of caution in many educators who lack both the time and the energy to cope with vitriolic or sarcastic commentaries on their well intentioned ideas. If we are to return social justice to the core business of education it is necessary for the kinds of transformative agendas associated with educational reform to be conceptualised as part of everyday life, rather than some optional, additional, burdensome extra chore. To this end it is equally necessary for us to recast the pursuit of educational justice in terms that allow it to be seen as fundamentally doable, achievable and realistic. More than this, it is vital for us to recognise that real people, in real conditions—people who may never, in fact, have heard of any of the approaches to equity-based reform outlined in this chapter—can, must and *already do* work in a range of day-to-day ways to create new relationships between diverse students and knowledge. Perhaps our most important task, therefore, is not to exhort educators to work better or harder in their pursuit of social justice, but to shine a light upon what is already done in order to demonstrate that teachers already have the kinds of skills and dispositions which will ultimately lead to change.

The chapters included in this book, therefore, work to illustrate—to spotlight—some of the multiple ways in which real educators and real students have worked together to disrupt some of the common patterns associated with educational success and failure. They have employed different and differing techniques to generate distance from taken-for-granted, naturalised and normalised pedagogical and social practices and then used the space that opened up to introduce, legitimate, celebrate and normalise new relationships between students, schools, technologies and knowledge. They move from working traditionally to working transformatively.

This is an important distinction. Traditional texts—be they books, classrooms, curriculum documents, pedagogical approaches or assessment regimes—are those that produce and naturalise narrow and restricting images of difference. They are often characterised by limiting, negative, stereotypical or tokenistic images of diversity and celebrate very homogenous, restrictive, predictable portrayals of individuals and groups. Traditional texts perpetuate cultural beliefs and stereotypes that align some characteristics (e.g., being male or thin) with some attributes (e.g., leadership, or power, or beauty) and other characteristics with different kinds of attributes. People from low-socioeconomic backgrounds generally feature in newspaper stories only as "victims" or criminals. Some people are included. Some people are excluded. Some people, when included, feature positively. Other people, when included, generally feature negatively. Traditional texts and contexts offer rewards and validation to groups who match wider cultural and social mythical norms. These are the mechanisms through which narrow and limiting behaviour are expected and rewarded. Pretty girls are regarded positively. Aggressive and active boys are seen as natural and normal. Families with social, cultural and economic capital are valued and celebrated. The patterns are familiar to anyone who has ever looked carefully at the kinds of imagery and behaviours routinely trotted out for us to admire and emulate. Movies and TV shows celebrate the bravery of white male able-bodied heroes and the beauty of white female able-bodied heroines. Villainy and betrayal are continuously linked to non-European characters, sexually assertive women, characters with some kind of physical deformity or, of course, an anti-American way of life.

Transformative texts, by contrast, introduce and validate difference as multiple and positive and also work to make explicit the limitations that traditional texts place on all of us. Transformative texts include, value and celebrate multiple ways of "being" and bring together bodies and qualities commonly kept in opposition: so a nurturing male; an intellectual woman; a heroic indigenous Canadian; a working class boy who loves ballet; a 1940s housewife who plays professional baseball; a father who stays at home. Transformative texts go beyond stereotypes and tokenistic inclusions to genuinely celebrate multiple ways of being a woman, a man, a citizen, a hero, a politician, a wife, a student and a learner. They are texts which undo the power of routinely naturalised understandings by taking a "both/and" approach to representing identity: We can be both a boy and a reader; a girl and a football player; an Indigenous Australian and a lawyer.

In relation to schools and technology, transformative texts are illustrated in the previous chapter by cases where educational projects have been able to bring together groups and practices routinely kept apart by the boundaries drawn by geography, money, or time. Connecting children in India with resources to allow them to ask questions and get answers is a transformative practice (see Chap. 3). Connecting children in after school tutoring labs such as 826 Valencia with experts who work, in turn, to provide students with a chance to conceptualises themselves as actual, successful writers involved in the production of legitimate texts is a transformative practice (see Chap. 3 for discussion).

Given the complexity of the world in which we operate it is possible for a text or context to be transformative in some ways but traditional in some others. Every context needs to be read in terms of how it represents and responds to a wide range of differences—age, gender, socioeconomics, physical ability, religion, culture, language, sexuality and so on. This reading can be facilitated by the use of some key questions:

- Who/what is included/represented or excluded/not represented?
- Who/what is valued or devalued? How do we know? Who gets to act independently or with authority? Who is positioned passively? Who is rewarded? Who is punished? Who has the most freedom? Who is constrained?
- Who/what is represented as natural/normal and, by extension, who/what is represented as aberrant, deviant, unnatural or "other"?

In the context of educational equity and technology, transformative texts create positive relationships between those kids often positioned on the margins. They allow children who may not match the "mythical norm" of the "good student" to experience success; to attract positive attention; to be recognised and valued for what they bring to a project. Central to this series of questions, therefore, is a focus on the extent to which we reproduce new or old relationships: relationships between kids and knowledge; between kids and their community; between kids and each other; and between kids and possible futures.

The chapters that follow outline a range of ways in which relationships have been changed by work undertaken at the edges of schooling. There is a final point that needs to be made here. Talk of imagining or re-imagining possible futures in

which diverse learners are positioned in a positive relationship with knowledge can easily generate the impression that we are working towards or interested in some enormous educational revolution: a reconstruction of the system of schooling and its underpinning approaches to curriculum, pedagogy and assessment. To some extent this is, of course, quite true and this is certainly the aspiration that underpins some of our claims. The contributors in this book share a strong desire to see schooling—at all levels and in all locations—done better and in ways which meet the needs of far more students. On the other hand we also argue that revolution is not always about the grand gesture or the dramatic act. Nor is change necessarily signaled by fanfares or protest marches.

I have argued elsewhere that the most powerful means through which narrow and limiting understandings of particular groups or individual become natural is repetition. Bigum makes this point powerfully in Chap. 3 when he talks about the ways in which so much contemporary practice is constrained by the pathways taken by others who went before us: we follow in their footsteps because they point us to what is, ultimately, a vastly easier path to take. Conversely, speaking back to dominant discourses about schooling is as much a process of repetition as it is a process of innovation. Indeed, innovation from my perspective relates less to the originality or strangeness of an idea or practice and more to the ways in which it helps to disrupt patterns and beliefs that have been resistant to change. This point has been made repeatedly by scholars committed to the contestation of dominant stories about education and society. For example, Trinh Minh-ha in 1990 described that displacement of mainstream practices that can come from repetition:

> By questioning over and over again what is taken for granted as self-evident, by reminding oneself and the others of the unchangeability of change itself. Disturbing thereby ones own thinking habits, dissipating what has become familiar and clichéd, and participating in the changing of received values—the transformation (without master) of other selves through one's self. (1990, p. 332)

The final point to make, therefore, is this.

Things need to change. So does the way we talk about change. Debates or discussions about the key terms at the heart of this book—information technology, social justice, educational futures—are rich with metaphors of revolution and transformation; innovation and cutting edges. Emotive and powerful terms such as these can have the unanticipated consequence of alienating and demotivating teachers who are already struggling under the weight of ever increasing public scrutiny of what they do, and how they do it.

It is possible and productive to use the perspectives offered by educated hope and joyful commitment to imagine educational possibilities and transformative practices. It is similarly possible for these imaginings to be small scale and modest. We proceed in the chapters that follow from a belief that ultimately it is the repetition of small-scale interventions—the ceaseless introduction of difference into environments skilled at returning to narrow and limiting understandings and practices—that may lead us into a future characterised by multiple possibilities and diverse ways of being not just a "good" student, but also an effective, happy, productive learner well beyond the boundaries of the classroom.

Taking up a modestly ambitious perspective, however, does not equate to a lowering of standards for equity-based initiatives. Quite the opposite. It supports the development of interventions and educational practices that demonstrate familiarity with the long and complex history of equity-based educational reforms and which are therefore well aware of the value of small, targeted and strategic interventions. In the chapters that follow diverse educators in diverse contexts illustrate the ways modest ambition shapes educational practices that, considered together, have the possibility to disrupt the traditional relationships between schools, technologies and learners and to contribute, by extension, to the creation of learning opportunities that work to future-proof students in diverse, multiple and responsive ways.

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Part II
Futures Oriented Classrooms

Chapter 5
Things That Matter: Student Engagement and Technologies in Knowledge-Producing Schools

Carmel McGrath and Leonie Rowan

Introduction

There are a number of important questions at the heart of this book: What is the purpose of schooling in the twenty-first century? How has this purpose changed since the current model of schooling emerged? How should, and to what extent can, schools adequately prepare children for an unknowable future? What role can technology play in a future-focused educational agenda? Who wins or loses from our efforts in education? And, perhaps most importantly of all, how can real educators make a real difference, to real children, in the complex real-world conditions within which our work is situated?

Any one of these questions is enough, individually, to keep anyone awake at night. Taken together, they generate both a sense of disquiet and a desire to actually do something different. This desire for change has been the basis of a sustained conversation between a group of educators in Australia for the last 10 years. As we have faced the daily challenge of deciding what to do with our students – be they in schools or in universities – confronted depressing data which indicate that some kids continue to do better than others, and encountered teachers who no longer really believed that schools were places for social transformation, our discussions about what to do now, next and into the future lead us to explore new ways of thinking about education.

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Underpinning many of our discussions is the recognition that in a world of change the functions and structures of schooling remain frighteningly constant. This is despite appearances to the contrary. Certainly there has been an increase in surveillance, testing and reporting. Curriculum has been constantly and publically reviewed. But these visible signs of "reform" are not to be mistaken for any actual innovation within schools. Rather, the endless reviews and constant scrutiny have helped to naturalise approaches to education that are frightening in their allegiance to a "back to basics" approach to educational crisis, consistent in their optimistic belief that technologies will solve what ever challenges arise and depressing in their lack of creativity.

Some other questions emerge. What if schools were (allowed) to be re-imagined? What if they were (able) to be re-purposed? What if we could let go some of our most entrenched beliefs about how kids and schools and teachers should act and move to ask "what if"? What if no one had ever seen a school before: What would it look like? What would we do? Could we then stop trying to dumb down the world to make it fit into schools? Or could we perhaps make schools fit the future?

There are a great many "what ifs" outlined here and it is easy to read the list as an implied critique of the previous and current work of educators. After all, teachers are easy targets. But this is not our intent. The world is full of committed passionate teachers – from childcare through to adult education – and most of them deserve our respect. So our list of "what ifs" does not signal a chapter that is focused on sniping at those on the front line. Rather, the chapter is designed to recognise that there may be more that can be done to prepare diverse children for diverse futures and to close the gap between those who win and lose at school. In Australia, for example, national testing of primary school students suggests that more than 10% fail to reach literacy and numeracy benchmarks in year 3 (Gillard 2009). This is worse for some children. Fifteen percent of children in remote areas, 22% of Australia's Indigenous children, 38% of children in very remote areas and 38% of students from low-socio-economic families consistently fail to meet national and international literacy and numeracy benchmarks (MCEECDYA Senior Officials Committee 2009).

The consequences of educational failure are, of course, well documented (see for example, Hudson et al. 2009; KPMG Foundation 2006). Success at school supports engagement, school attendance and literacy and numeracy achievement. This, in turn, is positively correlated to retention at school and the transition into employment and higher and further education. Educational level is connected, in turn, to a range of income, health and wellbeing measures.

It is in this challenging context that a collective attempt to imagine, describe, pursue, experiment, create and enjoy different ways of "doing school" has generated an approach to education known as Knowledge-producing Schools. The Knowledge-producing Schools (or KPS) agenda is characterised by a range of beliefs about and aspirations for schooling. The goal of this chapter is to outline the key principles which underpin the KPS project and to illustrate the ways in which these principles shape positive and, indeed, transformative teaching and learning initiatives. Importantly, these transformations do not take place in idealised, perfect settings filled with designer-learners and all the latest technologies. Rather they are

the product of positive and creative relationships between diverse teachers and diverse kids in very typical publically funded schools in Australia. As such, they provide excellent examples of how the concept of "modest ambition" introduced earlier in the book translates into excellent pedagogical practices that are centred on the importance of relationships.

A Starting Point: Towards Knowledge-Producing Schools

So what *are* Knowledge-producing Schools? Growing out of the writings of Australian scholar Chris Bigum, the KPS agenda offers one way of responding to both what has changed, and what has not changed, in the contemporary educational landscape. The core feature of KPS projects is a commitment to disrupting the traditional relationships that underpin so much of contemporary and past school practices. This includes relationships between schools and knowledge, between schools and teachers, between teachers and students and between students and their community. Historically schools (and students) have been positioned as the passive consumers of other people's "expert knowledge" and as only distantly connected to their community. This results in educational practices which are designed to help kids become good at "doing school" (as judged by people within the system) rather than helping them become confident at "doing life" (as perceived by the wider community).

The starting point for the knowledge-producing school, then, is the belief that we must reconceptualise the relationship between students, schools, communities and knowledge. This means seeing students not only as the consumers of curriculum prepared by others, but also as able, confident, capable *producers* of knowledge: knowledge, moreover, that is valuable to, for and within communities that exist beyond or across school boundaries (see Bigum 2000a, b, c; Rowan and Bigum 2010).

Within the KPS framework, teachers proceed from the belief that all students – regardless of skills, background or prior history – *can* and *should* be meaningfully involved in the production of knowledge. This is achieved through work on what KPS projects position loosely as authentic or "real world" tasks relevant to the worlds inhabited by the students. This raises questions, of course, about what counts as a real-world activity. Setting aside all our scepticism about the idea that there is ever any single reality that can be accessed by all people at the same time, we are referring, here, to activities that produce some kind of product – be it a discussion, a story, a plan, a project or a product – that can be externally validated and which thus forms a bridge between school and not-school. These authentic tasks and real-world projects allow students to recognise and respond to the needs, desires and priorities of particular communities and, of course, to their own interests within those communities and to use technology appropriate to the task.

There is no size limit or minimum scope for these activities. They can be enormous and designed for audiences of thousands (such as videos prepared for

an anti-drugs campaign), or they can be very local and designed to meet the real-world needs of a handful of children (such as a fund-raising event for a local child utilising word processing). Scope is not the issue: What is most important is that children are involved in an activity which *they* care about and which *others* care about. It is a connection that brings them into relationships with diverse people in diverse locations and offers them support and feedback that extends well beyond that on offer in the standard classroom environment.

The notion of connectedness (and the feedback it produces) is central to KPS projects. It is common for students in schools to work on projects that are seen only by a teacher, and, occasionally by a caregiver or family member. These kinds of tasks generally have no currency beyond the school walls and, in terms of feedback, receive, at best, the kind of "well done" applause that parents have long been offering to the wobbly pottery pots and biographies of famous individuals that schools require children to produce. KPS projects, by contrast, endeavour to ensure that the product is something *someone outside the authors of school curriculum will care about*. The aim is to see that out of every period of education – be it a week, a term, a year – a product is produced that is in some way meaningful to others beyond the school-child-family triangle. This could be other children, members of a particular community group, or on-line audiences. The specific audience (or, again, its size) is not the issue. Rather the key point is that a KPS project will connect students to some kind of community which exists independent of schools: a community that operates beyond the school walls and which provides students with opportunities to receive both guidance or support during the course of a project (in conceptualisation, design and implementation phases) and feedback at the completion of the project.

There are obvious resemblances between KPS projects and those advocated by other educational thinkers. Fred Newman has argued for the value of "authentic tasks" and "authentic pedagogy" providing students with the opportunity to work on projects "that are worthwhile, significant, and meaningful, such as those undertaken by successful adults: scientists, musicians, business entrepreneurs, politicians, crafts people, attorneys, novelists, physicians, designers and so on" (Newmann 1996, pp. 23–24). This work has had international impact and shaped the productive pedagogies movement that was popular in Australia during the early 2000s.

Of course, well before the work of Newman and his associates became popular Célestin Freinet outlined an approach to pedagogy which was premised on similar principles. Freinet emphasised:

> The pedagogy of work wherein students pupils were encouraged to learn by making products and providing services. He emphasized the value of enquiry-based and cooperative learning; taking children's interests and curiosity as the starting point for projects; the value of the "natural method" which involves authentic learning through real experiences and principles of democracy, as children learn to take responsibility for their work, and, indeed, for the community through processes of democratic government. (Monthubert n.d.)

And of course, many progressive education projects throughout the world have sought to engage one or more of these agendas.

With the emphasis on real-world tasks, community connections, authentic feedback and the production of knowledge, the KPS framework offers a new lens for conceptualising and reflecting upon transformative educational projects. In regards to our particular educational activity we aim to reflect consistently upon the following questions:

- Are students positioned as the producers or the consumers of knowledge?
- Are students able to produce products with a genuine purpose and value beyond school assessment regimes?
- Are students positioned as active or passive?
- Are students provided with a real-world audience?
- Do all students and all forms of knowledge have a chance to be valued?
- Does this audience facilitate their connection to a broader community? Is this community involved in the actual learning process?
- Does the experience create positive relationships between diverse children and knowledge? Between diverse children and the community?

These questions provide valuable reflection points – self-evaluation tools almost – for those working on KPS agendas. However, within these broad parameters schools implement KPS projects in a multiplicity of ways depending upon their analysis of where students, teachers and the community are at: what are their existing strengths and weaknesses; what are they interested in and motivated by; what are the hot topics and passions; and what kinds of community and other resources do we have access to?

Every KPS journey is different and students and teachers and the communities with which they work are *all* always learning. Gone is the positioning of teacher as all-knowing expert, and student as neophyte and apprentice. Gone is the notion of schools as places of expertise and "solutions" and community as the source of critique, distraction or problems. Instead the KPS framework works to generate and sustain new relationships between the key variables outlined above: schools, students, families, communities, knowledge and possible futures.

The rest of this chapter tells the story of one group of teachers and a principal who have been working with the KPS framework since 2002. We outline three different KPS initiatives and seek to draw attention to the way particular teams enact KPS in different ways whilst staying focused on the long-range goal: the creation of learning environments that are truly innovative in the ways they offer diverse children the chance to experience success as learners – and as citizens for the future. We use the term "innovative" here to signal, not simply something that looks different, or new, or technologically mediated but, rather, practices that seek to change long standing, entrenched social patterns. Rowan (2007, p. 128) has written elsewhere:

> the label 'innovative' might now be most meaningful to educators if it was applied to those processes, products or interventions that have changed in some way the precise 'things' that have historically proven *most resistant* to sustained, sustainable change. To be 'innovative', in this sense, would require not only (nor even) some of the more traditional hallmarks of innovation—chronological 'newness', the addition of technology, or the creation of new market opportunities—but rather some fundamental transformation, interrogation, or interruption of long standing patterns of educational access and success.

A Beginning

Silver River State school is located in a remote part of North West Queensland in Australia: a 10-hour drive from the nearest metropolitan centre and more than 15 hour away from the state capital. Back in 2002 the Principal of Silver River State School, Carmel, became interested in KPS projects after discussions with Chris Bigum.

She was particularly optimistic about the possibilities KPS seemed to provide regarding increased student engagement and began by looking out into her community for "real world," authentic tasks that could form the basis of a trial for the KPS agenda. An opportunity soon emerged. The local State Emergency Service (a volunteer-based organisation who provide emergency support to the community in times of crisis such as fire, or flood, lost hikers and so on) wanted to know what the people in the community actually did or did not know about the role of the SES. They hoped that the school could help them collect this information. As a first move Carmel met with an SES representative and then spoke to interested teachers about the ideas and task. Two teachers volunteered to take this on as a KPS pilot project and a meeting was set up between the SES representative, teachers and (importantly) a few students. The inclusion of the students is, in itself, an indication of an alternative approach to planning for these are the people who are most often excluded from planning stages of key educational agendas and positioned, as outlined above, as the passive beneficiaries of other people's wisdom.

At this meeting the small group discussed the challenge and plotted ways forward. They explored possible steps to be taken, how progress would be communicated, and what a final product or outcome might be. The next step was for the lead group to then take this information and ideas back to the class. Working together the class brainstormed a series of steps to be taken. First they needed to research all about SES, before inviting an SES representative in to ask clarifying questions and gain ideas to formulate the community survey. Positioning or recognising the SES as external experts meant that teachers and students were all positioned as learners. One student commented on the very positive nature of this joint learning: "Teachers had to ask questions too 'cause they didn't know either."

Indeed, right from the very beginning students were given the opportunity to become leaders in terms of the information they uncovered and the technology they used to manage and present it. This gave students early opportunities to experience success. One of the Year 5 students was able to show a range of very positive research and enquiry skills that really changed how staff and students had previously perceived him. This student enjoyed the idea of creating a real product but enjoyed even more the learning and interaction with community personnel. This student ultimately was proud to present the work of the class at a Principal's Business Meeting and spent several hours preparing a very well-polished talk without any of the traditional scaffolding provided by teachers.

This sense of ownership and level of engagement was widespread. Indeed, from the outset the teachers were impressed with the energy and motivation all students brought to the task of developing, collating and presenting survey data. One of the

really significant features of this – and other KPS projects – is that skill sets are developed naturally rather than artificially. That is to say: As students identified the next phase of their project work, they identified the skills they would need, and the class evolved to provide those skills. For example, when the SES asked the students to email them and suggested that the final product could be done as a powerpoint presentation or something similar so that the data could be shown pictorially or graphically, the teaching of email and Powerpoint was then planned and taught to students. In this way the introduction of particular skills was purposeful and meaningful.

When asked to reflect on the SES unit the students told their principal, Carmel, "We liked learning about the SES," "It was good interviewing people," "We did all the work ourselves," "The teachers had to ask questions too," "I think different to others about things" and "We got to work with people (referring to other students) that we don't normally work [with] and that was good" (notes from observation and reflection scripts).

Indeed, the student feedback was overwhelmingly positive. They loved working on a real task for the SES and were incredibly self-motivated to undertake what could easily been seen as the tedious tasks of writing surveys, sending them out, chasing people up for them and then collating the data. The students said they enjoyed this unit far more than any other unit that year, which certainly surprised the teachers. Interestingly, the teachers involved said they thought students would have rated a previous "gold mining" unit higher because of the hands-on fun of digging for gold in the classroom mock gold field. However the students overwhelmingly preferred the SES project. This raises an important point about the positive impact on student engagement of a real-world, authentic product. Involving students in fun gold mining tasks creates the kind of simulation of a real-world task that is common in schools. However, there was no real audience and no authentic product from a day spent digging for pretend gold in a pretend environment. The SES program, by contrast, produced a tangible, validated and valued resource which students could recognise as making a genuine – rather than make-believe – contribution to the community of which they were a part.

This validation was readily provided by the SES who were both impressed and surprised by the findings and the manner in which the on-going communication updates and final presentation were completed. The Year 5s information package, including CD and hardcopy of results, was used by the local SES to seek additional funding from their state body. This funding was used to promote a local awareness-raising campaign and the students were very proud of their contribution to this outcome.

This brief story gives an indication of the potential for KPS projects to improve engagement and, thus, skill development across a group of students. Central to the project's success was the teacher's willingness to hand over considerable authority and expertise to the external experts and the students: who together became creators of new, valued knowledge.

This provides an indication of the potential of a KPS project. As mentioned at the start of this paper, however, one of the key agendas for KPS work is improving

educational experiences, pathways and outcomes for *diverse* learners. This means being aware of and attending to the particular educational needs of students who may be at some risk of disengagement, alienation or failure without, of course, compromising the educational experiences offered to the student group as a whole.

The next two stories focus on projects that evolved to cater for the needs of particular cohorts of students.

Another Stage: In the Mines

This next KPS example illustrates the potential of KPS projects for connecting disengaged students, families and learning. It is based on the story of Jackson, a Year 4 student at Silver River, who was not meeting year-level benchmarks in any area. Teachers described him as often disruptive during lessons and attention seeking: a bit of a "class clown." Jackson had also been suspended for fighting and showing aggressive, defiant behaviours. He was, nevertheless, liked by other boys in his class but neither he nor his peers saw him as particularly good at "doing school." He was described as looking sullen in class and seemed reluctant to engage in conversations about his work. Jackson's parents, however, were keen for him to do well and they were always responsive to school-requested interviews and involved at other more traditional events such as sports day. Jackson's dad was a shift worker and it was often his mum who came to school if there were any "issues" to deal with. Outside these formal, scheduled events, however, they had little opportunity to connect with the school.

When Jackson's teacher noticed that he and his group of friends were interested in trucks and mining work, she decided to try to pursue this interest with them through the development of a unit focused on local resources. As she noted in her reflections on the project, she saw the possible connection between real-world interests and classroom engagement… "I thought this might [help] getting my hard-to-motivate boys interested – they like trucks, machines – they see it as relevant because most of them say they want to work in the mines when they're older."

The activity developed in multiple ways. As part of a "free time" activity within the unit, Jackson had started to build a small-scale replica of the underground mine. For many teachers this kind of work would be seen as an optional extra: a kind of creative add-on to the "real work" of learning about local resources. For the teacher, however, it was the kind of opening needed to improve the relationship between Jackson and learning: and to let him see himself as good at applying knowledge. Jackson began to talk to his family about his project and one morning after night shift, Jackson's dad came to the school, at his son's request, to visit the classroom and see his son's construction. Rather than seeing his arrival as an unscheduled interruption, an interpretation that would occur often in schools which relegate parents very much to the background, the teacher actively welcomed his visit and observed that the conversation between father and son about the replica was operating at a very technical level. Suggestions were flying back and forth about what was right and what needed to be added and so forth.

This opportunity created a bridge between Jackson's in-school and out-of-school worlds. It helped him see himself as competent in both domains and allowed his real-world audience – his father, a mine expert – to give him feedback that was authentic and valued. This was a specific goal for the teacher who later reflected on the value of "… utilising parents and community members as experts (especially dads because the students look up to their dads and if the dads are helping them and showing interest in their schoolwork then so will they.)"

Following the work in this unit Jackson's dad became more involved in his son's work at school and developed a good relationship with the teacher. This change had further flow-on effects. Jackson was an enthusiastic leader, especially among other boys in the class, and this generated a great deal of spontaneous encouragement by other students designed to get *their* parents, particularly dads, involved with the project.

This illustrates perfectly the idea of modest ambition. Jackson was a child who had learned to see himself as bad at schoolwork. As a result of the teacher's willingness to pursue her children's interests and encourage genuine partnerships between home and school – partnerships where the parents were seen as expert contributors to a unit of work rather than simply the audience to whom students present – Jackson was able to make the move towards seeing himself as a good learner. Perhaps not surprisingly teachers soon saw a significant shift in Jackson's attitude and mood. Teaching staff suddenly saw lots of smiles and he was also keen to share his work during the Principal's class visits. One day he actually grabbed Carmel, the Principal, by the arm and asked her to see his work! She noted: "How could I not go and spend the time to look and listen to his sharing. This is what it's all about! Teachers making the connections between family, interests and learning."

This connection was made possible because of the teacher's belief in positive connections with the community and willingness to let children use technology that was appropriate, no matter how modest or grand. During this unit many of the dads came on a regular basis to the class and at all sorts of different times that did not match nicely with the school day: often before or after shifts, and this often meant students were voluntarily working on their projects before and after school and at lunch times. There is a pattern of behaviours that teachers observe consistently during KPS projects: students' sense of ownership, an awareness that people other than the teacher will care about the product and a consistent engagement, enthusiasm and commitment to the task. All of this, in turn, improves achievement.

There is a point to be made here about the willingness of the teacher to let go of certainty and to embrace the unknown that is always associated with KPS kinds of projects. The teacher could have, at any time, turned away from embracing a unit of work that messed up a carefully planned timetable, disrupted scheduled lessons, and was, in essence, evaluated by folk other than school staff. But this did not happen. Rather, this teacher exemplified the KPS mindset of keeping the destination in mind, rather than obsessing over adherence to a pre-planned course of travel (McGrath 2010).

A similar flexibility is seen in another KPS story.

Me, Myself, I

This memorable KPS unit involved a focus on fostering opportunities for young Indigenous writers to produce narratives with the theme "Me, Myself, I" for a writing competition. The teacher negotiated a plan with Indigenous Elders and families through a local Indigenous Education Worker. Here, again, the willingness of the teacher to move away from certainty needs to be acknowledged. During an initial meeting between the Indigenous Education Worker[1] (IEW) and "Aunty M,"[2] the Indigenous students and families who were appropriate to be involved were identified and the project teacher was advised which students could be invited into a "storytelling day." The teacher had envisaged the Elders coming to school, telling some stories and getting the kids started on their writing. But as it happened the Elders would not hear of the storytelling being done at school and, instead, a visit to a significant local storytelling place was organised. The teacher recalls:

> Aunty M thought we should go out to Sybella Creek, they came up with who would tell the stories … Aunty M wants us to sit under a Gidgee tree and boil a billy… Go to a place, see a waterhole that never dries up and she says this place is the life blood of the people that were living there.

At this early stage the teacher expressed a concern that he was "losing control" over the work. Despite his unease, the teacher did not change the Elder's plan or reject it or try to impose limitations or structures around it, but rather made adjustments to his own plan and ideas to incorporate the "bush day" into the project.

The organisation was predominately done by the Elders but some of the technical and logistical aspects, such as permission slips and risk assessments, were done by the teacher. The teacher told Carmel "Aunty M worked out the kids and when I rang the families they also asked who was going and would be telling the stories before they gave approval." His comment highlighted his acknowledgement that the "Elder's knowledge" about protocol for family groups for storytelling and visits to certain "places" gave him a valuable insight into what parents thought was important in this situation. Permissions were granted.

The day was a mix of oral storytelling about childhood experiences, storytelling about rock paintings, storytelling about the children's families and great experiences while walking among the rocks of the creek bed and eating bush tucker prepared by the Elders. Through this experience the multiple worlds inhabited by the students were connected: They acquired new knowledge, saw their cultural background validated, and communicated their new knowledge – via authentic conversations and creative stories – back to the authentic audience of Elders and,

[1] IEWs are staff employed in schools to support the learning of Indigenous students and also to foster meaningful links between schools and Indigenous communities.

[2] In much of Australia the terms Auntie and Uncle are increasingly used to refer, with their permission, to Indigenous Elders.

as well, the teachers who also became learners. One brief exchange indicates the growing confidence of the children:

T1: What would you do now like with a sheep or whatever?
E1: See that Gidgee there, that Gidgee leaf, chuck that leaf on the coal there and that kangaroo, bit a kangaroo meat. That's the flavour. That's the Gidgee leaf.
T1: So put the green leaf on top of the coal and then…
E1: Yeah but not that green pod there, that's poison.
E4: You'll smell it?
T1: Oh yeah yeah. I can smell it.
E2: Yeah it kill a bullock that one.
T1: Oh.

Back at school the students had a great foundation and shared experience from which to draw for their narratives. The first drafts were done quickly. From this the teacher then taught some very focused elements that would improve the student writing, such as grammatical features and skills of expanding description through nominal groups. These potentially "boring" lessons were made meaningful through the rich experience where the students had really connected with their land, their Elders and their stories. Ultimately the students' work was not ready for the competition that had provided the impetus for the project, but this was far less significant than the fact that the students had an authentic audience from their own community. They got to enjoy sharing the narratives with the Elders who returned to listen to the completed stories. This opened up further points of connection. The teacher reflected that when he talked to the families and Elders about the storytelling, one grandfather said "That's good because I can show 'em the rockpaintings. They tell stories too."

Topics selected by children were significant to them for different reasons, including the fact that the stories were relevant to their family and community. One student returned from the adventure ready to tell the story about how he got his nickname "The Wag Tail" from his grandfather.

Willie Wagtail

Back when I was a little child, my grandad was cooking up eggs when my grandad woke me up and said, "We have to go to the last trough and fix it or the trough will keep leaking and it will break." When the trough breaks Mavis will be angry at me because this is her land.

So grandad and I were trying to fix it. As we were trying to fix it all the cows were watching us fixing it because I could see them real thirsty. All the pigs, the horses and the cows were lying down watching us trying to fix the trough. It took us about an hour but we still had fixed it.

Then I told my grandad that I was going to get a drink of water from the clean big tank we had. After my hand was full of water I told my grandad that I was finished getting a drink. So grandad and I were heading back home to Rocky Glen. While we were heading there, we saw the Willie Wagtail was flying next to us the whole way back.

That next day when grandad was packing up to go, we saw the Willie Wagtail again. So my grandad went up to give the Willie Wagtail a piece of meat that we had cooked last night.

> Then we cruised back to town and we saw the cows and pigs and horses drinking out of the trough that we first fixed while on the way to Rocky Glen. We then moved to town and we saw him again just before we hit the road. I said "Grandad, I reckon that little Willie Wagtail is smart." And now every time we go out to the Rocky Glen we always see a little bird next to us. And that's where we met the wagtail.
>
> The end.

Another student wrote about a family funeral she attended; her story was inspired by memories of her family and family connections in both Queensland and the Northern Territory. After many years away in a coastal location, her story was about re-connecting and developing a sense of family, a sense of identity.

Another student wrote a story about a boy who hunted goanna and was taken by a man whose "skin was different to his; he thought it was a ghost." This story was inspired by the boy's interest in hunting, and ideas and tales about his grandparents and from his aunty. This student had spent a number of years living in a coastal location and only recently returned to this area. He told Carmel:

> Yeah (this way of learning is) a lot different because back in (named another place) we never got a chance to go out bush. Yeah I really enjoyed it. … I'd actually like to go and hunt something and then we could cook something and sit around and tell stories.

There are literally dozens of stories of KPS initiatives that have developed throughout the last decade. Throughout these stories the participants and projects can vary dramatically but the recurring themes are:

- Student appreciation of tasks that are based upon their interests
- The value of a real-world audience
- The connection between a task that students regard as authentic and student engagement
- The challenge – to teachers – of letting go of total control and allowing other people to take up the role of expert
- A genuine sense of momentum
- The potential for robust KPS initiatives to provide multiple ways for students to contribute and thus multiple ways for diverse learners to achieve success

Teachers working within KPS contexts regularly make reference to the children who had been disengaged, alienated or struggling learners who found new levels of commitment when given the opportunity to be good at something they were passionate about. Sufficiently robust tasks also provide spaces for kids who may struggle with some aspects of schooling to see their particular talents validated and valued. For example, when one teacher was asked if there were any particular students who had surprised her during another KPS initiative based on developing a community art competition designed to raise funds for charity, she made the following comments:

T: I think the children have a respect for John, John is always needing learning support in the classroom.
R: Are you saying a new-found respect?
T: There's an acknowledgement of the fact that John knows some things and has the skills that the others don't… it's great for him.

R: What do you think those skills are?
T: Just on an artistic level, he's got a great sense of composition and colour knowledge. And just the process of doing all those fine cuts and gluing them down, and that with me just saying one thing and then John goes and does it all and directs all the others (students). Communicatively it's helped him because he's had to be clear on what he's saying and he has this real product he needs to get to, and he's got to get it done. And that's really improved since term 1 or 2 if you asked him to repeat himself he would just go 'ah' and get someone else to say it for him. So he's been more expressive.

John is not an isolated case. Another teacher told Carmel she had noticed a change in another student—Peter's—attitude to writing. She said that Peter had become more positive; he was doing project and other class work without teacher prompting and was writing at length, as opposed to previously when the teacher felt compelled to prompt this student for "each paragraph" at writing time.

When Carmel asked Peter about whether his interest in writing had changed during this project and he said "Yeah I've got something I can write about." On other visits to the class, the teacher said that Peter had started to initiate work for the project without teacher prompting and suggestion. He started getting on the computer each day to review project work, started going to the other classes to see how they were progressing with their artwork and began helping with his own class mosaic, which was not specifically his job. When Carmel visited the class to take a photo of the class mosaic this student was also the one that wanted his photo taken with the mosaic. She noticed that Peter was smiling when he was talking to her about the class project, which was something that had not been seen during regular class work previously.

Using their own initiative the two students, John and Peter, began to visit Carmel in her Principal's office to update her on the project. On one of these visits they were asked what they had learned from the project. The following is an extract of the talk.

John (J): Now I help others and I'm confident.
R: What has helped you feel more confident?
Peter (P): Most of us haven't done this sort of work before.
R: How is it different to other?
J: Communicating with the public.
P: Not so boring, hopping on the computer everyday, helping with the mosaic.
R: In.
P: You get to help other classes too, it's not just working in your own class.
J: Raising money for the charity was good.
R: I see you are very interested.
P: It's a lot easier and fun to work with other people.

John went on to say:

J: I used to do nothing and now I do work in the class and help other people. I never did that before and now I do.
R: You feel more confident?
J: Yes I do.

There is another theme that needs to be acknowledged: the courage and risk taking of the teachers involved. In a world which increasingly demands evidence that curriculum has been followed and assessment tasks completed, investing in a process which is inherently organic – as a result of the trust it places in students and the community – is an act of courage. At any stage of the project the teacher could have clamped down on student initiative or insisted on sticking to some pre-determined script. The teacher involved in the SES project discussed at the beginning of this chapter, offered the following reflections:

> Was thinking over the KPS work in the SES project and remembered that we had the initial idea of this community project and ideas about how it would go but when we had the initial meeting with the SES it totally changed the unit we were going to do, the real issue took over. The kids really took ownership and got a lot of personal real learning out of it. The thing I remember was the motivation; the kids were asking "Will we?" "Can we?" and they were coming up with suggestions. They decided to present the powerpoint to the SES at the end of the project. In the KPS work I saw value for students because it was so engaging, it was theirs, they found solutions and they discussed and held conversations about learning.

This teacher's willingness to set aside her own preconceptions about how the children should achieve the goal resulted in increased student engagement. Similarly, the teacher working with the Indigenous storytelling project had to put aside his concerns about what was going to happen next, and trust in the skills and knowledge of the community that was involved. This kind of school/community partnership is different to those that are typically found. The trust and respect that develops is something that cannot be predetermined or scripted. The outcomes too are always hugely significant for all participants.

Through these projects students have developed the kinds of core competencies with which high-stakes testing regimes are obsessed, such as:

- Strong literacy and numeracy skills
- Excellent multi-literacy skills including high level capacities in the "new basics" of ICT

More importantly, however, they developed:

- An understanding of what a changed and changing social and economic environment means for their present and their future (career, relationships, family and health)
- Skills in working cooperatively with others different to themselves
- A strong sense of self, and a positive attitude towards learning and life-long/life-wide learning

Afterword

Our goal in recounting these stories is not to suggest that there is some kind of magic formula that, if followed closely, will guarantee achievement of KPS goals. Nor it is it to suggest that there is one single pathway that can be followed that will suit every teacher or every child or every community.

Indeed, the whole basis of the KPS framework is that the world is complex and characterised by contradiction, uncertainty and change. In this context, formulas are not very helpful. Rather, what is most valuable is a clear sense of direction and a strong sense of purpose. This means having a destination in mind and a willingness to travel in whatever way best suits the prevailing conditions rather than insisting on adhering to a pre-determined, non-negotiable itinerary, which lays out in advance how, and in what ways, everyone should travel regardless of who they are, what they are interested in and where they have been before.

The teachers discussed in the examples above (and, indeed, the students and their community) share a commitment to a particular type of educational journey. It is a journey through which each child – regardless of gender, cultural background, socio-economic status, geographical location, family form, sexuality or prior experiences – is ultimately able to see themselves in a positive relationship with knowledge: knowledge they helped to produce and knowledge that is valued and validated by an authentic audience.

The teachers discussed in this chapter achieve extraordinary things but they do not have revolutionary agendas and unlimited resources or unusual technologies. They are, rather, excellent examples of the kind of educated hope outlined at the start of the book: They are aware of key problems faced by many of their students (including declining engagement, problematic family relationships with schooling) and are working to improve the relationships between the children, their caregivers, their community and the pursuit of knowledge. Because of this close focus on responding to where kids are at (rather than where school curriculum often assumes them to be) and a parallel commitment to getting kids re-engaged with learning (rather than curriculum), the specific ways in which particular teachers or schools take up the KPS agenda varies from time to time and context to context. Underpinning all the work, however, is that belief that schools can – must – move away from representing children as deficient, lacking or unskilled towards seeing them as genuine contributors to the knowledge that sustains our society. These stories show what real kids, with complex histories, can achieve when provided with environments that offer genuine challenges, professional support, and opportunities to take risks and reap the rewards.

To Conclude

Knowledge-producing schools take seriously the business of preparing children – learners, people – for a world which is both significantly changed, and stubbornly unchanged. The KPS agenda challenges us to respond to new times without reproducing old patterns of educational success and failure. It is a challenge based upon a commitment to excellence for everyone. This challenge is well captured by Henry Giroux (2009, np) who argues:

> If formal education is to remain a site of critical thinking, collective work, and social struggle, public intellectuals and progressive social forces need to expand its meaning and purpose. That is, they need to define public and higher education as a resource vital to the moral life of the nation, open to working [with] people and communities whose resources, knowledge,

> and skills have often been viewed as marginal. The goal here is to redefine such knowledge and skills to more broadly reconstruct a tradition that links critical thought to collective action, human agency to social responsibility, and knowledge and power to a profound impatience with a status quo founded upon deep inequalities and injustices.

Giroux here makes clear the connection between schools, teachers, and knowledge production, and equitable, socially just futures. The stories explored in this chapter make it clear that teachers, students and the communities of which they are part can all play a valued and valuable role in this process. While the projects discussed above can be challenging, risky and often quite scary, they provide possibilities for students to stop seeing themselves as rats within an increasingly maze-like schooling system – a maze which rewards them when they push the right buttons or ring the right bell – and to see themselves instead as autonomous, valued individuals who have the ability and the right to make a contribution towards understandings of, and activities within, their wider community.

The question, for our future, is perhaps….Will we let them?

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Chapter 6
Empowering Students as Knowledge Builders

Jan van Aalst and Carol K.K. Chan

Introduction

'Knowledge building' refers to the practices by which the state of knowledge in a community is advanced. It exists throughout society – for example, in scholarly communities, innovative corporations, clubs, online game communities, and artistic communities – but is rarely found in schools. One of its defining features is a shared goal within a community to extend the frontier of knowledge in that community. Scardamalia and Bereiter (2006) contrast it with 'learning', which they consider the passing of a community's intellectual heritage to the next generation. For example, the articulation of a contemporary interpretation of *Hamlet*, leading to a new production of Shakespeare's play, can be considered knowledge building, but the effort to understand an existing interpretation learning. In the first case a new intellectual artefact is created; in the second students become familiar with and internalise an intellectual artefact that pre-existed, but is new to them.

The goal of this chapter, which appears in a book on future-proofing students for the twenty-first century, is to examine the potential of knowledge building for addressing twenty-first-century educational needs. We do not believe that "proofing" students for a largely unknown future world is feasible, however, in common with the other authors we are committed to the goals that underlie what can be broadly defined as a future-proofing aspiration: a mindset which acknowledges the vital importance of creating more student-centred and democratic learning environments; twenty-first-century skills such as working together, ideation, and knowledge creation; increased student responsibility for their own learning; and the thoughtful use of IT to support learning. We agree with Collins and Halverson (2009) that the nature of schools must change to make better use of the potential of

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educational technology to address such needs. We relate knowledge building to twenty-first-century skills, review the educational context in Hong Kong, and discuss our progress to implement knowledge building there.

Knowledge Building

As an educational possibility, knowledge building is based on research on different forms of expertise, such as writing, problem solving, and playing chess. Many studies in the 1960s through to the 1980s showed that experts rely on vast amounts of domain knowledge and approach problem solving differently than novices. For example, chess players rely on knowledge of a vast collection of board patterns (de Groot 1965), and physics experts first analyse problems qualitatively to understand which physical principles are involved and then apply formulas, whereas novices directly apply formulas (Mestre 1991). From the vast literature on expert-novice comparisons, there would be little reason to think that children could be considered "expert-like" in their approaches to learning.

Knowledge building can be understood from a different type of comparison (Bereiter and Scardamalia 1993): between experts and people who, despite similar training and experience, have not become experts (experienced non-experts). This kind of comparison focuses on the approaches to learning that people who become experts use in their domains of expertise, rather than on expertise as an end state. Bereiter and Scardamalia found three major differences between experts and experienced non-experts. Experts were aware of the limits of knowledge in their fields; engaged in progressive problem solving, in which they reinvested cognitive resources into studying a problem at progressively deeper levels; and were committed to a shared goal to advance the state of knowledge in their fields. Bereiter and Scardamalia proposed that although young children clearly have much less domain knowledge than experts, they could be considered expert-like if they already use these strategies. Their research program aims to facilitate the learning strategies of people on the career paths of experts in school. Their first software, computer-supported intentional learning environments (CSILE), was designed to help students maintain a focus on the use of writing to construct knowledge rather than just transfer their ideas to written form. Its successor, Knowledge Forum, was first released in 1997 (see Fig. 6.1 later in the chapter; Scardamalia 2004).

Early theoretical papers argued that teachers usually do much cognitive and metacognitive work that can be executed by students (Bereiter and Scardamalia 1987), and that educational activities were frequently not aligned with learning goals, so that learning was a by-product of activities rather than an intended goal (Bereiter and Scardamalia 1989). As Bereiter (1992) observed, in school projects such as building a model of a human lung, the model, rather than the desired understanding of the human lung, often becomes the outcome of the project. Thus, among the main pedagogical challenges for implementing knowledge building in school were: transfer of control over learning processes from the teacher to students, and a

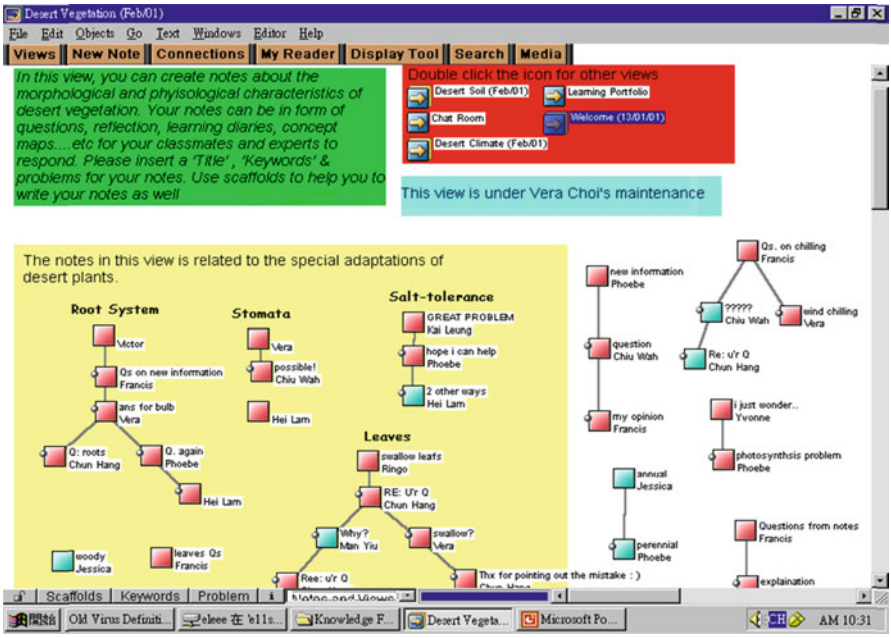

Fig. 6.1 Section of a view (a shared workspace) in Knowledge Forum. Notes are represented by square icons (*dark* if they have been opened by the user, and *lighter* if not.) A *line* between notes indicates that one note is a response to the other. Notes can be moved around in the view, and drawings can be embedded in the view background to provide organisation (conceptual or otherwise). This view was maintained by a student

focus on understanding and idea improvement rather than task completion. Despite extensive research and theoretical and technological developments in the last two decades, these challenges have remained. In the twenty-first century, addressing these problems has become even more urgent than in the 1980s.

Brown and Campione (1996) observed that classroom implementations of innovative approaches are often reduced to procedures that distort the approach to such an extent that the principles that underlie it no longer are recognisable. Therefore, Scardamalia (2002) developed a system of 12 principles that describe the socio-cognitive and technological dynamics of knowledge building, which are employed to guide classroom work. In the next subsections we briefly discuss the six principles we consider most pertinent to our work.

Improvable Ideas

The improvability of ideas is an epistemic point that draws from Popper's (1972) theory of objective knowledge: Ideas are improved by means of a public discourse of scrutiny, testing, and modification. In this respect, the ideas that students

encounter in their formal education, such as Newton's laws of motion, provide the most reliable explanations of phenomena, but may some day be challenged by new evidence, analyses, or ideas. Thus the work students do to "improve the quality, coherence, and utility of ideas" (Scardamalia 2002, p. 78) is epistemologically similar to knowledge creation in general.

The contribution of an idea to a public discourse is a *creative act*, and requires a psychologically safe environment. For example, students must feel that their ideas are taken seriously, that their social status in the class is not compromised if they contribute ideas, and that their ideas are not used inappropriately. In Canadian classrooms, we have observed that some students are reluctant to contribute an idea to Knowledge Forum for fear that other students will "copy" their idea (e.g., van Aalst and Hill 2006, p. 34). And, as one teacher noted, the notion of sharing ideas that are in some way inadequate runs counter to the culture of schooling: "…The name of the game in school is to keep [students' theories] hidden, not to bring them out in the open, not to ask in case it's a stupid one, not to write something down in case it's the wrong answer" (quoted in Hewitt 1996, p. 132). In Asian contexts these issues can be even more prominent, since students avoid "losing face" in a context where students are often ranked within their class.

Epistemic Agency

According to the principle of epistemic agency, students "set forth their ideas and identify gaps in understanding; they deal with problems of goals, motivation, evaluation, and long-range planning that are normally left to teachers" (Scardamalia 2002, p. 79). This principle is crucial for empowering students to be in control of their own learning, which is required for lifelong learning.

An important aspect of epistemic agency is that students are aware of what they know and do not know. For example, they may be aware that there is much more to know about a topic than they currently know, and that their investigative work must therefore involve the study of external sources that are accessible to them. From this, students design and carry out investigations to advance from the community's collective knowledge. Epistemic agency also requires that students are able to judge when they have made acceptable progress. In this, they may check the overall scope and coherence of what they have come to understand and external requirements such as curriculum guidelines.

Epistemic agency relies on a wide range of twenty-first-century skills, including ability to identify and retrieve information in a variety of media, read for understanding, summarise what is known, and decide when it is time to review progress. Because these activities are complex and take place in a community, sophisticated social skills are also required, including the ability to resolve disagreements, plan, monitor, and judge the merit of what has been accomplished. The teacher does not usually know the answers to all the questions that the students are investigating, but he or she should have expertise in the requisite skills and model them.

Collective Responsibility for Community Knowledge

Students are members of a community, and work towards the shared goal to advance from what the community collectively knows (Scardamalia 2002). That students are members of a community implies that they feel a sense of belonging to the group, are willing to work with each other, and are helpful to one another. The emphasis on communal goals requires collaborative and cooperative skills that surpass those needed for most forms of learning in small groups. Clearly the teacher has an important role in cultivating these abilities, and may need to help the students when important ideas are ignored, some students are not contributing, or social conflicts develop. However, over time, students also fulfill this role.

In education, the emphasis on shared goals and accomplishments is controversial because educational success is measured almost entirely in terms of individual achievement. The teacher may need to persuade high-achieving students that a focus on shared goals can benefit them. Nevertheless, outside of school adolescents are attuned to learning in communities including gaming communities, clubs, and online communities such as YouTube and Facebook (Collins and Halverson 2009). Communities provide authentic contexts for learning that build on students' interests. Research in education is increasingly giving attention to learning in informal settings, including in authentic communities. For example, Roth and Lee (2004) investigated how middle school students contributed to the knowledge base of a local creek.

Democratising Knowledge

Scardamalia (2002) defines democratising knowledge as follows: "All [students] are legitimate contributors to the shared goals of the community; all take pride in the knowledge advances achieved by the group" (p. 80). Knowledge Forum is an online knowledge base to which *all* students can potentially contribute. In contrast, relatively few students can contribute to any whole-class face-to-face discussion (Hoadley and Linn 2000). Teachers who collaborate with us have often observed that some students who are silent in class are prolific writers in Knowledge Forum. The relative anonymity of asynchronous discussion, which does not require the simultaneous attention of other students in the class, seems to provide additional psychological safety that enables students to make contributions. Effort by teachers and students to focus on idea improvement, rather than the person who contributes an idea, also enhances this safety.

Although all students contribute to the work of the community, they may do so in different ways. In the 1990s, some students in an inner city school had limited writing skills in English and wrote notes in Spanish; other students translated these notes to render them more accessible to the community. More recently, children in the earliest grades of elementary school enter notes for children who have not yet developed the requisite skills. These approaches make it possible for students with varied literacy levels to contribute their ideas.

Knowledge-Building Discourse and Embedded and Transformative Assessment

Bereiter (2002) argues that the knowledge of a community is reified in its conceptual artefacts – its proofs, theories, ideas, and explanations – and that these are improved by means of public discourse. Knowledge building exists *in* its discourse. However, the discourse must be oriented toward the advancement of the community's collective knowledge. An experiment is not just motivated by a scientist's own curiosity, but by its potential for illuminating gaps of knowledge in the community. New investigative methods are developed when the community feels that it can no longer make progress with existing methods. Thus, part of the discourse involves the review and synthesis of progress.

The discourse is *progressive* in the sense that it builds on what is already known and advances lead to new questions and ideas. There are *emerging lines of inquiry* that were not anticipated at the outset. This situation can be contrasted with linear inquiries that stop once an answer to the initial question has been found, such as the 5E model of inquiry (Bybee et al. 2006) that is commonly used in K-12 education. However, outside of school it is common: A student may seek to play and understand a video game at continuously more advanced levels (Gee 2007).

The major implication of a knowledge-building discourse for education is that it is cognitively more demanding than the discourse by which students typically learn in school. Knowledge builders cannot look up the correct answer in the back of the book, but must devise other methods to become confident that a knowledge advance has taken place. We believe that most uses of online forums in education do not currently reach the level of discourse that is required for knowledge building (Scardamalia and Bereiter 2006; van Aalst 2006, 2009). Therefore, the principle of *embedded and transformative assessment* is used to support the enhancement of knowledge-building discourse. As part of their knowledge-building efforts, students self-assess their progress and evidence of the knowledge-building principles in their discourse, and take steps to enhance these. Current research is developing tools that visualise online discourse to render such assessment more feasible in typical classrooms (Teplovs 2010).

Addressing the Needs of Diverse Learners Through Knowledge Building

As a community-oriented practice, knowledge building takes advantage of the diversity of interests, knowledge, and abilities within classrooms. There are opportunities for all students to make valuable contributions, learn from others, and develop their interests. And although no large-scale studies are available and students with high prior achievement generally outperform students with low achievement,

the literature suggests that students across ability levels are able to participate in and benefit from knowledge building. For example, Niu and van Aalst (2009) compared the performance of students in a mainstream and an honors version of a Grade 10 social studies course; they examined alignment between the discourse and knowledge-building principles and domain knowledge in a post-experience portfolio. They found that the discourses in the two courses were similar from the point of view of the knowledge-building principles, but that on the portfolios students in the honors course outperformed those in the mainstream course – to a degree consistent with their higher prior achievement (approximately 20%). Our other studies show similar effects (van Aalst and Chan 2007). Relatively small variation in post-test scores in some studies also indicates that the insights gained by a few students are widely diffused (Zhang et al. 2007).

It is worth noting that while the usual argument for knowledge building is primarily cognitive, one could also argue for it from the perspective of addressing the *needs of students disenfranchised with school*. For example, Banks (2008) points out that due to globalisation, diversity is increasing dramatically in classrooms in many countries. He argues that young people need to be prepared for "transformative citizenship": citizenship that enables them to go beyond the values and moral principles of existing society to change society. This view is consistent with that of knowledge building, which emphasises advancement of the frontier of knowledge (Scardamalia 2002).

In the following vignette we describe briefly how an at-risk student, as a result of his work on Knowledge Forum, became interested in writing, and entered and won a regional writing competition. Though the extent of what was accomplished in this example can be overstated, the introduction of Knowledge Forum seems to have provided the student a way to become more engaged with his education, and socially more accepted.

Vignette 1: Knowledge Building and Student Voice

James was a Form 4 (Grade 10) student from secondary school that enrolled the academically weakest students in Hong Kong; its students were around the 10th percentile on a standardised placement test. Such schools provide their students poor access to tertiary education and white-collar jobs. Students frequently are unmotivated, and relatively few graduate. However, some of James' teachers became interested in knowledge building, and hoped that it might offer their school a way to get students more interested in their education.

James had been an isolated and silent student for years, and his teachers thought that he had several learning disabilities; he did not seem able to make many useful contributions during class activities. But when one of his teachers used Knowledge Forum, James began writing quite a few notes. He said that he liked it because he had more time to think about his ideas before writing them than he would have in class. The teacher and James' classmates considered his ideas valuable, and James gained more respect among his peers. James became very interested in writing, and through the encouragement of his teacher began to improve his writing. He entered an inter-school writing competition – and won!

Chinese Learners and Educational Reforms in Hong Kong

The work described in the remainder of the chapter focuses on our efforts to implement knowledge building in public schools in Hong Kong. This work is possible in part because of the close alignment between knowledge building and the twenty-first-century skills that underlie a major curriculum reform. In this section we discuss the current educational context in Hong Kong. Specifically, we examine the cultural roots of government examinations and curriculum reforms since the beginning of the twenty-first century.

For more than two millennia, Chinese society was shaped by the teachings of Confucius, and the system of civil examinations inspired by them. The civil examinations endured from the Han dynasty (206–220 AD) till 1905. Throughout most of this period, they were used to select men from all walks of life for civil service positions, which came with prestige and social status. The underlying ideal was that all men could prepare themselves for the examinations and had access to government positions, regardless of their social class or family history. (Women were excluded throughout the period.) Preparing for all the examinations required many years of effort and commitment, but this was believed to lead to the moral perfection desired of those in government office. Han (1946) suggests, "the discipline was so thorough that those who succeeded in passing the examinations were looked upon with a respect that amounted to reverence" (p. 158).

The civil examinations were reformed frequently. For example, in the eleventh century the examinations changed dramatically under the influence of Neo-Confucianism, a philosophical movement drawing from Taoism and Buddhism and providing a conceptual basis for the teachings of Confucius. Among Neo-Confucian concepts were *li* (understanding, coherence) and *xin* (mind). Whereas in the Tang dynasty the "meaning" of the Classics entailed knowing to what their words pointed, eleventh century intellectuals saw a role for the mind, which was "capable of grasping the patterns, principles, commonalities, and systems that underlay what was manifest … in the texts" (Bol 2008, p. 66). This opened up the possibility of interpreting the Classics to illuminate policy problems of the day, and was closer to the Confucian teachings emphasising thinking for oneself and inquiry. In time, Neo-Confucianism became the curriculum, and examination candidates were expected to write essays in which they reasoned about policy issues of current interest. From a modern perspective, we might call the underlying learning theory constructivist. It could even be argued that candidates were building knowledge.

However, in the Qing dynasty (1644–1912), the civil examination system gradually failed for two main reasons (Elman 2000). (1) It could not be scaled up. As participation increased, examiners were no longer able to read essays closely and focused on conformity with the requirements of the "eight-legged essay" rather than the big ideas of the candidates; in addition, the examinations became extremely competitive and no longer provided the possibility of upward social mobility to commoners (Elman 2000). Over time, dissatisfaction grew among intellectuals concerning the adequacy of the civil examinations for selecting the most talented

men for civil service. (2) In the nineteenth century, influences from the West and social unrest also increased. By the first two decades of the twentieth century, the dynastic system, the civil examinations that supported it, and the dominance of Confucian thought all ended.

The transition to new models is still incomplete (Chan 2009). The civil examinations provide the foundation for the rigor and competitiveness of the current government examination system, and Confucian values such as effort and moral and social development continue to influence how students, teachers, and parents think about learning and education. For example, research on conceptions of learning of college students of Chinese and European descent shows that the former have conceptions of learning that refer to hard work, moral development, and "heart and mind to learn"; when such students fail they attribute it to a lack of effort rather than a lack of ability (Li 2002, 2009). In a study of management issues in science classes in China, Israel, and Australia, Lewis et al. (2005) found that Chinese teachers were more likely to mention that "learning to respect authority was a significant outcome of education" (p. 731). In Hong Kong, results on the Hong Kong Certificate of Education Examination are used to select students for Advanced Level courses. These examination results thus have important consequences for students, teachers, and school administrators, and teachers are reluctant to employ methods that may compromise them (Gao and Watkins 2002; Wu and Huang 2007). In Hong Kong, parents of all social classes invest much effort into enrolling their children in a good school and supporting teachers (e.g., making sure that homework is done); many parents who can afford it may send their children abroad to continue their education in a less competitive environment after the HKCEE. Nevertheless, East-Asian educational systems have consistently led to strong performances on international comparisons of achievement, particularly in mathematics and science (Stigler and Hiebert 1999). All of these effects constrain the extent to which a Western approach like knowledge building can be implemented in East-Asian contexts.

East-Asian governments have realised that new approaches are needed for the twenty-first century, in which sustained innovation and knowledge creation are important capabilities. As a result, the Hong Kong government has invested more than a decade in preparing for a major reform of the secondary school curriculum. This reform includes emphasis on learning how to learn, student-led inquiry, project-based learning, reading to learn, and school-based assessment (CDC 2001; CDC/HKEAA 2007). The New Secondary School (NSS) curriculum launched in 2009 reduces secondary school from 7 years to 6, and will increase the length of undergraduate university education from 3 to 4 years by 2012. It also has introduced a new core subject, Liberal Studies, in which students are expected to use their knowledge learned from other subjects to articulate positions on complex societal problems; developing understanding of multiple perspectives on a problem and argumentation are key capabilities to be developed by this subject. The NSS is based on decades of research on how people learn and changing views about the roles and nature of assessment.

We expect that pedagogical practices based on the NSS curriculum need to be more structured than most Western examples of constructivist learning, but take

advantage of effective collaborative and reflective learning strategies that lead to understanding of domain knowledge and higher-order thinking. We believe that if the NSS is successful, it will lead to pedagogical innovations that advance not only on existing practices in Asian countries but also in Western ones.

Progress Towards Knowledge Building in Hong Kong

Since 1996, much effort has been invested globally in the development of an international community of teachers and researchers. The goal of this community is to build synergies between local teams for developing and sharing pedagogical designs and research; the community meets annually for a summer institute at the Institute for Knowledge Innovation and Technology (IKIT, www.ikit.org), and has organised several international collaborations. In Hong Kong, we have co-led the Knowledge Building Teacher Network (KBTN, kbtn.cite.hku.hk) with Nancy Law since 2006; it currently involves more than 60 teachers from 25 schools. The KBTN employs a mentoring scheme in which teachers who have implemented knowledge building in their own classrooms hold 50% seconded positions at the KBTN and lead professional development activities for the remaining teachers, including workshops, collaborative pedagogical design, and classroom observations (Chan 2011). In the next subsections, we describe the main pedagogical designs developed by the KBTN. Both of these models exemplify how teachers in Hong Kong interpret and adapt knowledge building in terms of local constraints, especially the importance of government examinations.

Implementation Path with Knowledge-Building Portfolios

Knowledge building – as conceptualised in this chapter – was first implemented in Hong Kong classrooms in 2000. Over the years, researchers and teachers have developed a pedagogical model and classroom design that aim to remain faithful to the spirit of knowledge building, but attend to the contextual dynamics in Hong Kong that we described earlier. The following four-phase implementation path has been employed in Hong Kong in a variety of subjects (Geography, Chemistry, and Chinese) and at grade levels ranging from Grade 8 (diverse abilities) to Grade 12 (advanced courses). We have found the outcomes of this approach to be consistently encouraging in these classrooms (Lee et al. 2006; van Aalst and Chan 2007).

Phase 1: Develop a Collaborative Classroom Culture

Chinese classrooms are not attuned to knowledge construction and collaboration. Teachers see their roles as explaining difficult material clearly and preparing students

for examinations, and students do not like to discuss their ideas publicly before they are confident about them (Gao and Watkins 2002; Li 2009). Therefore, KBTN teachers like to spend several months creating a learning environment in which it is safe to share and discuss ideas, but in which activities are oriented toward understanding – before they introduce Knowledge Forum. For this, they introduce students to effective cognitively oriented learning strategies. Some teachers implement concept mapping as a strategy for determining what students in a small group understand about a topic; teachers of Chinese use reciprocal teaching (Palincsar and Brown 1984) extensively in the context of *reading to learn*, which is an important "key task" in the NSS curriculum (CDC 2001).

During this phase activities are highly structured, but they cultivate social interaction in small groups that is oriented toward understanding subject knowledge, and competence in the use of cognitive tools such as concept mapping and reciprocal teaching. This blending of social interaction and cognition is not always evident in Western classrooms. In our earlier work involving Canadian teachers, some teachers were very interested in having students work together, but were reluctant to teach them the skills students needed to make it effective. The teachers were very concerned with developing a sense of community among their rather unmotivated students, but it was not the kind of community that aims to improve knowledge. A study of Australian and Taiwanese students found that Australian students tended to focus on the quality of social interactions, and Taiwanese students more on the learning goals underlying the task (Aldridge and Fraser 2000).

Phase 2: Inquiry and Curriculum Adaptation

Although Phase 1 orients the learning environment towards collaboration and knowledge construction, it does not yet accomplish some important changes that are required for knowledge building: The teacher mostly remains in control of the learning goals and tasks. In Phase 2, students begin to use their learning experiences during class as a foundation to articulate and investigate shared problems of understanding. Due to time constraints and emphasis on examinations, teachers in Hong Kong are reluctant to use class time for work on Knowledge Forum but assign it as homework: Standard exercises are replaced by student-to-student interactions.

The key goal of the pedagogical design here is to utilise the skills developed in Phase 1, and frame students' work in Knowledge Forum in such a way that shared problems of understanding emerge from their discourse, and that there is room for these to be investigated. Thus, the learning environment becomes more *community oriented*, the learning goals become *emergent* and *authentic* to the students, and agency over the educational process is substantially turned over to the students. Although the learning goals and what students will learn are not known in detail at the outset, students are individually and collectively accountable for what they learn, and the skills learned in Phase 1 help to keep students' work on Knowledge Forum oriented toward advancement of the class's knowledge.

For example, in a Form 3 (Grade 9) Chinese Culture course, the teacher asked students to start by exploring their thoughts about the school rules, a topic of considerable interest to middle-school students. This strategy was innovative because it encouraged students to express views and inquire into authentic problems. In Hong Kong, students are required to follow many rules, such as the permissible length of the school uniform. The teacher encouraged students to work on problems that held their interest, and helped them to advance from these to the principles that underlie school rules, and notions of freedom and choice; this was then connected to the teachings of the Classics. The ensuing discussion on Knowledge Forum led to an investigation into notions of "rules of propriety and rituals" *li* (禮), central philosophical concepts in Chinese culture. Students utilised progressive discourse on Knowledge Forum to deepen their understanding, and examined their beliefs and values related to Chinese philosophies and culture. They were asked to interpret Chinese classical texts from Confucius to contemporary authors and newspaper readings students chose for themselves. This teacher blended structure and openness through knowledge building. Students investigated their own questions and ideas, but were expected to make *constructive use of authoritative sources* (Scardamalia 2002), taking reading-to-learn strategies developed in Phase 1 online. The teacher required regular contributions to Knowledge Forum from all students and monitored their progress. This course was mandatory for all students at the school, hence involved a more diverse student population than our work in more advanced and elective courses.

Other KBTN teachers have used similar approaches for other subjects. For example, students in a Grade 12 Geography course used Knowledge Forum to investigate problems of understanding concerning plate tectonics that remained after classroom teaching (van Aalst and Chan 2007). Work on Knowledge Forum led to the integration of ideas discussed in class, supported by examples and elaborations, and led to a more comprehensive understanding of the topic that was shared by most students in the class. Students pursued their own interests and emergent questions, but in doing this they kept the examination syllabus in focus when deciding whether a problem merited additional effort. Students discussed relationships among plate tectonics, continental drift, and seafloor spreading in detail because explaining these relationships was considered important to an understanding of plate tectonics. Interviews showed that students used Knowledge Forum to develop their understanding of domain knowledge for the examination. Some students said that when they wrote on Knowledge Forum, they needed to understand the contributions of their peers, and that this led them to study more and enhance their own understanding; they also said that the ideas of others provided them a broader perspective on the topic under study.

Phase 3: Deepening Knowledge-Building Discourse

After students have worked on Knowledge Forum for 1–2 months, teachers initiate activities that help students reflect on and improve their discourse, and that

improves the integration of work on Knowledge Forum with classroom events. Thus, they bring the principle of embedded and transformative assessment into focus.

Some teachers institute "KB talks," which are whole-class face-to-face conversations about the database that help students gain an overview of progress, set new goals, and solve problems that do not require extensive discussion (Zhang et al. 2007). Teachers in the network vary regarding the time they devote to KB talks; however, the more progressive teachers see this as crucial for the articulation of emerging questions and ideas. They devote attention to showing that students of diverse abilities and backgrounds can contribute to the collective progress – even a superficial question can bring about much interest, and the teachers acknowledge such contributions during KB talks.

Many teachers also begin to use analysis tools that provide information about participation rates and the social structure of the online discourse. Knowledge Forum includes assessment tools that allow teachers to detect easily whether all students are contributing notes, are reading a substantial number of notes, and have at least several collaborative partners who read and build onto their ideas. Teachers in Hong Kong are eager to use such tools to gain an understanding of how the class is progressing. Although the analyses tend to be initiated by the teacher, the tools are designed so that students can eventually use them independently. As shown in Fig. 6.1, teachers may also ask students to moderate specific discussions and teach students the use of advanced features of Knowledge Forum to enhance their discourse. van Aalst (2009) suggests that without explicit attention to advanced tools, the use of Knowledge Forum may settle at a rudimentary level, at which students write and respond to notes, but do not synthesise what is being learned and do not consider what merits further investigation or discussion. Especially if students are pursuing emergent goals, it is important that their advances accomplished in Knowledge Forum are easily identifiable.

Phase 4: Knowledge-Building Principles and Electronic Portfolios

After students have used Knowledge Forum for some time, the knowledge-building principles are introduced; these provide a technical vocabulary that students can use to understand what they have been doing on Knowledge Forum. For example, students often spontaneously identify the diversity of ideas as a benefit of discussions on Knowledge Forum, and note that some students who had remained silent during class contribute to Knowledge Forum. The knowledge-building principles make sense to students when they are introduced to them at this stage.

Once students are familiar with the principles, some teachers ask them to use them to self-analyse the class's discourse. Although there are considerable variations in design, one approach is to ask students to select clusters of notes they considered useful, and discuss the extent to which they show evidence of several of the principles. Students write up their analysis in a "portfolio note" in Knowledge Forum, which has hyperlinks to the notes in the clusters. We have reported empirical studies of these portfolio notes elsewhere (Lee et al. 2006; van Aalst and Chan 2007).

We found that portfolio note scores predicted conceptual knowledge over and above depth of explanation and depth of inquiry, and students said in interviews that preparing the portfolios helped them understand how to improve their future contributions to Knowledge Forum. Lee et al. (2006) found that the use of principle-based portfolios enhanced depth of inquiry more than portfolios in which students did not use the principles.

Phase 4 completes the trajectory by providing a more conceptual basis for students' analysis of online discourse than was possible in Phase 3. We believe this kind of experience is important if students are to understand the dynamics of knowledge building.

Enhancing the Integration of Technology Use and Classroom Events

The foregoing implementation path has several important advantages. It is a *gradual* approach, in which teachers first implement or enhance collaborative and cognitive strategies to improve learning, and later initiate students into a reflective practice that involves the use of Knowledge Forum, learning the knowledge-building principles and assessments of online discourse. Gradual implementation seems necessary in Hong Kong's education culture with its emphasis on competitive examinations that test comprehensive knowledge and understanding. Without a gradual implementation path, discussions can be unfocused and unproductive. With it, the database can be a communal memory of what the community has come to understand – and a resource for consolidating understanding when the class approaches its examination.

However, this implementation path does not go sufficiently far in opening possibilities for emergent learning goals, epistemic agency, work on problems that are authentic to students, and progressive inquiry. As a result, teachers have difficulty fully incorporating knowledge building into their classroom practice. Among the main difficulties are the nature of classroom discourse and the framing of work on Knowledge Forum. Therefore we are studying how teachers who have more experience with Knowledge Forum may enact a comprehensive pedagogy that is more clearly oriented toward knowledge building. We first provide a vignette of such a teacher's classroom practice, and then discuss the issues arising from it.

Vignette 2: Student Voice at Charles K Kao Secondary School

> The 41 students in the Grade 10 Physics class sit in groups of six or seven around large lab tables. In these groups they do many things such as conduct brief experiments, discuss results and questions, and solve short tasks. There are cheers and sometimes applause. There is a lot of motion. Students walk up to the blackboard to explain a point to their peers. We also find students *working* at the blackboard before explaining, with the teacher some

distance away. We find the teacher helping the students (e.g., passing materials to them). Sometimes the teacher can be found at the students' elbows, thinking about what is going on *with* them. And sometimes the teacher just sits for a moment at a table with the students. Though there is always much to do, the pace never feels rushed. The students look relaxed and happy to be doing physics. There are few management problems. Though the class size is large, the lab does not feel crowded.

The teacher uses the experiments from the textbook, but often considers the full experiment too laborious to keep the students engaged and interested. Therefore, a specific group of students will often complete just one part (e.g. varying the mass but not the force in a Newton's Second Law experiment). Different groups then complete different parts, and two members from each group are called upon to share their findings with the class at the blackboard. When some students are not satisfied with an explanation there may be laughter but it is never demeaning. For example, after two students had explained to the class how a sea breeze arises at a beach, one student asked whether this application applied to daytime or night. When the students said, "I don't know," there was laughter, but other students and the teacher then helped to develop a more satisfying explanation. The teacher allowed the time she had planned for students to provide their explanation (2 min) to expand to more than 10 min, to allow students to think through the problem. In examples like this, where many ideas are proposed and progress is slow, the teacher does recap and teach the correct explanation, but it is an explanation that has at least partly been articulated by the students. The main purpose of doing this is to ensure that students remember the best explanation, rather than a minor point that was made along the way.

The blackboard is a space that *belongs to the class*, rather than the teacher alone. The teacher usually provides a very brief introduction to a short activity and provides students an issue to think about during their experiments. For example, introducing a quick "exploding carts" experiment that all the groups did with data-logging equipment, she asked students: "Where does the kinetic energy come from?" After the experiment a question then arose, in which a student recalled that in an earlier (free fall) experiment the velocity was independent of the mass, but in the current experiment it was not. As in the example involving the sea breeze, this question lead to an extended discussion.

Although the classroom discussions are focused on ideas and explanations, they are fixed in time, and are not later available for retrospection.

This vignette is intended to suggest that the learning environment is a community in which students have fun, care for each other, and are focused on learning physics. Small-group activities are not just activities to be completed, but set the stage for thinking about scientific phenomena. The class's discourse focuses on explanations in terms of causes and effects. In having students provide explanations to each other, the teacher is developing a cognitive strategy – self- and peer explanation – that is known to lead to deep knowledge in science (Bielaczyc et al. 1995). Although student ideas form the basis of the class's discourse, the blackboard has remained a focal point in the classroom: After their initial work in groups, students are explaining to the whole class.

We have collected extensive data in this classroom focusing on attitudes toward science, epistemological beliefs, performance on explanation and problem-solving tasks, and conceptual surveys. Results indicate that students had more positive attitudes toward science than in comparison classes, made acceptable progress toward conceptual change, and raised conceptual questions about lesson material.

The teacher developed the social practice of peer explanation to the class in approximately 1 month, in quite a structured way. At the beginning of the school

year, students prepared their explanations in small groups, and two students from each group were called to make a 2-min presentation of their explanation. Over time, it became a more dialogic process, in which the teacher had her eyes open for opportunities for students to come to the blackboard. In a few months the students became very comfortable with this practice and accepted it as normal.

However, the creation of this kind of learning environment is difficult. The teacher had two abilities that made it possible: She was able to identify what Viennot (2003) calls the "critical details" involved in understanding physics topics, and through her questioning and task design she was able to focus students' thought on those critical details. We regularly observed a second teacher at the same school, who had excellent command of the critical details and provided superior explanations to students, but was uncomfortable with allowing students sufficient time and space to struggle with them on their own. A third teacher also had excellent grasp of the critical details, but was not quite able to orient questioning and tasks toward them; he rather tended to focus on the procedures involved in tasks.

The foregoing discussion shows that two issues are crucial to the implementation of knowledge building. First, teachers need to learn how to facilitate classroom discourse that is focused on ideas and explanations. Second, this discourse is likely to be constrained significantly by limitations on instructional time. We have concluded that it is impossible to adequately address the second issue without making the use of educational technology central to classroom activities. Therefore, we have outfitted the lab with an interactive whiteboard (IWB) and a laptop computer for each small group of students. The IWB makes it possible to save the diagrams and notes from student presentations in Knowledge Forum, and also to access Knowledge Forum, the Web, and computer tools and files such as results from experiments. Students use the laptops to review recent work on Knowledge Forum in their groups, often in preparation for class presentations. Our initial experiences suggest these tools provide a more seamless knowledge-building environment, which makes linkages between online and offline discourse less artificial. In current work in this classroom, we are exploring how to optimise the balance between face-to-face work and work on Knowledge Forum.

Summary

This chapter has provided a general overview of knowledge building as an approach to fostering twenty-first-century skills – particularly for East-Asian students. We discussed knowledge building in terms of knowledge-building principles (Scardamalia 2002). Idea improvement and collective responsibility for community knowledge define the *overall goals* toward which knowledge building is oriented, and knowledge-building discourse is how it is accomplished – the knowledge building is *in* the discourse. Epistemic agency and embedded and transformative assessment refer to two general sets of responsibilities that students have in knowledge-building communities, but that are currently in the domain of teacher actions.

Democratisation of knowledge identifies another goal: that students are empowered to deal with their own needs for knowledge. We discussed the significance of government examinations in Hong Kong (and China generally), and their impact on classrooms, and described two pedagogical designs to support knowledge building in this context.

In the four-phase implementation path teachers begin by enhancing aspects of teaching and learning that are not specific to knowledge building but that help to create a social and academic environment in which it can develop. From Phase 2, teachers implement knowledge building and learn the tools and concepts for reflecting and improving their practice. Although this implementation path provides a framework for implementing knowledge building, we do not think that it – by itself – can go far enough in helping teachers transform their pedagogy. The second approach that we described requires a more comprehensive investment in knowledge building, in which discourse in Knowledge Forum can be integrated more fully with daily classroom events. Although this technology-rich environment has not yet been fully enacted, we believe that it is essential to making knowledge building the focus of a class's efforts.

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Chapter 7
Changing Spaces, Changing Places

Helena Gillespie and Rob Walker

Educational Technology and the Classroom

In the history of educational technology, new technologies have often been conceived as novel devices that promise to transform classrooms by short cutting mundane routines. The fountain pen meant teachers did not have to mix ink and distribute blotting paper along with the ink wells. Video replaced the need to black-out the classroom to view the projector screen. Computers needed space and an infrastructure of power and connectivity.

Along with new affordances, new technologies have also required new skills, and removed old ones, and as such they have carried with them a hidden curriculum that, while possibly delivering greater effectiveness, has the potential to undermine established practices and cause disruption in the learning environment. Distributing the ink wells was a messy and tedious job but it required a measure of discipline and organisation that served other purposes. Placing the computer in the classroom meant that teachers had to plan around access to it, and then found they had to change their lessons to accommodate the fact that it introduced students to a new world of editing text (and now images).

How will classrooms change, we have asked, as we introduce new technologies? We have asked this question successively in the last 50 years about radio, film, TV, pocket calculators, the overhead projector, and computers, and now about mobile devices. It seems as though concerns about the immanent transformation (even the demise) of the classroom as a consequence of some new technology is an enduring element in the story of the classroom. Curiously though, we have less often questioned those technologies that have quietly become integral to classrooms

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and classroom practice – books, poster paints, the biro, large windows, new designs for classroom furniture, even changes in dress, food and new expectations of childhood.

Perhaps one part of the conceptual error lies in thinking of classrooms as sensitive to single interventions, and it might be better to think of them as enduring and robust cultures or systems that have persisted long past their initial invention as social settings for producing mass literacy. The truth is that classrooms are not easily transformed. They are not simple communicative settings, but socially complex and educationally multi-faceted. As the anthropologist, Jules Henry, often pointed out (for example, in his book, *Culture Against Man 1966*), at any one time, there is almost always more than one set of meanings being communicated and children are always learning more than one thing at a time. Moreover, some children might learn differently in similar circumstances. What gives one child confidence and a sense of success can cause another child to experience failure and self-doubt, or perhaps both at the same time. Henry (1996) used the term "polyphasic" to describe learning in context. One of his examples involves observations of a spelling bee in an elementary class. Here children were not only learning to spell, and as they did so experiencing success and failure, but learning how to contain these feelings in themselves and absorbing them into the social relations and status differences within the class. Classrooms contain many information channels and, to use the language of actor-network theory, new technologies are more often than not ingested into an assemblage that includes the active involvement of human and non-human elements. The technology (in this case of the chalkboard) does not stand alone but takes different roles in the class as its use is adapted for different purposes.

One aspect of this process involves a division between technology usage inside and outside the classroom. Some technologies are classroom specific – the OHP and the textbook, for example, were purposely designed for educational use. Others adopt specific classroom forms. For example, for many years, educational radio, TV and film were instantly recognisable by the use of a very specific form and style of narrative voice (different from, but directly comparable to, a teaching voice) and the liberal use of primary colours in their graphics. More recently this has been replaced by a tone that implicitly insists that learning is fun, but the underlying question has always been whether there might be a threat to the teacher's authority once we admit to the classroom voices and sources that may be more reliable, more current and better researched. We used to ask "Who needs a teacher if you have a good library?" Or, as Marshall McLuhan's words reflect, "Why do we need classrooms once the external environment is richer in information than the teacher?"

It follows that we see "new technologies" less as transforming and more as interruptions to complex routines that need to be managed by teachers and students. This does not mean that some innovations do not have positive educational outcomes – the opening up of editing to students made possible by computers is a case in point – but many technical innovations fail to make an impact, or quickly become absorbed, or even have reverse effects to those intended (much individualised learning led to curriculum uniformity rather than diversity).

There have, of course, been significant transformations in classrooms and in teaching, though in each case, technology has been a contributory aspect rather than a direct cause. The invention of mass instruction ("whole-class teaching") in the mid-nineteenth century remains the most significant, along with forms of small-group organisation in the post-war period. In both cases these have involved a network of actors and new affordances. Some of these were in architecture and design – larger roof spans, new forms of lighting, innovations in furniture design. Some were in curriculum and pedagogy – the availability of printed text and the need for associated literacies, reconceptualisations of teaching and learning as ideas about knowledge and skills shifted. And perhaps above all there have been new social visions that included education as a key element in progress, emancipation and individual achievement. The visionary industrialists of the nineteenth century and His Majesty's Inspectorate (in the UK) in the post-war period played a significant part in engineering change alongside the work of a remarkable generation of teachers.

Current Issues in Primary Education in the UK

Where Are We Now?

Sometimes it must seem to children growing up in Britain today that they cannot win. When their lives and enthusiasms are reported to the adult world in newspapers, on the radio or on television it is all too often in terms of stereotypes. At one extreme they appear as suffering innocents or "brave little angels" in a dark and menacing world. At the other, they are portrayed as little devils: The "tiny tearaways" whose anti-social behaviour is supposed to be beyond the control of parents, teachers and police. They find themselves bemoaned as an obese, screen-obsessed generation of couch potatoes, leading pampered and over-indulged home lives: yet they are represented as the over-worked and over-stressed victims of a hardened selfish society where they can no longer be sure of proper physical or emotional nourishment (Alexander and Cambridge Primary Review 2009).

In the wake of a 40-year period in which UK primary schools have been pulled into a centralised and unified national curriculum, the *Cambridge Primary Review* looked in detail at children's lives and primary education in the early twenty-first century and begin their report with an assessment of a popular myth about the difficulties of childhood. Alongside this, the *Children's Society Report* found that "In many ways our children have never lived so well" (Layard and Dunn 2009).

These two sources contrast with a more popularist text on growing up in twenty-first-century Britain, *Toxic Childhood* (Palmer 2006), where screen-based technologies are ranked alongside family breakdown and bad diets as a cause of the eponymous condition. In short there is a pervasive image, promulgated by the mass media, that childhood in twenty-first-century Britain is a troubled and troubling experience.

The disjunction between moral panic in response to society running out of control and a strong desire for schools to reassert order has recurred for as long as we have had compulsory schooling. Yet, if you visit schools on most days, in most classrooms, you will find lively and optimistic children working with good teachers in positive ways. Despite the rhetoric, many of them are engaged with screens and using learning technologies in productive and creative ways.

Technology cannot easily be disentangled from these powerful myths about the corruption or loss of childhood, for it is itself an important element within them. The role it plays in children's lives and their education is bound up with the myths and assumptions about the quality of childhood in Britain. It is impossible to consider the current and future state of educational technology without acknowledging that we are on non-rational and often controversial ground, and that technologies, especially those that are screen based, have been blamed, directly or indirectly, for violence, obesity, lack of educational achievement, poor social skills and just about any other ill of modern society. Yet in the largely positive classrooms which educationalists know exist widely, technology is omnipresent, in desktop computers, interactive whiteboards, laptops and even in the mobile phones (although switched off!) in practically every teenager's pocket. So how did we get here? How did we end up in a technology-permeated world with technology as part of the education system, yet its part in children's lives is still sometimes questioned, sometimes derided and frequently feared?

In order to provide an answer the question of where we are now, we need to look outside classrooms as well as within. Over a 30-year period we have seen a range of government initiatives, central and local (and to some degree European). These have funded hardware and training, promoted successive technologies, encouraged teachers and promoted case examples of good practice.

The story we tell here begins in the 1980s, when the UK government (along with many others throughout the world) decided that it would be a good idea to put computers in schools. Until then, largely seen as industrial or commercial tools, computers had begun to invade the workplace and now began to be put in schools and in homes. The race to be the school computer of choice was won by the BBC Microcomputer, developed originally for the Open University. Heavily promoted by a government anxious to keep a home-grown computer assembly industry, it was quickly adopted by schools where children played simple educational games and learned to program.

While they used this computer at school they played on the more game-focused Sinclair Spectrum computers at home, and there began a troubling divide between home IT and school, a divide which still exists, and is even wider, today. While many IT advocates attempt to close the gap between "work" and "play" by bringing games-oriented programs into school, the two worlds remain distinct and largely apart. What counts as learning, the nature of assessment, how people collaborate, calls on forms of creativity, use of time, location, social networking, all remain distinctively different in work and play environments in schools (though some software companies claim to have merged work and play cultures).

Following significant government-funded programs (the National Program in Computer-Assisted Learning in the mid 1970s, which was aimed primarily at universities, and the Microcomputers in Schools Program in the 1980s), the UK saw heavy investment in in-service training for teachers and the move of computers away from the school office and maths departments in secondary schools to a more ubiquitous presence throughout the system. Initially this was managed by creating computer suites and dedicated computer rooms but this quickly led to the use of trolleys that could be wheeled to the point of need, and then to classroom-based laptops and strategically placed desktop machines.

By the end of the 1990s, the situation was that schools were well equipped in terms of current hardware, computers were networked and systems managed by specialists and most teachers had basic competence in software for word processing and internet searching. One of the outstanding problems was around safety issues. There has been considerable popular debate about the best ways to keep the excesses of the internet at bay – pornography and chat rooms in particular, but among those better informed, there is equal concern about credit card fraud, the activities of small but extremist political groups – often right-wing groups linked to music and teen culture sites – and about bullying and harassment. Most school systems managed these problems by putting in place software that limited access to the internet but the problem was that this slowed access speeds and made the internet almost unusable, given that most schools were still operating with a limited number of dial-up telephone lines. It was only when broadband became more widely available and cheap to access that schools were able to make effective use of the services increasingly becoming available. The result was that for a period of 5 years or so from 2000, most children accessed the internet at home, or from public libraries and community-based centres when they were doing school work, and often used internet cafes for game playing.

A key organisation (from the days of radio on) in the UK has been the BBC. Particularly in the 1940s and 1950s, the BBC sponsored Schools Broadcasting that brought valuable curriculum resources into schools. This was later developed into extensive educational output through television and, later, video. Faced with the changes in schools' use of computer technologies, the BBC turned to providing web-based resources alongside a program called "Blast!" which was a mobile multimedia lab which toured the country providing teenagers with hands-on experience in working with a range of media.

While these developments were a natural response to increasing convergence they brought the BBC (a publically funded service organisation) into conflict with the private sector, particularly a company called Research Machines (RM), which had grown from being a provider of cheap, basic computers for schools to becoming the major provider of IT services for education. Faced with accusations of unfair competition, the BBC effectively closed its educational provision and reduced its web presence.

Another recent loss in IT infrastructure is the (2010) decision of the government to close BECTA – this has been an agency offering advice and guidance on the educational uses of IT, has provided valuable research data on use and uptake of

new technologies and has been particularly active in encouraging parental involvement.

Among surviving organisations working in the UK to promote effective and innovative use of technology is Futurelab. Futurelab, as its name suggests, has been forward-looking and has developed useful software and materials for use in schools. It has also run extensive workshops and information-gathering sessions and reported its work through a well-attended annual conference. If we have a contemporary equivalent to the role played by HMI in the post-war period it probably lies in NGOs like Futurelab, Ultralab and research groups at the Open University and elsewhere.

Case Study: The Story of the Lesson

We do not pretend that this classroom is typical, but neither is it entirely atypical. The school has been recently rebuilt and reorganised (a First and Middle Schools redeveloped as a Primary School in line with local policy). The teacher was known to us and was willing to let us observe her class. The school is in an urban setting but not one of income extremes.

Henri has a year 5 class. She is a recently qualified teacher, although she has considerable experience in teaching in other countries. The class are working on a project around making news. The lesson is seen as a project-based curriculum project though clearly incorporates aspects of literacy.

The students had recently visited the local newspaper offices and were beginning to produce news in a number of ways. One group are preparing stories for the school radio station while others are preparing written news stories. There is a strong focus on the skills of journalism, and the children are keen to discuss what makes a good journalist and what makes a good news story, and where to find the news. When we ask, they tell us:

- The journalist looks at the internet to get stories, he checks to see what other people have said.
- My mum reads the paper but I like to listen to the radio. It's more like "now" on the radio.
- I like the *Newsround* website (*Newsround* is a BBC News program that goes out about 5 pm and is aimed at younger viewers), it tells you how to make a news story.

The whole-class teaching was based on careful teacher questioning – with the teacher encouraging reflection on students' visit to the newspaper offices. The teacher prompted the children to consider the decisions the journalists had made, asking such questions such as:

"How did the journalists decide what was a good story?"
"What was the first thing they did?"
"How did they decide on a headline?"

By linking the rationale and the process for journalism in the lesson, Henri encouraged the children to reflect on the rationale and processes of their own task. However the decision making about choices in the stories they were writing lay with the children, not the teacher, and as such levels of pupil engagement are high.

In the lesson the children work in their writing books and use their personal laptops (each child has their own named machine which they can choose to access at any time in the lesson). They use the laptops both to look up and record information. Both the teacher and the children use the Interactive Whiteboard (IWB or Smartboard) to access the internet and the teacher uses it to guide the children's learning and record their ideas.

Technology is part of the everyday life of this classroom. This is evident in the way that the children move between traditional paper-based resources like their writing books and newspapers and the newer learning technologies. It is also noticeable that there is substantial pupil-to-pupil and pupil-to-teacher talk, often centred around the screens, with lots of sharing, pointing and discussion about the websites used and their ideas.

One group of children were keen to talk about their school radio station, where they record programs and are able to play them to their peers. They talked about how they had learned to work the equipment and to make programs, their enthusiasm clearly captured by this medium. Resources for the lesson are managed through the IWB, from which the teacher accesses the school VLE, where resources were stored.

The most striking thing about the lesson is the number and diversity of literacy skills on display in the lesson and seamless ways in which the children (and teacher) move between them. There is very little changing of gear as they move from one to another; the transitions are smooth and seamless. Some of these skills are traditional, others are "new," but, perhaps most important, the children have to navigate their way through a wide range of possibilities, making judgements about what to say and what to write at each point. The range of options includes:

Aspects of literacy in terms of speaking and writing:

- Pupil-to-pupil talk about technical aspects of the work, what to do next and about their visit to the newspaper.
- Pupil and teacher talk about what to do, about writing conventions in different genres, about the visit to the newspaper, about technical aspects of what to do, praise and encouragement in their work.
- Pupils write in their books in pen and pencil, drafting stories. The teacher focuses on ways of organising writing in her group and individual teaching and the children respond well, understanding how conventions of writing affect the way the written piece communicates to the reader.

In terms of listening and reading:

- Pupils and teachers engage in conversations throughout the lesson; ideas are shared and discussed.
- Pupils and the teacher read a variety of texts: newspapers, displays on the walls, electronic text via the IWB and the laptops, as well viewing both still and moving images on a *Newsround* website.

Reflecting on the lesson, one question raised is about the nature of these literacies. There is no doubt that the modes of teaching, including the deployment of learning technology, created high levels of pupil engagement in learning, and in engagement in literacy. But to what extent this constitutes "new" literacies, or traditional literacies, or something in between, is open for discussion.

The term "literacy" has been widely used in Primary Education in the UK since the late 1990s with the introduction of the "Literacy Strategy" in Primary schools. This initiative was aimed at raising the standard of the teaching of reading and writing, and as a result improving the test scores of pupils leaving Primary schools for Secondary Schools. In general terms, the policy initiative did achieve this, but there were some unexpected outcomes in terms of an impact on pupils' ability to write at length and in terms of speaking and listening related to writing. This was thought to be mainly due to the restrictive and prescriptive nature of the pedagogies introduced as part of the Literacy Strategy. Some of this criticism has come from new pressure groups, particularly from those who write books for children and from the creative sector generally. As a result, in the past 10 years, both policy makers and individual teachers have been engaged in rethinking what effective literacy teaching might mean. It is in this context that "new" literacies have begun to emerge in schools. Broadly speaking, these new literacies acknowledge that many of the forms of communication which children now encounter are delivered by "new" electronic media, the understanding and creation of which require a different set of skills from "traditional" literacies. This is not just a question about working on screens rather than on paper; it is about moving between different forms and different genres with a degree of confidence. It is about editing and production.

Towards New Literacies

The idea of a developing and evolving definition of what it means to be "literate" is not a twenty-first-century concept. Teachers of media studies in schools have been addressing the issue of developing appropriate literacy teaching and learning for many years. What has changed in the past 20 years is the rapid pace of developments as a result of new digital cultures and practices, both in education and in children and young people's lives in general.

So what is twenty-first-century literacy, and how can teachers like Henri approach teaching in new ways to make the children in her classroom literate for the world in which they are growing up?

There has been much focus in the early twenty-first century on narrowing the "digital divide" (BBC 2010) between rich and poor children and families.

While there has been moderate success in allowing access to digital resources for children and families from a range of backgrounds, there remains a divide between the technologies that children and young people use in their lives within and outside schools. Outside school many children and young people lead complex and lively digital lives, interacting through social networking and gaming consoles,

and using their mobile phones for a variety of functions as diverse as texting, taking photos and accessing websites. In schools, the pace of adoption of the latest digital technologies is slower, with mobile technologies and the complex communications capacity of the web being largely unused. This divide between in-school and out-of-school technologies raises a range of questions for teachers and education policy makers: To what extent can or should schools seek to utilise the available technologies within schools? And to what extent can or should schools develop their approaches to literacy to encompass the new literacy of the twenty-first century?

Futureproofing Schools

Schools in the UK face a very challenging time at the time of writing. After a decade of substantial investment, a change of government, coupled with the global financial crisis, has meant that education finds itself under serious financial pressure. For schools, the demise of the "Building Schools of the Future" program (Department for Education 2010) and BECTA (2010) has meant that important support networks for the development of classroom spaces which embrace learning technologies have disappeared. The results of these developments, and perhaps more to come, have yet to be fully understood. It does seem, however, that schools will be encouraged to take a more autonomous approach to their curriculum and resources development. With new education policy encouraging schools to leave local authority control to become "academies" and new "community-based" schools being set up under the "Free Schools" initiative there is scope for schools to set their own agendas and it could be that these are conditions under which pedagogical development could take place. The question this raises, however is what are the prerequisites for developing a future proofed pedagogy? The answer encompasses the following:

- Teachers need to be well supported, from both within their schools and from outside agencies to develop the own pedagogical approaches.
- Head teachers and school leaders need to be well informed about the most recent developments in terms of resources and pedagogies in order to provide effective leadership in their schools.
- If we want teachers who are inventive and creative, then we need to find ways to invest in them that support these qualities. Teaching is not simply a performance that can be scripted. Teachers bring to teaching their lives and careers, interests and enthusiasms, not just their training.
- Schools need to be adequately funded to enable them to build and resource teaching spaces that enable schools to innovate.

In the United Kingdom, education in general and schools in particular have some interesting times ahead, as cuts to funding bite and new initiatives take hold. Much of the future of twenty-first-century literacy in schools, it seems, as it perhaps always has, will depend on individual schools and teachers.

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Chapter 8
Teaching and Learning: Tales from the Ampersand

Pam Hook

Introduction

Whilst the terms teaching and learning are almost routinely joined together in educational debates, there are questions that can be raised about the extent to which learning outcomes are a *genuine* focus within these discussions. The task of trying to meet the needs of diverse students is challenging; it is easier to offer simple technology-based solutions and neglect the broader issues around pedagogy. The Differentiated Curriculum Model (DCM) explored in this chapter is focused on learning outcomes through the use of The Structure of the Observed Learning Outcome (SOLO) Taxonomy, and is an attempt to address the needs of diverse students in technologically mediated environments whilst keeping a focus on pedagogy. SOLO is a model of learning that makes learning outcomes visible to all regardless of age, gender, culture or socio-economic background. The DCM is used in New Zealand to provide diverse students with an explicit common language for learning outcomes, for self-assessment and peer-assessment. With the DCM, diverse students learn to synthesise and integrate information; identify learning experiences and learning interventions aligned to their intended learning outcomes; choose relevant technology-mediated environments in which to learn; and build knowledge to create new understandings. In this way diverse students become versatile learners with ownership and control of their learning outcomes. Uncertainty is seen as a challenge rather than something overwhelming, paralysing or something that cannot be influenced. Positioned in the ampersand of teaching *and* learning when supported to have autonomy over their learning and their

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outcomes, diverse students are ready to live well with others in whatever contexts their futures might offer.

> Before we knew about SOLO we were basically prestructural or unistructural (about learning) we didn't know how to get up to relational or extended abstract. Learning was just … you know … ask a question and answer it. But now we can get deeper and find out more using this thinking. It is definitely better now we know what to do. (8 year old students describe learning with SOLO Taxonomy)

When asked to imagine what is needed for an uncertain future we think of stockpiling items for survival; plastic containers of clean water, materials to make fire and shelter, goods for barter, weapons for protection. We also need to learn how to live well with others.

Living well with socially and culturally diverse others requires people who can make good choices around participation and who can offer good actions when it comes to contribution. To make good choices requires cognitive skills in synthesising and integrating information; to take good actions requires social skills. The heterogeneous socio-cultural demographic of New Zealand is changing rapidly and provides many rich contexts for learning those future-proofing cognitive and social skills. However, when it comes to developing the cognitive skills required for living well with others, the New Zealand education system is marked by "high quality: low equity" outcomes (UNICEF 2002). Stuart Middleton opined in his keynote address to teachers at the Learning at School10 Conference, "We have the best education system in the world for some students," (Middleton 2010). The Minister of Education, Hon. Anne Tolley, captures a similar sentiment with "We know that many of our students are among the best in the world, but we also know that we have a large group that fall well behind" (Ministry of Education 2010c). These opinions reflect the international benchmark reports for reading, mathematics and science literacy (PIRLS, TIMSS and PISA) that continue to reveal that, although New Zealand students are achieving above average outcomes compared to other OECD countries, there is a wider variation in these literacy, numeracy and science outcomes than is observed in other similarly achieving countries (Ministry of Education 2010a).

In terms of equipping all New Zealand students with the necessary future-proofing cognitive and social skills the real numbers behind this variation tells us that in 2008 nearly a third (29%) of young New Zealanders left school without the New Zealand National Certificates of Educational Achievement[1] (NCEA) level 2 qualification, the minimum necessary qualification platform for further study, training or skilled employment (Department of Labour 2009). The gap between high-performing and low-performing students in New Zealand represents a lost potential that undermines the future opportunities for a significant proportion of young people. The variation in achievement outcomes within New Zealand schools continues to be larger than between New Zealand schools. Even more concerning are the

[1] National Certificates of Educational Achievement (NCEA) are New Zealand's national qualifications for senior secondary students. NCEA is part of the National Qualifications Framework.

statistics for Maori and Pasifika[2] students whose achievement continues to be outstripped by Pakeha[3] and Asian students. Maori students continue to be more likely than non-Maori to leave school with no qualification. Maori and Pasifika students continue to be overrepresented in the number of students who leave school without the NCEA level 2 qualification. Whilst 29% of students leave school without NCEA level 2 or above, the rate increases to 37% for Pasifika students and 50% for Maori students (Ministry of Education 2010b, c).

A failure to address equitable learning outcomes for all young New Zealanders translates into a future where we have failed to future proof almost a third of young New Zealanders with the cognitive and social skills necessary to reduce the risk of social and economic disadvantage and poverty.

The daunting task of trying to meet the needs of diverse students sees people looking for simple solutions. A common pattern in this regard is to try and find what "the group" has in common. This has resulted in a wave of projects designed to respond to the assumed characteristics of the so-called "millennial learners" (or screenagers, or thumb people, or digital natives, or gen now, or gen next or whatever the current label is). These projects put forward technology as some kind of magic fix for meeting the needs of diverse students, a panacea for all that troubles us; projects that often completely forget about the broader issues around pedagogy. Thus whilst the terms teaching and learning are almost routinely joined together in these educational debates around gross demographics, there are questions that can be raised about the extent to which learning outcomes are a *genuine* focus within these discussions.

Any future-proofing curriculum, however gently conceived, needs to be flexible enough to include all New Zealand's diverse students regardless of their age, gender, languages, culture or socio-economic background. It needs to include a broad palette of what we understand works for diverse learners, and be designed around these pedagogical approaches that keep the focus on the learning outcome. Most of all in conceiving a curriculum we need to resist the idea that any technology is automatically an aid to learning or understanding; to understand that in technologically mediated environments – just like all other environments – it is up to the teacher to provide students not only with competencies in technology use, but skills in understanding learning and relationships formed when using technology.

This chapter explores a future-proofing curriculum and programme currently in place in New Zealand. The New Zealand Curriculum (NZC) and Te Marautanga o Aotearoa Curriculum (for years 1–13 in English- and Maori-medium settings respectively) have a flexibility that encourages the explicit development of local curricula that cater for diverse contexts (Ministry of Education 2007, 2008). The Iterative Best Evidence Synthesis Programme provides the evidence to help educators address "what works and why" when meeting the learning needs of diverse learners (Ministry of Education 2003a). It is designed to challenge low-equity

[2] Pasifika are Pacific peoples who are now living in New Zealand.

[3] Pakeha are New Zealand-born people of European descent.

outcomes and encourage quality teaching that is evidence-based and caters for both diverse learners and contexts.

Flexibility within the NZC allows the development of school-based curricula to meet the needs of diverse students. Schools who adopt the DCM as their school-based curriculum develop student versatility. The DCM is purposely designed to develop the cognitive and social skills needed to live well with others. Using SOLO, diverse students are able to describe what they are learning, how well it is going and what they intend to do next using a common language of learning based on the explicit, proximal and hierarchical SOLO learning outcomes. Students are confident in their ability to synthesise and integrate information to make decisions.

This provides students with an important sense of ownership and control. Rather than being passive in a learning environment they are very much active in the creation of learning environments and strategies which meet their needs. When in control they are able to see uncertainty as a challenge they can attempt to master rather than something that they cannot influence. Students in control of their own learning understand that there is a future role they can play, future processes they can influence; they become engaged in learning and feel hopeful about the future. It seems plausible that schools with an explicit model of learning, a model that allows ongoing assessment for improving learning outcomes, will also find it easier to show the "high quality: high equity" outcomes so critical to preparing – future proofing? – diverse students for living well with others.

Logical Processes for "Learning to Learn"

> It helps us to learn. It helps you to think and do a few things that you want to do. Because it helps you connect ideas and learn and think in your head. (5–6 year old student describes learning with SOLO Taxonomy)

Learning to learn is a significant component of any future-proofing agenda and a "non-negotiable" principle in the NZC (Ministry of Education 2007, p. 9). When teaching and learning focuses on learning outcomes they become explicit and visible for students and their teachers. Students can explain what they are learning, assess how well it is going and judge what they should do next. They are versatile. Conversely, the lack of a simple, explicit and reliable model of learning and processes for learning to learn and identifying learning outcomes can hamper students' capacity to offer these explanations and judgments. This is especially the case for those diverse students who enter school from economically poor households without the experiences, resources and social capital favoured by the institution of school.

Diverse students need a model of learning that makes learning outcomes explicit and visible to all regardless of gender, cultural and socio-economic backgrounds if they are to learn to learn. The DCM, a curriculum based upon SOLO, identifies three key elements, four school-wide commonalities and at least six logical processes

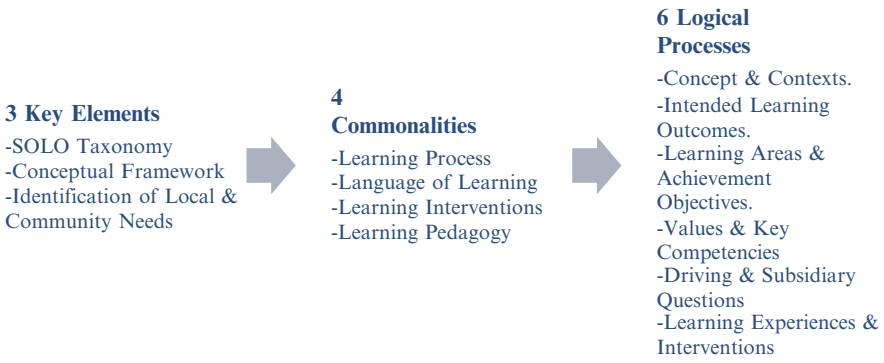


Fig. 8.1 Elements, commonalities and processes in the DCM

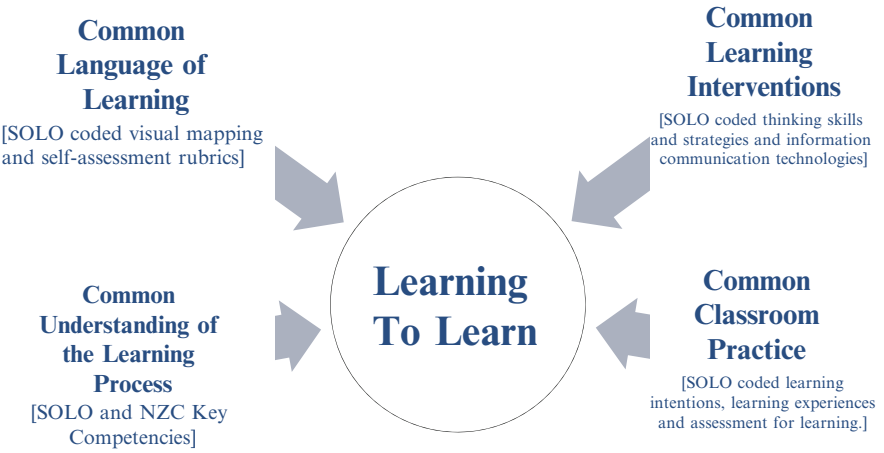


Fig. 8.2 Shows the common understandings necessary for "learning to learn"

of value when helping diverse students learn to learn (refer Fig. 8.1). The DCM is more iterative than linear in its design – relying upon continuous rather than restricted feedback during its design, implementation, and assessment phases. It is an emergent curriculum with a coherent vision of "learning to learn" where the detail of the logical processes is intended to emerge over time.

An explicit model of learning outcomes – SOLO Taxonomy (Biggs and Collis 1982), a conceptual framework to develop learning experiences, and the identification of local and community needs as contexts for student knowledge building (Bigum 2004) are **three key elements** to a future-focused curriculum. **Four commonalities** are necessary for "learning to learn" (refer Fig. 8.2). These are a common

understanding of the learning process (SOLO and NZC Key Competencies), a common language of learning (Visual mapping of SOLO learning verbs and self-assessment rubrics), common learning interventions aligned with SOLO learning outcomes (ICT and thinking) and common classroom practice (Constructive alignment[4] of ILOs and learning experiences against SOLO).

The **six logical processes** – concept & contexts, ILOs, learning areas & achievement objectives, values and key competencies, driving & subsidiary questions and learning experiences & learning interventions – are only loosely defined. Content detail emerges over time as a consequence of continuous feedback and feed-forward discussion to test and improve the learning outcomes. Adopting an iterative design approach for "learning to learn" helps ensure a responsive curriculum. Iteration and refinement of any process can occur at any point in the learning cycle, and are influenced by student learning outcomes or learning behaviours which in turn influence the design detail of the other processes.

This chapter describes the DCM and the learning-to-learn processes used in New Zealand schools. The first part examines SOLO as a model of learning and framework for developing a language of learning. This is followed by an explanation of how schools use the processes for "learning to learn" and how this supports the needs of diverse learners.

SOLO as a Model of Learning

> I think that SOLO helps us by letting you do things for yourself not someone doing it for you. (Year 6 student describes learning with SOLO Taxonomy)

SOLO is integral to the DCM which is designed to help diverse students "learn to learn" by focusing on the ampersand in teaching and learning, the learning outcome (refer Figs. 8.1 and 8.2). SOLO is a model predicated on "what the student does" rather than "what the student is" or "what the teacher does" (Biggs and Tang 2007, p. 16). It provides an explicit model of learning (and a common language of learning) for what to do when you don't know what to do next and for supporting student relationships.

SOLO provides a simple, reliable and systematically hierarchal way of describing how a learner's performance grows in complexity when mastering any academic task (Biggs 1999, p. 37). SOLO is content independent and thus provides a generic measure of understanding across different disciplines and within different kinds of environments, including those that foreground various forms of information technology. In addition SOLO provides obvious and reliable discriminators between

[4] Constructive alignment is a process used for designing intended learning outcomes, learning experiences and assessment tasks, where there is a deliberate alignment between the planned learning experiences and the learning outcomes. Students are actively involved in assessment (self and peer) to reinforce learning.

Fig. 8.3 Students from Waterlea School demonstrate hand signs for SOLO learning outcomes

simplistic and more sophisticated levels of outcome, and thus of the quality of the learning outcome. Diverse students in Year 0 and 1 classes, in ESOL programmes, and full immersion Te Reo Maori Rumaki Units[5] find it easy to use simple SOLO hand signs to describe their learning outcome against SOLO and what they should do next (refer Fig. 8.3). Older students find it easy to self-assess and peer-assess learning using SOLO-coded assessment rubrics using success criteria they have helped construct.

At the p*restructural level* of understanding (*Whakarangaranga*), the task is inappropriately attacked, and the student concedes they have missed the point and need help to start. At the u*nistructural level* (*Rangaranga Takitahi*), one aspect of the task is picked up, and student understanding is disconnected and limited. At the *multistructural level* (*Rangaranga Maha*), several aspects of the task are known but their relationships to each other and the whole are missed. At the *relational level* (*Whanaungatanga*), the aspects are integrated through sequencing, comparison, causal explanation etc., and contribute to a coherent understanding of the whole. At the e*xtended abstract level* (*Waitara Whanui*), the new understanding at the relational level is re-thought at another level, and used as the basis for prediction, generalisation, reflection, or creation of new understanding.

SOLO can be used to design learning experiences for declarative knowledge (knowing about) and functioning knowledge (exercising active control over) (Biggs and Tang 2007, p. 81). The relational and extended abstract levels of SOLO also focus learners on actively exploring relationships with others and in doing so changing the way students feel about themselves and others. For example, when 5-year-olds are self-assessing their functioning knowledge, in terms of how they manage themselves at the start of the school day, a unistructural outcome might simply see them putting their book bag away, whilst an extended abstract outcome sees them managing their own getting-ready-to-learn activities and looking around to see ways in which they can improve these and or can help others. When older students investigate risk management in travelling to and from a big event, they understand it at an extended abstract level when they collaborate successfully to create a collaborative resource (e.g., online Google map, geocache, Twitter channel, YouTube Channel,

[5] Whänau Rumaki are total immersion Mäori language units set up within main-stream school systems. Rumaki Units operate under the governance of each school's Board of Trustees.

blog or wiki) to which other footpath adventurers, pavement crack tourists and sidewalk sightseers can refer (and contribute) when they travel safely between their homes and the places where people gather to take part in a "BIG Event" (New Zealand Transport Agency 2010). SOLO learning outcomes at relational and extended abstract levels require both cognitive and collaborative activity. The collaboration required changes relationships between diverse students and others, and this changes how students feel.

> Tino pai rawa atu te Akoranga nei natemea, ka taea e au ki te ako i te kaupapa, ki te whakamarama i te kaupapa me te mohio kei hea te taumata maku. Ka mohio au mehemea kei te taumata 'whakarangaranga' ka piki ake taku matauranga ki te tae atu ki te 'rangaranga takitahi.' Kei te taumata 'rangaranga maha au etahi wa kei 'whanaungatanga' heoi ano ko te wawata kia tae atu ki 'waitara whanui' natemea ko tera te taumata teitei moku. He rawe te kawe tahi i te ako o nga kaupapa i te taha o te Kaiako, natemea ka tu rangatira au. Tauira tau wha.
>
> Translation: I enjoy using SOLO rubrics because I can self assess and peer assess, and everyone knows where they are in their learning. I know that if I start at prestructural I need a lot more help from the teacher, and my main goal would be uni structural learning. I am not at prestructural or unistructural, but at multistructural and sometimes relational, and my main goal is to be extended abstract. I like how we share the learning in the class, it makes me feel important. (Year 4 student describes learning with SOLO Taxonomy)

SOLO can be used by diverse students and educators alike to define curriculum achievement objectives, ILOs and learning experiences that describe different levels of cognitive complexity, and for evaluating learning outcomes. It is possible for teacher and student to determine the cognitive and functional complexity of student understanding and where to target the learning experiences and learning intervention (refer Fig. 8.4).

In making learning outcomes visible, SOLO helps diverse students and their teachers identify the complexity of a student's understanding and from this determine future learning needs – the "where to next?" This means SOLO plays a pivotal role in building student versatility. Both teacher and student have an understanding of learning outcomes that enables the design of cognitively differentiated ILOs through constructive alignment, success criteria and learning experiences, the "what am I doing?", and the assessment of cognitive complexity within learning outcomes, the "how well is it going?" and "what should I do next?"

SOLO has advantages over Bloom's cognitive taxonomy (Bloom 1965), the traditional taxonomy for differentiating learning experiences. SOLO is a theory about teaching and learning based on research on student learning rather than a theory about knowledge based on the judgments of educational administrators (Biggs and Tang 2007, p. 80). A second advantage lies in SOLO's facility in enabling student and educator to understand and evaluate learning experiences and learning outcomes in terms of ascending cognitive complexity (Hattie and Brown 2004). Thus, if SOLO is used to design the learning experience and its assessment, then it is possible to design the follow-up learning experience at an appropriate level of cognitive complexity in order to challenge yet not overwhelm. SOLO can be used to design a learning experience or ask a question at one level of cognitive

Mahere Aromatawai/ Aromatai	keite ako inga tikanga o te hanga Tuhinaga Taki, tika ai.
 **Waitara whānui**	Ka taea te hangahanga Tuhinga Taki ā- Whaiaro, aha rānei e pā ana ki ngā kaupapa kato huri noa i te Ao whānui, kātahi ka whakahiato hei *hangā* Pukapuka rauemi motuhake māna ake, kātahi mō te *Iwi whānui* hei tauira
 **Whaīnaungatanga**	Ka taea te hangā Tuhinga taki Whaiaro rānei mā te whakamahia te Tukanga tuhituhi me te whai i te Anga Tuhinga Taki kātahi ka *whakamārama* i aua wāhanga me te *tūhono* i te katoa hei hangā kōrero whanui
 **Rangaranga Maha**	Ka *raupapatia* ngā whakaaro, mahere ai, ka timata ki te whakamahia ngā ara tikanga tuhituhi whānui.
 **Rangaranga takitahi**	Ka *tāutu* tētahi tikanga o te Tuhihga Taki mīa te whai i ngā ara e rua.
 **Whakarangaranga**	Mā te Kaiako au ka *tautoko* ki te tuhinga taki, mārama ai.

Developed by Lisa Te Aurere Reweri 2010. *Attributed to Hooked on Thinking*

Fig. 8.4 SOLO self-assessment rubric used by Rumaki Unit students at Sunset Primary School, Rotorua

complexity whilst at the same time determining different levels of complexity in the student learning outcomes or answers within that level. For example it is possible to design a learning experience using compare and contrast, a declarative knowledge verb at the relational level and at the same time assess a student's learning outcome or answer against success criteria written at unistructural, multistructural, relational or extended abstract levels. Finally and significantly, when working with teachers, SOLO provides greater clarity when writing ILOs. For example an intended learning outcome from the "understanding" level of Bloom's revised

taxonomy includes verbs such as classify, compare, exemplify, conclude, demonstrate, discuss, explain, identify, illustrate, interpret, paraphrase, predict and report (Anderson and Krathwohl 2001). SOLO differentiates these verbs from one level in Bloom into three different levels of learning outcome, allowing a more effective targeting of ILOs and greater clarity when helping students learning to learn (Biggs and Tang 2007, p. 80).

SOLO and a Language of Learning

> I use the SOLO Taxonomy in all my subjects, it helps me plan out what I am writing, what I am doing, how to work things out. If I want to get this far I have to chuck in some relational aspects of it … and once you have written your essay, your paragraph you can reflect back on it or think about what you have done, evaluate how you have done your work and kind of reapply it, try a bit harder, change it to show extended abstract thinking. (Year 11 students describe learning with SOLO Taxonomy)

Associating the levels in SOLO with "declarative knowledge verbs" (Biggs and Tang 2007, p.79) has been fundamental to developing a visual language of learning in the DCM. Learning verbs selected from commonly used achievement, merit and excellence task descriptors in NCEA are used in a visual language of learning to help diverse students learn to learn. Ten visual maps based upon the different learning verbs are coded against a level in SOLO, and have associated SOLO-coded self-assessment rubrics containing five hierarchical SOLO-coded success criteria. Target vocabulary and student exemplars help scaffold learning literacy learning outcomes (refer Table 8.1).

The visual nature of the maps and their associated self-assessment rubrics make the process of "doing" the learning verb explicit to diverse students. The language of learning in schools – define, describe, sequence, classify, compare and contrast, causal explanation, part whole analysis, analogy, generalise, predict and evaluate – is made visible to diverse students regardless of their age, gender, culture or socio-economic background. For example, the HOT compare and contrast map and self-assessment rubric, in Fig. 8.5, is at the SOLO relational level because the process of comparison requires students to link relevant ideas. However, the comparative statement formed from the map can itself be coded against SOLO. The process of comparison asks students to identify relevant similarities and differences and they can do this by listing (SOLO multistructural learning outcome), listing and linking ideas through explanation (SOLO relational learning outcome), and by listing, linking ideas through explanation and looking at the linked ideas in another way through generalisation (SOLO extended abstract learning outcome).

By identifying the cognitive complexity of the learning experience the diverse learner and the teacher can purposefully target the desired learning outcomes with specific learning interventions. Deliberate and purposeful acts of teaching and learning follow. For example students wanting to understand the ideas and information they have researched about aid agencies in New Zealand may choose thinking skills/strategies or information communication technologies (ICT) to connect and link

Table 8.1 Student learning outcomes and learning interventions

Student learning outcomes and learning interventions [Level of understanding displayed and hooked on thinking language of learning map and rubric]		
SOLO taxonomy Structure of observed learning outcomes (Biggs and Collis 1982)	Example	Learning intervention Language of learning map and rubric
Extended abstract 	Learning outcomes go beyond subject and makes links to other concepts – generalises	HOT generalise map and rubric HOT evaluate map and rubric HOT predict map and rubric
Relational 	Learning outcomes show full connections made, and synthesis of parts to the overall meaning	HOT analogy map and rubric HOT cause effect map and rubric HOT analyse map and rubric HOT compare contrast map and rubric HOT classify map and rubric HOT sequence map and rubric
Multistructural 	Learning outcomes show connections are made, but significance to overall meaning is missing	HOT describe map and rubric
Unistructural 	Learning outcomes show simple connections but importance not noted	HOT define map and rubric

these ideas for a relational level learning outcome. Thinking strategies with SOLO relational learning outcomes include concept maps, Venn diagrams, SWOT analysis, continuum lines, T-diagrams, time lines, cycles, story boards, GANTT charts, De Bono's Yellow and Black Hats, and CoRT thinking Plus, Minus and Interesting. ICT applications to target SOLO relational learning outcomes in the aid agency research include UQuinturaUH http://www.quintura.com, a visual search engine that clusters/classifies/groups and links related topics, collaborative timelines like HUXTimelineUH http://www.xtimeline.com/index.aspx for sequencing information with others, collaborative concept mapping like C Map http://cmap.ihmc.us/ or Webspiration http://mywebspiration.com/ for classifying, comparison, causal explanation of aid agency outcomes, and HCenSEARCHipUH http://carl.cs.indiana.edu/censearchip/ a censorship search tool allowing students to compare search results for topics in different countries.

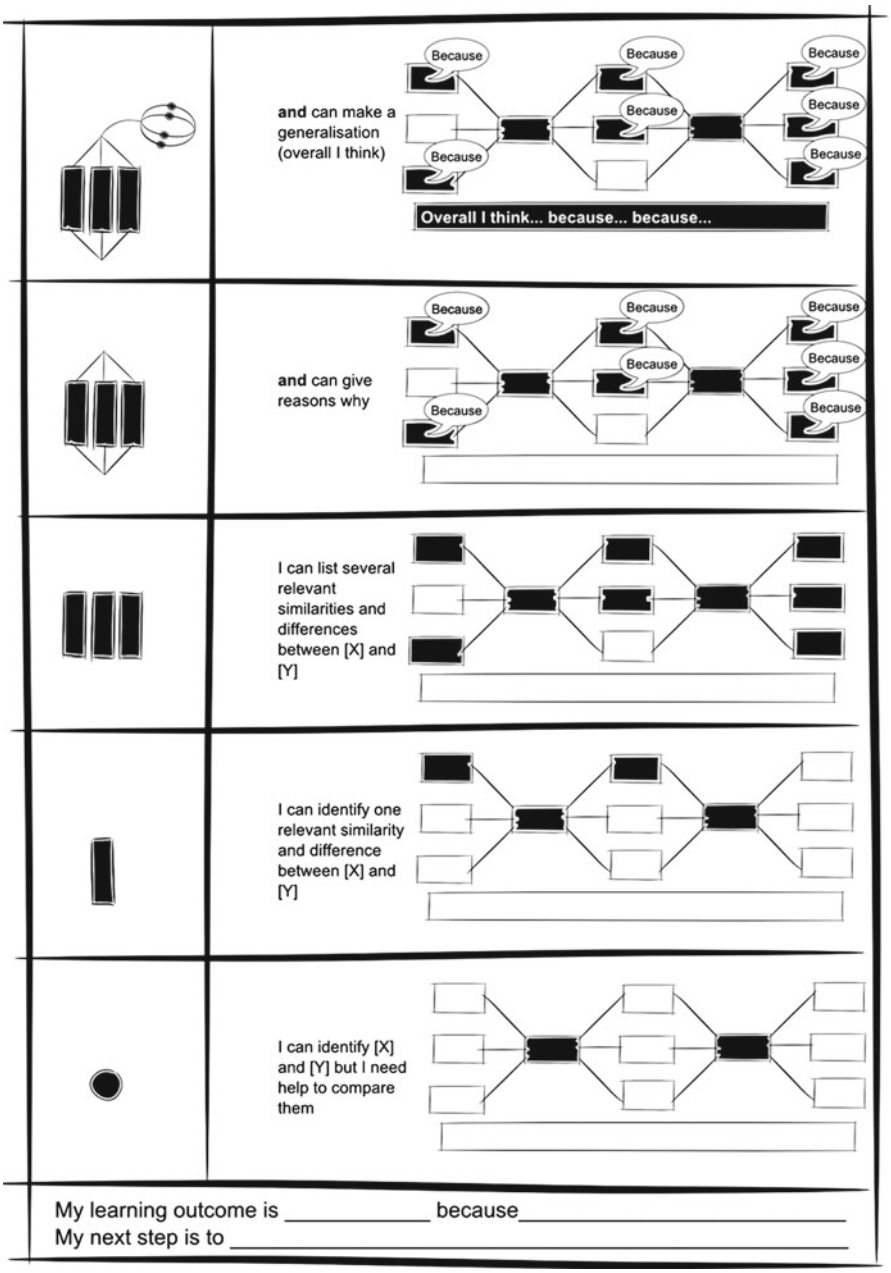


Fig. 8.5 HOT SOLO compare and contrast map and student self-assessment rubric

SOLO is especially valuable in technology-rich learning environments where teachers need help to resist the idea that any technology is automatically an aid to learning or understanding of diverse students. It is difficult for teachers to avoid techno-determinism in their use of ICTs with students. As Turkle explains "We approach our technologies through a battery of advertising and media narratives; it is hard to think above the din" (Turkle 2008, p. 4.). Using SOLO helps teachers become more thoughtful about the intended learning outcomes of diverse learners and the process of constructive alignment makes explicit to teachers the pedagogical content knowledge required to help students meet these outcomes.

Using technology to make connections is no quick fix for diverse students; experience has shown that technology-mediated learning environments are just as likely to reproduce, perpetuate, naturalise and exacerbate existing inequities and relationships of racism, sexism, homophobia and poverty. Simply introducing and using technology in schools to create "engagement" and so called "innovative and exciting learning environments" does not meet the learning needs of diverse learners. Teachers have an important role in designing and moderating the learning outcomes from technologically mediated learning environments when technology is used to connect kids with kids; kids and their communities and kids and learning. Just as in other environments teachers have a responsibility to provide students not only with competencies in technology use, but skills so they can exercise active control when learning and building relationships with others. SOLO helps teachers design learning environments to achieve these outcomes through deliberate and purposeful acts of teaching aligned to meet the learning outcome needs of diverse learners.

For example, when the intended learning outcome is for students to become successful digital citizens it is not sufficient to talk about engagement and encourage students to blog, podcast, Twitter, make Google SketchUp 3D models and movies they upload on YouTube. Teachers must create technology-mediated learning environments focused on the intended learning outcomes and designed to help diverse students to build knowledge and skills of their roles, rights and responsibilities when participating and contributing as digital citizens and to take actions as digital citizens to change their communities for the better. To do this successfully they need to carefully assess the declarative and functioning knowledge of students as digital citizens to determine what they need to "learn next"; carefully assess the pedagogical content knowledge of teachers to teach the declarative and functioning knowledge needed to meet the identified learning needs of their students around digital citizenship; provide the specific pedagogical content knowledge identified as being needed by teachers for them to move their students' declarative and functioning knowledge of successful digital citizenship; observe teachers when they are teaching students the declarative and functioning knowledge they need to "learn next" to become successful digital citizens and take part in feedback and feedforward conversations afterwards; build students' knowledge and skills of their roles, rights and responsibilities when participating and contributing as digital citizens; support students taking actions as digital citizens to change their communities for the better; and carefully assess the impact of these learning experiences on valued student learning outcomes, using these assessments to advise the future

professional learning needs of teachers. SOLO as a model of learning outcomes helps make all these steps and processes explicit when helping teachers help diverse students become successful digital citizens.

The DCM: A Future-Proofing Curriculum in Practice

> With teachers using the SOLO framework we have been given the tools to achieve and understand what is going on – it is not all in the teachers' hands which allows us to take responsibility for our own learning which in turn also gives us a sort of freedom which is useful and a feeling of control over our own learning. (Year 12 student describes learning with SOLO Taxonomy)

The DCM keeps a determined focus on the learning outcome, making it visible to the diverse learner.[6] The model is designed to be used to respect individual abilities and interests, encourage diverse students to identify their own learning needs and to connect students with their local community. In short the model translates The NZC vision of "young people who will be confident, connected, actively involved, lifelong learners" (The Ministry of Education 2007, p. 7) and as such is designed to prepare students for making good choices on how to participate and taking good actions in how to contribute so that they can live well with others.

"Learning to learn" is achieved through flexible provision where differentiated content, process, product and learning environments are supported by the educational system but can be determined by the learner. The processes in the DCM are used by both teachers and students to plan and re-plan the learning experiences and learning interventions that encourage learning to learn. From the ability of schools and communities to identify authentic contexts for learning about concepts, to the differentiation of learning experiences against explicit learning outcomes (SOLO), all process elements in the model enhance responsiveness to the learner and develop the versatility of the learner. Processes can be used collectively or selected independently as the learning need arises.

The DCM meets the principles in the NZC: placing the learner at the centre of teaching and learning, high expectations, Treaty of Waitangi, cultural diversity, inclusion, learning to learn, community engagement, coherence, and future focus. It is predicated on responsiveness to the diverse student to build a sense of self efficacy and engagement in learning. Engagement develops when students see a task as something they can be successful in; as something to be mastered, and when they can be actively involved in designing and assessing their own learning. Thus, engagement starts when students can make decisions about why, what and how they are learning. When diverse students know why and what they are learning, they can

[6] Examples of student learning outcomes, student comment and teacher feedback on the DCM processes for learning to learn above can be found online at: Hooked on Thinking DCM Collaborative Online Book: http://hooked-on-thinking.com/wiki/doku.php

also reliably and validly determine how well they are learning using the SOLO-coded language of learning visual mapping and self-assessment rubrics. They make good choices and take good actions over what they need to do next. The processes provide a practical response to the challenges of future proofing the learner regardless of their age, gender, culture or socio-economic background.

Processes

The first DCM process explores **concepts and contexts**. Concepts allow diverse students to engage with universals, those timeless, abstract ideas that helped develop enduring understandings of complex issues around how to live well with others in the past, and present. They are likely to prove worthy of understanding for living in a rapidly changing future world. The Treaty of Waitangi principle of acquiring knowledge of te reo Maori me ona tikanga[7] can be explored through Maori world view concepts like Whanaungatanga (relationships and connections), Kaitiakitanga (guardianship), Ako (to learn, to study, to teach), Taonga (treasures), Tino rangatiratanga (self management and determination), Turangawaewae (a place to stand), Manaakitanga (respect and generosity) and Whakatauki (stories, proverbs and communication). When teachers, students and the wider school community are invited to be part of the concept identification process the resulting concept curriculum wall becomes a conceptual driver for learning that is highly visible and owned by the school community (refer Fig. 8.6).

Concepts are contextualised by identifying potential local, national and global issues that develop students' understanding. These include contexts for experiences relevant to school, whānau, hapū, iwi and the local community. For example when the key understanding for the concept of sustainability was "Our choices have consequences", students' local and community needs and interests were used to identify opportunities for knowledge building. The contexts identified can be developed by helping students to think like a novice or problem solve like an expert within a field of knowledge, discipline or learning area.

Developing **driving and subsidiary questions** clarifies the focus of conceptual understanding. The driving question is the focus for the design of learning experiences. It is a question that often takes a while to develop and one that is tested and refined a number of times before it settles. "Am I a guardian? Me he mea ko hau te kaitiaki?" is an example of a driving question developed to drive student learning with the concept "sustainability". Testing how open, undermining, rich, provocative, and practical the question is (Harpaz 2005) proves useful when developing potential questions with teachers, as does Simon's intentional framework for asking visitor questions in museum exhibits (Simon 2009, p. 140). For example "Make sure you care about the answer to your question" ensures that the question has

[7] Te reo Maori me ona tikanga relates to the Maori language and its customs.

Fig. 8.6 Concept curriculum wall map under construction at Jean Batten School, Auckland

emotional appeal to teachers and students. "Make the question personal", heightens the sense of personal agency of diverse students; it suggests empowerment. "Ask the question in a speculative way" is a trigger suggesting there is something new to be discovered; there is knowledge still to be built.

The driving question is unpacked into **three subsidiary questions/tasks** that all students aim to answer by the end of the learning program. These assess learning outcomes at SOLO multistructural, relational and extended abstract levels. The driving question "Am I a guardian? Me he mea ko haut e kaitiaki? " becomes:

1. Define guardianship (social, economic, or environmental sustainability).
2. Explain the cause and effect of a sustainable action (social, economic or environmental).
3. Plan and undertake an action where you make wise choices and become a guardian (social economic or environmental).

SOLO scaffolding of subsidiary questions makes the cognitive complexity of each explicit to diverse students. Each SOLO task descriptor is aligned to differentiated learning outcomes in SOLO. Each has a visual process map and self-assessment rubric.

Functioning knowledge, learning how to take good actions to live well with others, is addressed through the NZC **Key Competencies** – capabilities for living

Table 8.2 SOLO self-assessment rubric for Key Competency relating to others

Key competency: relating to others Dimension: getting on with others in group work on school camp				
Prestructural	Unistructural	Multistructural	Relational	Extended Abstract
I need help to know what you are talking about	*I behave in a way that suits me*	*I behave in a way that suits me and I accept that they will act in a way that suits them*	*I adjust how I behave in response to who I am working with*	*I constantly review my behaviour when I am with others to see if I can be a better friend or make the group work better*

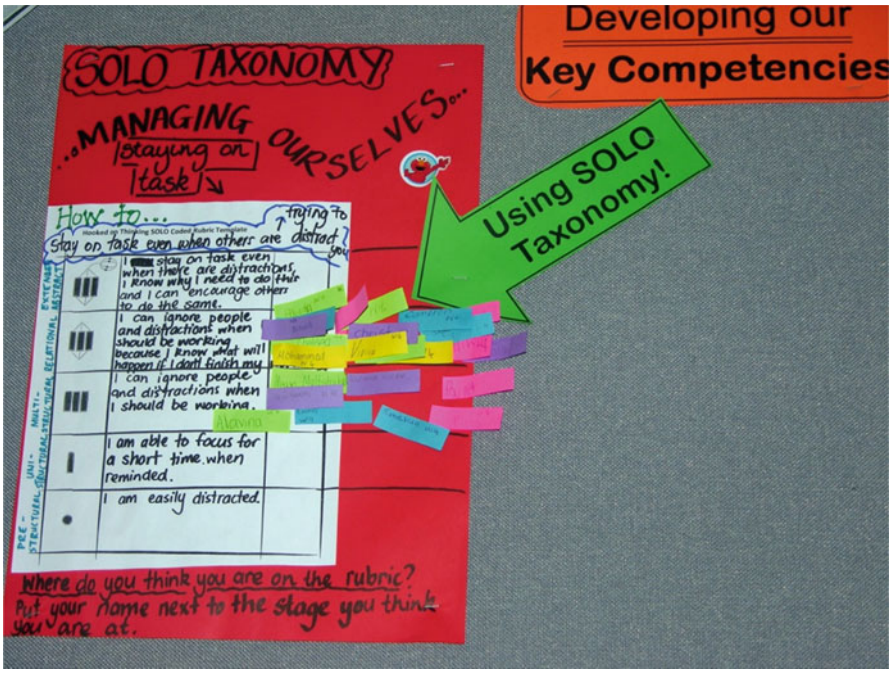


Fig. 8.7 Students SOLO self-assess against NZC Key Competency "managing self"

and lifelong learning, and **Values** – "to be encouraged, modelled, and explored" (Ministry of Education 2007, p. 10, 14). The DCM integrates the key competencies and values into learning experiences, providing opportunities for students to use SOLO to self-assess the development of their competencies with respect to thinking; relating to others; participating and contributing; managing self; using language, symbols, and text; and the exploration and modelling of school values. Student creation of SOLO-coded self-assessment rubrics for the key competencies and values helps student actions when learning to live well with others (refer Table 8.2 and Fig. 8.7).

Table 8.3 Writing ILOs using learning verbs from SOLO

Learning Area: Science	Intended Learning Outcome
Living World – Ecology	
Understand how living things interact with each other and with the nonliving environment	(Possible SOLO Learning Verbs – Define, describe, sequence, classify, compare and contrast, explain, analyse, generalise, evaluate, predict, create)
Achievement Objective	***Multistructural***
Level 1 and 2:	Define 'living thing'
Recognise that living things are suited to their particular habitat	Define 'non–living'
	Define 'habitat'
	Describe a living thing
	Describe a habitat
	Relational
	Sequence changes in a habitat over time
	Sequence a change in living things within a habitat over time
	Compare and contrast two different habitats and the living things found there
	Explain how a living thing is suited to a particular habitat
	Extended abstract
	Generalise about living things and their habitat

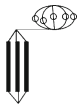
Conceptual and contextual understandings are aligned with the disciplinary knowledge and skills (from the learning areas and achievement objectives in the NZC) that will provide key ideas and processes to build coherent understanding. The local community contexts identified previously inform the choice of discipline or learning areas, and the choice of learning area or discipline informs the choice of contexts.

Writing **intended learning outcomes (ILOs)** for conceptual, contextual and learning area understanding relies upon the learning verbs in SOLO. SOLO's coded language of learning verbs (define, describe, sequence, classify, compare and contrast, explain, analyse, evaluate, predict, generalise and create) is used to write specific ILOs for the achievement objectives using constructive alignment. This differentiation of the ILOs, through the process of constructive alignment, ensures that the learning needs of all students are considered, and creates an explicit and visible developmental scaffold for complex learning outcomes (Table 8.3).

Using SOLO to align **learning experiences and interventions with ILOs** ensures differentiation of learning experiences, adding choice and challenge. These learning experiences bring in ideas, knowledge and skills (SOLO multistructural), link these ideas knowledge and skills (SOLO relational), and look at these linked ideas in a new way (SOLO extended abstract) (refer Table 8.4). These learning experiences are in turn supported with SOLO-coded learning interventions in thinking and ICTs. Coding against SOLO ensures learning experiences challenge and support diverse students, allowing teachers to identify cognitively appropriate learning interventions, and students to identify where they are in the learning process, and what to do next.

Making the SOLO coding of learning experiences visible to students builds versatility and autonomy, preparing them for more challenging self-directed

Table 8.4 Planning template for learning experiences and learning interventions coded against SOLO

	Learning experiences:		
	Learning experiences that best meet the learning intentions and achievement objectives that match your students' abilities		
 ***Bringing in ideas:*** (Identify/label/list/ define/describe/retell/ recall/recite)	 ***Linking ideas:*** (Sequence/classify/ compare contrast/ cause effect/analysis part whole/explain/ analogy/question)	 ***Putting linked ideas in another context:*** (Predict/hypothesise/ generalise/Imagine/ reflect/evaluate/create)	
Thinking interventions that target bringing in ideas:	Thinking interventions that target linking ideas:	Thinking interventions that target putting linked ideas in another context:	
ICT to enhance conditions for bringing in ideas:	ICT to enhance conditions for linking ideas:	ICT to enhance conditions for putting linked ideas in another context:	

collaborative research and knowledge building. Students need help to think like a historian when researching their local community, to survey local commuters like a town planner when investigating public transport, to broadcast like a journalist when reporting on a local weather bomb, or to design experiments like an environmental scientist when mapping a local stream. A SOLO-coded template is used by teachers and students to co-construct self-assessment rubrics for research and knowledge building. This enables them to identify where they are in terms of formulating a question, locating relevant information and data, collating data, analysing and creating new knowledge, and sharing new knowledge, and their next goal (refer Table 8.5).

The teachers with whom we work are often overwhelmed by the expectation that meeting the needs of diverse learners means they must qualitatively differentiate the learning experiences of every student they teach. In strictly timetabled secondary schools, where classes change on the hour, this represents differentiating the learning experiences of over 150 students each day. Those who remain undaunted and are determined to find ways to differentiate learning experiences for their students are often disappointed by the lack of practical advice on the "how to" of differentiation. They complain that "checkbox audit" (Taylor 2001), or bullet-pointed "exhortations" for content, process and product (Riley et al. 2004, p. 33), or "fill in the gap," differentiated planning templates based on Bloom's taxonomy (Roberts and Roberts 2001), are helpful but limited in their practical applicability to inclusive learning environments. In addition they mostly ignore the challenge and possibilities expected for integrating information communications technology (ICT) (Ministry of Education 2003b). Using the DCM, a differentiated curriculum model focused on the student learning outcome through SOLO Taxonomy and constructive alignment, is one small step towards providing teachers with a fully integrated, robust perspective on diversity that asks us to reexamine the fundamental premises of our pedagogy and to make the best possible choices about the roles that technologies can play in our teaching.

Table 8.5 An example of a co-created rubric for learning outcomes when knowledge building

Knowledge building rubric	Research questions	Planning the research	Collection/recording relevant information	Analysing information and data	Creating new knowledge	Knowledge sharing
Prestructural						
Learning outcomes show unconnected information, no organisation. Task not attacked in appropriate way	I need help to come up with a relevant focusing question/s	I need help to start looking for resources I need help to identify my research tasks and timeline and chart them in a GANTT chart	I need help to find resources and collect information I need help to organise and keep records of what I find	I simply represent what I have discovered without analysis I use only one data representation method-e.g. writing or podcasting	I try to sum up what I find out but I need help to make a generalisation I need help to evaluate the new content and the effectiveness of the research process	I try to communicate my research findings to others but I need help to provide a summary and a bibliography
Unistructural/multistructural						
Learning outcomes show connections are made, but significance to overall meaning is missing/Learning outcomes show simple connections but importance not noted	I have relevant focusing questions to bring in facts and information. E.g who, what, why when, where questions	I have ideas about the resources I will need and how I will access them My GANTT chart, research tasks and timeline are generally correct	I have collected accurate and relevant information from more than one type of resource I have recorded the information clearly and appropriately	I have analysed the information appropriately by defining terms, describing, labelling, identifying etc. I have used more than one data representation method; e.g. Maps, graphs, tables, paragraphs, diagrams, podcasts, video, Diigo, Netvibes, Google Apps, Jott, Twitter, Del.icio.us tags	I have collected relevant ideas in my conclusion and have tried to make a generalisation I have an evaluation of the new content and the effectiveness of the research process	I have communicated a clear summary of my research findings I provide a summary and a bibliography

Relational						
Learning outcomes show full connections made, and synthesis of parts to the overall meaning	I have relevant focusing questions to bring in facts and information and to link these facts in different ways. E.g define, describe, sequence, classify, compare, explain causes, analysis (part whole)	I have planned how I will collect all the different resources linked to my inquiry context My GANTT chart research tasks and timeline are complete and I have made annotations and explanations where appropriate	I have collected a range of clear, relevant and reliable information from a number of different relevant resources I have recorded the information clearly and appropriately in more than one format/method/or platform	I have analysed a range of information by defining terms, description labelling, identifying, sequencing, classification, comparison, causal explanation, part whole analysis etc. I have used a range of appropriate data representation methods to make links between data	I have a range of relevant ideas in my conclusion and made at least one reliable generalisation with evidence I have made a clear and relevant evaluation of the new content and the research process	I have communicated a summary of the inquiry research in a context that makes connections with the audience I provide a full bibliography
Extended abstract						
Learning outcomes go beyond subject and makes links to other concepts – generalises	I have a range of relevant focusing questions to bring in facts and information, to link these facts in different ways, and to look at these linked ideas in a new way E.g. define, describe, sequence, classify, compare, explain causes, analysis (part whole), justify, generalise, predict, evaluate etc.	I have planned how I will collect all the different resources linked to my inquiry context and include contingencies if things don't go to plan My GANTT chart tasks and timeline all correct and completed with explanations and annotations where appropriate. I have made predictions and allowances for tasks that may not fit the plan	I have collected a range of clear, relevant, reliable and valid information from a number of different relevant resources I have recorded the information clearly and appropriately using a range of appropriate recording methods. I have indicated the level of reliability and validity of the data collected	I have analysed a wide range of information by defining terms, description labelling, identifying, sequencing, classification, comparison, causal explanation, part whole analysis and evaluation, prediction, generalisation, creating new understandings I have used a wide range of appropriate data representation methods to link, extrapolate and interpolate data	I have made many relevant points in the conclusion, and valid generalisations with evidence and or predictions I have made a clear, and relevant evaluation of the new understandings and the research process. I include personal reflection and a prediction on where to next	I have communicated a summary of the inquiry research in a context that makes connections with the audience and enables audience participation and further knowledge construction I include a full bibliography and include web based tagging and web annotation

Conclusions

The DCM provides one example of the way teachers and schools can work towards the modestly ambitious agenda outlined in this book. The model relies upon SOLO as a model of learning, takes a conceptual approach and views students as knowledge builders for their local communities. The flexibility and iterative design of processes within the model allows schools to personalise student learning to learn across local and community contexts in all learning areas and levels of the NZC.

When diverse students in New Zealand use The Structure of the Observed Learning Outcome (SOLO) as a model of learning, they share a common language of learning with their peers and their teachers. Student learning outcomes are made visible to all regardless of age, gender, culture or socio-economic background. A differentiated school-based curriculum built around SOLO provides diverse students with an explicit common language for learning for self-assessment and peer-assessment. They can synthesise and integrate information; identify learning experiences and learning interventions; choose technologies to learn with; and build knowledge to create new understandings. They are positioned at the ampersand in teaching and learning, with a sense of freedom, control and autonomy over their learning outcomes. They are versatile, they have learned how to learn; they are at home in the ampersand of teaching and learning.

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Chapter 9
Scissors, Papers Rock: Old-World Technologies for Future-Proofing Pedagogy. Re-engaging Students in Mathematics Classrooms

Margaret Marshman and Peter Grootenboer

Introduction

> From starting out as someone who hated maths and was never very good at it, I am finding I am so enjoying it!! And what's more … I'm understanding it!

Mathematics is a subject that employs and is amenable to a range of technologies from simple tools and materials, to advanced ICTs and mathematical equipment. However, despite the hope of improved and more effective mathematics pedagogy through modern technologies (e.g., computer programs, websites, hand-held calculators), student disengagement is a continuing problem. Students continue to reject mathematics when they have a choice, particularly in the senior school years and at tertiary levels (Australian Academy of Science 2006; Grootenboer and Zevenbergen 2007). Furthermore, students continue to see mathematics as irrelevant, dull and of little practical value and so many complete their formal mathematics education with poor mathematical identities and feeling mathematically disenfranchised (Grootenboer 2010).

This has significant consequences in terms of both "national good" and social justice. Learners who disengage with mathematics have restricted employment opportunities as their university study options are limited. Furthermore, mathematics graduates are in short supply and mathematically based professions are highly paid (Australian Academy of Science 2006). Similarly, as society becomes increasingly technologically dependent, there is a concurrent increase in the mathematical demands and requirements of the nation and world. This means that the Australian workforce needs many more mathematics graduates if it is to remain globally competitive. Clearly, if students are rejecting mathematics at school, there are

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important long-term consequences. In order to "future proof" students, and society at large, it is imperative that schooling facilitates the development of strong mathematical identities amongst an increasingly diverse pool of learners.

However, this chapter proceeds from the belief that it *is* possible to engage students in deep mathematical learning by using investigations and a relationship-centred pedagogical approach. This often involves the use of technology. However, despite the fact that contemporary images of schooling primarily include computers and similar devices as the so-called "learning technologies" with the most to offer millennial learners, there are a diverse range of (forgotten) technologies – concrete manipulatives, blocks, measuring devices, and 2-dimensional and 3-dimensional shapes – available and appropriate. The key point is not so much the technology used but the way it is used.

In this chapter we want to illustrate the potential of what might be thought of as old-fashioned technologies whose creative use challenge the common assumption that only computer-based, high-end technology can engender student engagement and deep learning. We discuss mathematical investigations that employ simple technologies and demonstrate the role they play within an investigative approach designed to support the development of particular mathematical concepts. Specifically we discuss the use of open investigations where students need to think and reason mathematically and apply their mathematical knowledge to solve problems and discuss the way such an approach – and its selective use of every day technologies – can work to develop new relationships between students and mathematics.

The data that underpin this discussion come from lessons taught by the first-named author (Margaret) with her Year 9 mathematics class in a metropolitan high school in Queensland. As such, the chapter is a reflective account and inherently personal and subjective. Primarily we discuss investigations as a pedagogical approach in mathematics that promotes greater engagement and more robust student mathematical identities, particularly amongst the students at this school who were generally disadvantaged in terms of their mathematical learning opportunities. We outline how simple technologies can be employed to promote rich mathematical learning and the development of robust mathematical identities. Throughout the chapter this pedagogical approach is illustrated by some student work samples. As an opening move it is necessary to define what we mean by investigations.

Investigations

Students who develop robust mathematical knowledge and skills, and positive mathematical attitudes and dispositions, are to some degree "future proofed." Their "future proofing" is in the greater education and employment opportunities that will be available to them, and their improved capacity to engage in a world that is inherently increasingly more technological and mathematical. However, it is also the case that students who do not develop healthy mathematical identities at school have limited capacity and opportunity to engage fully in higher education, many professions, and society at large.

Mathematical investigations are one way students can be encouraged to fully engage in mathematical learning, particularly those students who have been alienated by traditional approaches to mathematics education (Boaler 2008). A good investigation has multiple entry points allowing students to start at their own level and to design their own pathway (or pathways) through the challenge. Indeed, investigations allow students to undertake activities and thinking that resonate with the practice of mathematicians, and so they can be viewed as authentic mathematical tasks (Burton 1998). In this way, investigations allow for the alignment of teaching, learning and assessment.

Investigations vary in their length, complexity and mathematical demands. For example, they can be short activities where students are looking for patterns or trends so they can generalise a situation and develop/discover a rule or formula. However, they can also take a week or a whole term and draw on a range of mathematical concepts. Furthermore, investigations can be quite focused and narrow, or very open and relatively unstructured. Longer tasks, when appropriately chosen and carefully supported, are useful for engaging and motivating students to want to learn the next mathematical concept that they need to continue with the task (Zevenbergen and Grootenboer 2009). For example, if students are investigating the health and wellbeing of students at their school in response to a newspaper or television report, this could be used to develop understanding about the construction of questionnaires and sampling techniques to avoid bias, data presentation (tables and graphs), data analysis (mean, median and mode) as well as interpretation. Therefore, it is important that the teacher chooses tasks carefully, and identifies the particular mathematical concepts that students need to understand to be able to successfully complete the investigation. It goes without saying that to work in this way teachers need to have a very sound mathematical knowledge and confidence in their capacity to work mathematically: this means being aware of mathematics as it works in "the real world" as opposed to some of the schooled and domesticated versions of mathematics that drive some seriously uninteresting school initiatives.

The Investigative Process

Within an investigation there are three main stages which students are taught:

1. identify and describe;
2. understand and apply; and
3. communicate and justify.

However, students do not necessarily follow these stages in a linear manner, as they may move back and forward as they revise their ideas and planning. In the first stage, the students need to describe the investigation in their own words to ensure that they understand what they are being asked to do. They need to identify the mathematics and link it to what they know and may have used on previous occasions when similar tasks have been undertaken, as well as identify new mathematics that they need to learn. They also need to plan possible pathways through the

investigation, and decide on which pathway to begin. For the investigation of the health and wellbeing of students at their school students need to decide what aspect they will investigate, what questions they will ask and how they will collect their data. They then need to decide how they will present, analyse, and interpret their data, and then compare it with the stimulus material.

During the second stage, students are representing the problems with objects, pictures, models, and/or symbols. By applying their known mathematics to the investigation, the students are developing new mathematical knowledge, procedures and strategies as they generate possible solutions. They then need to consider the reasonableness of these solutions and validate their findings with observations, trials or experiments. It is primarily during this stage that the learning of new mathematics will occur. Teachers can further facilitate this by using "think aloud" strategies to give students access to their advanced mathematical thinking. This process provides scaffolding during the investigation to develop conceptual understanding and allow generalisation, particularly using simple technologies such as concrete manipulatives and measuring devices.

Mathematical ideas and relationships can be expressed in a variety of different representations, including symbols, diagrams, objects and words. Contemporary discourses around school routinely drift towards the celebration of computers as the solution to just about every issue associated with curriculum and pedagogy. While it is obviously possible (maybe even essential) for computers to play a positive role in education they are not the only, nor always the best, pathway forward. Their presence moreover can obscure the valuable contribution that other, more familiar technologies – pens, papers, calculators etc. – can play in a well conceptualised classroom. These non-computing technologies can also function as "powerful learning tools" (Van de Walle 2010 p. 5). As students move from one representation to another they increase their understanding of the concept. The use of physical objects that the students can manipulate to build models helps them to develop their spatial skills and to visualise patterns to enable them to make generalisations.

The third stage in an investigation is to "communicate and justify." During this stage, students communicate their mathematical processes, solutions, and conclusions, and justify their choice of procedures and strategies. This may be orally to the other members of their group or to the whole class as part of a whole-class discussion, or in writing as a piece of written assessment. It is also an opportunity to listen to the perceptions and ideas of others, and to challenge and/or support their ideas. It also encourages the students to reflect on their learning and their solutions, and make connections between new and prior learning. This process will be illustrated in the examples that follow in the second half of the chapter.

Investigative Pedagogy

An investigation-focused classroom will require a different sort of pedagogy than does the traditional teacher-centred textbook-driven approach. Investigations usually require students to be working together collaboratively, so the classroom will be rich with purposeful discussion. When students work together collaboratively they

are working towards a common goal and supporting each other and their own learning (Gokhale 1995). The teacher's role shifts from being in direct control to that of facilitator and "wise guide." The teacher needs to "let go," and have confidence that the students can solve the task and allow them the time and space to do it. This, indeed, is a key feature of the kind of relationship-centred, future-proofing agenda outlined through this book: Students need to have a real sense of ownership and the opportunity to work on, and succeed within, real learning challenges. Students certainly will make mistakes along the way, but this is part of the mathematical learning process, and so the teacher needs to work with the students by listening actively and supporting their discussions. A key to this is asking good questions such as: "What do you think the problem is asking?" and "What ideas have you tried so far?" Furthermore, the teacher needs to give suggestions cautiously and encourage students to test their own ideas: "How can you decide?" and "Why do you think you might be right?" This sort of questioning (which informs an approach to learning that is immediately transferrable to and relevant within diverse contexts beyond schools) helps to focus students so they can see the mathematics they are performing and to make sense of the mathematical ideas. It also allows the students to progress the investigation and experience the joy of completing a challenging problem. Investigations also allow the students to learn to formulate their own questions so they develop their independent sense of inquiry. Finally, class discussions are used at the end, where ideas from different groups are shared, discussed and debated, to promote a community of learners and expose students to a range of different strategies and ideas. Of course, this sort of pedagogy demands a purposeful and supportive class environment, and hence the need for a relational approach.

In another investigation students were asked to develop a strategy for when to deal on the television game *Deal or no Deal*: This is a popular chance-based game where contestants gradually eliminate each of 26 suitcases containing possible prize money ranging from 50c to 200,000 dollars and, based on the number of cases left in play and the amount of guesses they have to make each turn, decide whether or not to accept an offer made by the invisible banker to stop play in return for a certain amount of money. The students were asked about their understanding of chance:

Teacher: What do we mean by chance?
Student 1: Chance is the probability of something happening.
Teacher: Can you explain?
Student 1: A coin landing on heads rather than tails is a 50/50 chance.
Teacher: And?
Student 1: Rolling a 1 on a six-sided dice is a one in six chance. Rolling a six-sided dice and rolling a zero is impossible because there are only numbers 1 to 6 so it's impossible.
Also a lot of games shows work on chance.

Teacher to a second student: What does chance mean to you?

Student 2: Chance depends on ratio. If you flip a coin it is a 50/50 chance that you get heads or tails. If it is more than 50 or less than 50 it is an unfair chance.

Then students were encouraged to think of chance outside the classroom.

Teacher: What about some everyday examples?

Silence

Teacher: What is the chance your mum will be late picking you up?
Student 3: She's always late!
Student 4: I ride my bike.

Then students were prompted to pick up the language of chance:

Teacher: What words might you use when discussing chance?

It is important that teachers have these discussions with students so that they are aware of where their students' understandings are so that they can help to eliminate possible misconceptions and also ensure that students are able to use correct conventional mathematical language.

Relationship-Centred Pedagogy, Student Engagement and Mathematical Identities

Students learn more than just mathematical concepts and skills in their mathematics classes, and they are involved at more than just a cognitive level (Boaler and Staples 2008). They learn how to think about themselves as learners, and the extent to which they are able to function as independent problem solvers. Furthermore, Putman and Borko (2000) stated that "how a person learns a particular set of knowledge and skills, and the situation in which a person learns, become a fundamental part of what is learned" (p. 4). To this end, identity is a useful concept to examine and understand mathematical learning because it includes the broader context of the learning environment, and all the dimensions of learners' selves that they bring to the classroom. In the mathematics classroom students develop beliefs and attitudes about mathematics, themselves as mathematicians, and themselves as learners. These beliefs articulate with (sometimes challenging, sometimes reinforcing) wider beliefs about what it means to be a "good" mathematics student and a good mathematician. This includes widespread sorties stories which represent mathematical ability as more commonly seen in boys than girls, and in high socioeconomic status (SES) communities rather than low SES communities. In other words, the learning that occurs in a classroom does not occur in isolation. Nevertheless, within that classroom learning is very much cognitive and affective. As such, in the mathematics classroom students have the opportunity to develop/try out/gain support for a "mathematical identity" (Zevenbergen and Grootenboer 2009) that may be different to the identity others often ascribe to them. This impacts directly upon their sense of themselves as learners more generally: both in and beyond the contexts of schooling, thus going some way towards "future proofing" them not only for mathematical tasks specifically, but for other challenging scenarios more generally.

Viewing mathematics education as a process of developing students' mathematical identities (and, by extension, challenging some common identities often attributed to them) requires educators to attend to the values, beliefs, attitudes, aptitudes, dispositions and emotions that students experience while they are learning their mathematical knowledge and skills. Historically, this has not been the case. Mathematics has been represented as a space of logic rather than emotion, of reason rather than reaction – a scenario which is widely thought to contribute to students' disengagement from mathematics at an early age.

It is widely claimed that students are disengaging with mathematics (Brown et al. 2008) because maths is thought to be 'hard', 'boring' and 'useless'. Given the ubiquitous and high-profile nature of mathematics, it means that many students are at risk of missing a large range of opportunities related to employment, higher education, and aspects of life in a modern world.

Furthermore, it is important to note that disengagement and poor mathematical achievement is not evenly experienced across society. Historically girls and students from low socio-economic backgrounds and Indigenous students have been disadvantaged by the long-standing traditional forms of mathematics education that have pervaded, and hence these students have also had less access to all the benefits of mathematical success. However, the seminal work of Boaler (2008; Boaler and Staples 2008) has shown that students who have traditionally been marginalised in mathematics education can develop strong mathematical identities when an investigative approach is employed that centres on deep and rich mathematics. In this case it is not a simple matter of providing students with access to mathematical learning experiences but rather the more complicated project of bringing disenfranchised students into a positive relationship with mathematics.

The relational basis of teaching was highlighted by Connell (1993):

> Being a teacher is not just having a body of knowledge and a capacity to control a classroom. That could be done by a computer with a cattle-prod … Just as important, being a teacher means being able to establish human relations with people being taught. (p. 63)

To this end, Palmer (1993) suggested that the very heart of teaching is relational. In this sense, the relationship is more than just a social connection: It includes assumptions about learners, about teaching and about pedagogy. The characteristics and nature of quality pedagogical relationships between teacher and student have been discussed widely, but here we want to highlight the importance of the student-teacher connection in building students' mathematical identity and the role this plays in creating learners with the kind of positive disposition towards learning that is part of the future-proofing agenda at the heart of this book. Palmer (1993) suggested that effective teachers are able to connect with both student and subject, and in the process they facilitate the students' relationships with the subject – their mathematical identity.

> The teacher, who knows the subject well, must introduce it to the students in a way one would introduce a friend. The students must know why the teacher values the subject, how the subject has transformed the teacher's life. By the same token, the teacher must value the students as potential friends, be vulnerable to the ways students may transform

> the teacher's relationship with the subject as well as be transformed. If I am invited into a valued friendship between two people, I will not enter unless I feel that I am valued as well. (p. 104)

The teacher's role in facilitating the development of students' mathematical identity is one of connecting student and subject. The goal of this bridging is to invite students to develop a strong, enabling and warm relationship with mathematics.

A relational and supportive classroom does not mean students are protected from challenging or difficult mathematical ideas. Rather, it allows students to engage in intellectually challenging material (Palmer 1993). Indeed, the development of strong mathematical identities requires teachers to provide a socially supportive **and** intellectually challenging environment in the classroom (Fredricks et al. 2004; Lingard et al. 2002). Most students enjoy a challenge, particularly when the task is relevant and meaningful (The Centre for Collaborative Education 2000, cited in Hilton 2006). All too often, however, challenging curriculum and equitable outcomes are represented as either/or choices. The students, who are the focus of this chapter, were disengaged from schooling. Yet the study outlined in this paper and those of others have found students can be helped to become both more engaged and more successful within authentic (rather than "dumbed down") mathematical challenges as a result of the approaches taken by schools and teachers. Providing students with experiences, tasks and, above all, a supportive environment within which they could experience success allows them to become much more open to challenges precisely because they believe that they know how to go about solving them. When students are given challenging and engaging tasks they have the potential to develop deep mathematical understanding and knowledge about concepts as they explore the complex connections and relationships (Department of Education and the Arts 2004). These investigations can be promoted and enhanced through substantive conversations between students and teacher and amongst the students themselves (Zevenbergen and Grootenboer 2009). To this end, the relational nature of the classroom extends beyond the teacher-student dyad, and there also needs to be an atmosphere of mutual respect, where all students are encouraged to take risks and all students believe they have valuable contributions to make. In such an environment students are more able and willing to engage in rich mathematical tasks. In the next section of this chapter we explore key strategies associated with the development of positive mathematical identities: collaborative learning and authentic conversation.

Collaborative Learning, Authentic Practice and Mathematical Identities

As mentioned previously, at the heart of an investigation-based pedagogy is student collaboration. Working collaboratively is consistent with the "authentic" mathematical practice of mathematicians (Burton 1998) and consistent with the agenda explored in Chap. 3. Learning is a social process and students need to have opportunities to engage in substantive conversations, so the learning environment needs

to be one where "children publically express their thinking and, more generally, engage in mathematical practice characterized by conjecture, argument, and justification" (Cobb et al. 1993, p. 91). Authentic conversation, in this context, promotes deeper and more robust learning.

However, collaborative learning is not simple and it can cause tension when students' previous experiences of school mathematics have largely involved a traditional teacher-centred approach (Cobb et al. 1993; Solomon 2007). Therefore, the teacher needs to provide a classroom culture where open discussion is thoughtfully managed and students are able to trust one another. They need to encourage students to build on each other's explanations and continue conversations until they have constructed a class meaning, rather than just expecting and relying on the teacher's interpretation. This can be quite challenging for some students. Some of the students in the class that is the basis for this chapter had always struggled with mathematics and developed coping strategies of either becoming the class clown or being disruptive. These students had thereby given themselves permission not to participate in mathematical activities and so distanced themselves from failure with the premise that "if you don't try you don't fail."

However, working through this process ultimately results in students who are more likely to believe that success in mathematics comes with attempts to "make sense of things" rather than memorising the teacher's method of solution (Solomon 2007; Cobb et al. 1993). Lampert (1990) suggested that for real mathematical learning to occur, students need to make conjectures, explain their reasoning, and be able to discuss and justify their own thinking and the thinking of others. A key goal of authentic conversation, then, is to support students as they develop equally authentic, transferrable, real-world skill sets that go beyond the kind of artificial memorisation routines so widely celebrated in schools and, indeed, within many high-stakes testing regimes.

There are some key features associated with the successful use of collaborative learning and authentic conversation that are important to point to here. First, to create such a classroom culture it is necessary to also have intentional discussions about *talking about* mathematics so that all students are aware of their roles and responsibilities regarding thinking, participating and cooperating in both small-group and whole-class discussions (Cobb et al. 1993; Solomon 2007). Second, the teacher does not evaluate the students' responses per se, but questions, probes, and prompts, and provides alternative conjectures for consideration. Third, students are expected to share not only their solution but their understanding as well (Cobb et al. 1993; Solomon 2007), but for this to successfully occur, teachers and students need to be able to share the authority within the classroom.

This leads to a fourth key feature. Within the classroom the teacher has historically been positioned as the significant authority and the person who possesses the knowledge, power and position to control and direct what occurs. However, teachers can share this authority with their students when they allow them to ask questions and to clarify their own understanding, and when other students are encouraged to speak as experts and answer the questions of others. This more democratic classroom allows students to think, reason and work mathematically, but it requires teachers

who have a strong sense of efficacy (Smith 1996) and mathematical activities that are rich and have academic and intellectual quality.

Finally, good investigative problems engage students quickly and facilitate the development of significant mathematical knowledge, skills and dispositions (Lampert 1990; Smith 1996).

This combination of traits is consistent with the concept of authentic pedagogy put forward by (Newman et al. 1995) where students' "accomplishments … are significant, worthwhile and meaningful" (p. 1). They performed a large study which demonstrated that the use of authentic pedagogy led to a significant improvement in student performance irrespective of gender, race, ethnicity and socioeconomic status. Classroom instruction requires higher-order thinking, substantive conversations, deep knowledge and connections to the world beyond the classroom. The assessment tasks require the students to organise information, consider alternatives, use disciplinary content and processes and communicate their understandings and findings in a written format. The task or problem must be connected to the real world and be for an audience beyond the school (Newman et al. 1995).

To summarise, then, for this type of relationship-centred, authentic, investigative pedagogy to be successfully enacted in a classroom it is the teachers' responsibility to provide the students with the skills necessary to participate, and to establish an environment that allows this to happen. In this student-centred, democratic environment students and teachers work actively together. The teacher's role is to guide investigations, to prompt substantive mathematical discussions, to scaffold student thinking, and to encourage students to make connections with their prior learning and construct their own conceptual frameworks (Queensland Studies Authority 2007). In such an environment, when children see that their experiences and knowledge are valued, they are more motivated to listen to each other and the teacher, and therefore they are more likely to learn and develop more robust mathematical identities. For example, students are more likely to share their ideas and value different strategies for solving problems through listening to diverse opinions, supporting their claims with evidence, engaging in critical and creative thinking, and participating in open and meaningful dialogue. This then promotes a higher and deeper level of thinking: In response to the question "What did you learn today?" one student gave a reply that represents those of many others: "To think harder more often."

The next section explores an example of this investigative relationship-centred pedagogical approach.

Section 2: Example of an Investigative, Relationship-Centred Pedagogical Approach

In the remainder of this chapter we will illustrate the framework outlined above via exploration of an investigative approach used in the development of measurement concepts with a Year 9 class. The school was situated in a lower socioeconomic area of an Australian city. Other than the top stream classes most students were disengaged

from schooling. Facilities in the school were tired but there had begun a process of revitalising both the buildings and the curriculum. The class (a midstream class) was taught by the first named author (Margaret) and in previous years the students had experienced a fairly traditional mathematics education based around teacher exposition and textbook exercises. Margaret's observations were that the students were initially disengaged with mathematics and generally they believed that it was largely irrelevant and boring. In class they appeared to spend a lot of time off-task and this was verified by their lack of bookwork.

In an attempt to engage the students with mathematics they were presented with the major, open-ended investigation that was the focus that underpinned and sustained the learning of this mathematical unit. The students initially investigated the "swimming pool" task and did some preliminary planning, and this gave rise to some more teacher-directed investigations that were designed to help students develop particular concepts (e.g., volume). In each case, simple technologies – (blackboards, white boards, scissors, glue) enabled the students to explore and test their ideas.

Major Investigation: Designing a Swimming Pool

The students were given a task that required them to design a swimming pool composed of a least two 3-dimensional shapes, and included:

- making a scale model,
- doing a 3-dimensional drawing,
- drawing a dimensioned plan and elevation to scale, and
- calculation of:
  - the area of their pool to be tiled;
  - the capacity of their pool; and
  - the area of the pool cover.

The school was located in Queensland, Australia, where swimming pools are common features in back yards. The task was the focus of a whole term (10 weeks), and included a number of different mathematical aspects, including area, surface area, volume, capacity, scale, three-dimensional drawing, and plans and elevations. The students were given the task at the beginning of the term and allowed time to think about it and do some initial planning. Students drew sketches of their proposed pools that included a wide variety of shapes including trapezoidal prisms and cylindrical and half cylindrical spas. At this point the students appeared to have some incentive to learn the mathematics they needed to complete the task, and so more teacher-directed and focused investigations were used to facilitate the development of the required specific mathematical concepts.

This task was handed out at the beginning of the second term of school. During the first term I had worked hard at developing a supportive classroom where students

were expected to explore/investigate questions and problems. This required building respect within the classroom, that is, respect for themselves so that they felt valued to take a risk and try different ideas, respect for each other so that they learnt to discuss and critique others' ideas without attacking the person, and respect for the classroom so that we could build a community feel. My role included not judging student responses per se, but by asking them to explain their thinking and asking questions I encouraged them to think more deeply and find their own errors. For example, "Explain how you did it," "Why did you do it that way?" "Is there another way you could do it?" "Have you thought about …?" The students were encouraged to work together collaboratively and then share their solutions and thinking. All responses were valued and discussed.

Teacher-Directed Investigations to Develop Area and Volume Concepts

Because the students had decided on a wide variety of shapes for their pool they needed to be able to calculate the area of a wide variety of shapes. An investigative pedagogy was used throughout the term to help the students develop a conceptual understanding of the different areas of measurement. Examples of some of these investigations are shown below.

An initial question posed to the students was "Why is the area of a rectangle given by length × width?" Students were given centimetre grid paper, and by drawing various size arrays on the grid paper (as shown in Fig. 9.1) they were able to see "visually" how the formula had been derived. This then formed the basis of a series of other investigations to derive the formulas for the areas of a variety of other shapes. The students did this by cutting the shapes and rearranging the pieces into a rectangle and, hence, determining the formula. Examples are shown for a triangle below (Fig. 9.2). The students were able to *see* the area relationship through the investigation with the simple technologies (e.g., scissors, grid paper) employed.

The capacity to see the area relationship and then determine the area formula became more important as the students investigated and determined the rule for the area of the parallelogram and trapezium shown in Fig. 9.2. By cutting out the pieces and then further cutting them up and rearranging them into a rectangle, the students were able to generalise the relationship in order to determine the appropriate formulas.

The investigative process of cutting a shape and rearranging the pieces into a rectangle was then extended to the circle. By cutting a circle into successively more fractions and placing them together as shown in Fig. 9.3 they are able to see the shape is approaching a rectangle of length $\pi \times$ radius and a width of the radius which gives the formula $A = \pi r^2$.

The students then employed their new knowledge, skills and understanding to make progress on the major investigation of the unit (i.e., designing the swimming pool).

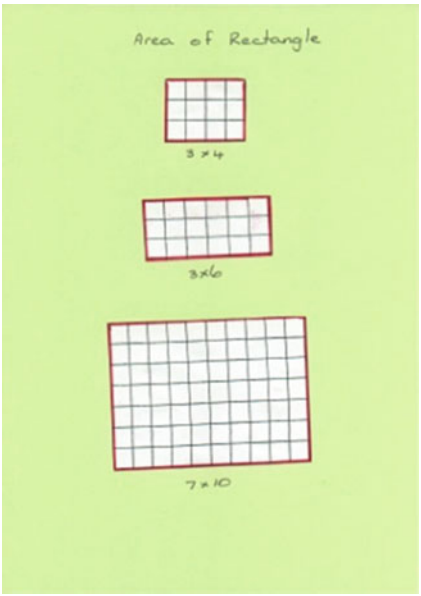

Fig. 9.1 Developing the formula for area of a rectangle

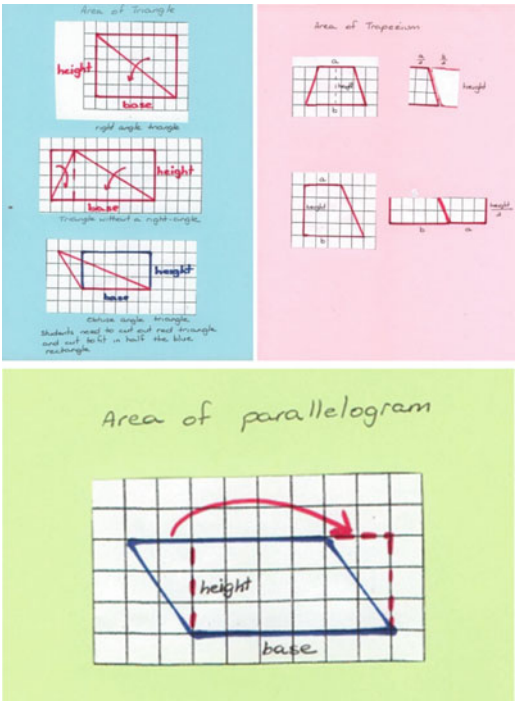

Fig. 9.2 Developing the formula for area of a triangle, parallelogram and trapezium

Fig. 9.3 Developing the formula for area of circle

As part of their major investigation the students were required to determine the capacity of their pool, and in order to calculate the capacity of their pool, the students first needed to be able to calculate its volume. The formula for the volume of a prism can be determined by beginning with a rectangular prism and so the students began investigating this by building prisms with multi-link cubes. The students then determined the area of the base (by counting the number of blocks) and comparing it to the array model which can be determined from the number of blocks in the length multiplied by the number of blocks in the width. With each layer of height students can see that by adding the same number of blocks as in the base this repeated addition of the layers can be simplified to multiplication and generalised to $V_{prism} = A_{base} \times \text{height}$. This is shown in Fig. 9.4. This activity can be extended by drawing a table with headings length, width, height and volume and looking for the patterns in the numbers across the table.

The students further explored the volume of hollow prisms by filling them with water and then measuring the capacity by pouring the water into a measuring cylinder. From this the students were able to determine (amongst other things) that 1 cm^3 equals 1 ml mathematically, and, hence, they could understand and appreciate the relationship between volume and capacity. Furthermore, the students were able to explore how to calculate the surface area of a variety of shapes by cutting out the nets of the shapes and folding them to make the solid. Here again, the use of simple technologies and an investigative pedagogical approach enabled the students to engage in authentic mathematical practices and to learn key mathematical ideas.

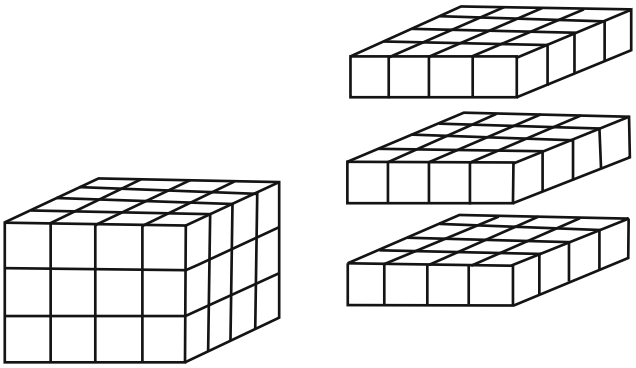

Fig. 9.4 Developing a formula for a volume of prism

Returning to the Major Investigation

Once area, volume and scale drawings had been understood the students were in a position to design their pool. The students worked on their pool designs in friendship groups, thereby ensuring a good working relationship within the groups. Once the pools were designed, the students were able to use cardboard, scissors, rulers and glue to build a scale model of their pool. Because the task had been left open, the students were able to choose their own level of complexity for their pool, and their designs were not constrained by their teacher's preconceived ideas (or indeed, commonly accepted aesthetic norms for pool design!). Also, the students had to determine how they were going to approach their construction of their model vis-à-vis their design, and they followed different tactics. Some students carefully planned their model by doing dimensional calculations first and then they built their model, while others decided to build their model first and then think about scale and dimensions. Those that chose the second approach tended to have to build a second model with dimensions and a scale more conducive to their calculations. Either way, the learning was more powerful when they were having discussions with a partner and making choices, particularly when they needed to reconsider their ideas.

Student Learning

Throughout the unit the students produced work samples that revealed aspects of their learning. These included the products directly associated with the mathematical tasks concerned (e.g., the pool design models as shown in Fig. 9.5 below), and journals in which they reflected on the development of their mathematical identities.

Fig. 9.5 Some different pool designs

The elaborate and relatively intricate nature of the pool models made by the students (some examples shown in Fig. 9.5) indicated that they had the confidence to try something beyond the basic requirements. The "pool" on the left (in Fig. 9.5) is heart-shaped; the students have used two semicircles and a square to construct the heart, and have included a frustum beneath the square to give the added depth. The middle pool contains a rectangular prism with triangular pieces added on each end that slope up allowing for a gradual increase in depth. The third design is a square prism to give the central area depth, and then semicircular-based prisms and rectangular prisms have been added on opposite sides. The intricacies of these shapes indicate that students were deeply engaged in the task and willing to construct interestingly shaped pools even though this has made their mathematical calculations much more difficult. It has also given them the confidence to use shapes for which the formulas have not been determined as whole-class activities. As such, in general the students developed more robust and resilient mathematical identities – greater mathematical confidence and enhanced mathematical knowledge and skills. To help the students process their learning through the unit, a range of "metacognitive technologies" were employed.

What the Students Learnt: Evidence from Their Journals

One key feature of the investigative pedagogy employed for this project was the integration of student journals. Borasi and Rose (1989) suggest that when students write about their learning in journals they have opportunities to reflect on their feelings, beliefs, knowledge of content and processes and in the process make meaning of their mathematics. This can lead to a better understanding of mathematical content as students personalise it and make connections with other knowledge, and problem-solving skills can also be enhanced as students reflect on how they do mathematics. Furthermore, reading student journals allows teachers to evaluate individual student understanding and tailor activities to suit their needs. By responding with supportive comments to the journals, teachers can create an atmosphere of trust with their students, and this enhances the student-teacher relationships which, in turn, creates an environment where students feel safer to take risks in their learning.

Students in this class were asked to write in journals to explain mathematical concepts as a way to articulate their thinking and ideas, and for the teacher to see how students' understanding was progressing and to identify particular misconceptions or difficulties. Each time the students wrote in their journal the teacher wrote an individualised response that was meaningful and specific to the student. Initially students saw this as something that had to be done and there was a level of resistance. However, when they were asked to explain aspects of their learning experiences, for example: "What did you like about the lesson?", "What didn't you like?", and "What did you find difficult?", they become more coherent and confident at expressing their views. An example of their responses is shown below.

Student: Today finding the volume of a prism was easy because I had my friends around with me to help. I learnt that if I'm in a group … it's fun, I learn, and it's easy.
Teacher reply: I am glad you found it easy to learn with your friends. How could your group have worked better?

This response was indicative of some of the ways the students were able to consider the affective dimension of their mathematical learning. Below is a short journal excerpt that was written as a part of the measurement unit.

Prompt: How do you find the area of a parallelogram?
Student: A = length × perpendicular height.
Parallelograms are like rectangles pushed on their side.
Parallelograms have 2 sets of equal sides.
Teacher reply: So why then does the formula for area of a rectangle work for area of a parallelogram?

Here, the student was able to self-assess their mathematical understanding in a non-threatening space, and there was also evidence that they were beginning to develop a broader and more robust understanding of the concepts concerned. Also, the journal enabled a conversation to develop, and the teacher (Margaret) encouraged the student to think deeply by asking a question that required the student to connect and contrast related ideas. The journals were used after the unit was complete, and as the year continued the students began to view their journal as an opportunity for a personal discussion with the teacher and so the student-teacher relationship continued to build. This in turn allowed the teacher to develop their teaching practice cognisant of the individual and collective perspectives of the students in the class.

Concluding Thoughts

The focus of this chapter has been on the development of robust student mathematical identities through pedagogy based on the use of simple technologies in mathematical investigations. We have also contended and illustrated that this form of pedagogy is

effective only when students can meaningfully engage in the activities, and this requires a great deal of focused discussion both with their peers and with their teacher. Therefore, the teacher needs to establish and sustain a classroom climate that encourages open discussion and is built on good relationships between the teacher and the students, and between the students themselves. Such a relationship works to transform the relationship between students and mathematical knowledge both within and beyond classroom contexts.

We suggest that within such a mathematics learning environment, students are more able to develop appropriate mathematical skills and knowledge, and positive attitudes and beliefs about mathematics – strong mathematical identities. There are a number of key conclusions that can be drawn from this case study.

Firstly, we believe that the students' mathematical learning was enhanced both qualitatively and quantitatively – they learned more and they learned it better. The students showed through the products they produced in response to the investigative tasks (and their subsequent formal assessment tasks like examinations) that they were able to calculate the area and volume of a range of shapes and solids, and for many the complexity of these was beyond what is normally expected of students at their year level. This is an important outcome, because a common reason given by teachers for not engaging in investigative-type pedagogy is the impact it has on the development of students' mathematical knowledge and skills. Clearly, in this class anyway, the students have not only achieved at the level that one would expect, but some have exceeded the curriculum demands for their level. In the large longitudinal study undertaken by Boaler and Staples (2008), they also found that students (in their case from marginalised backgrounds) achieved more and better through an investigative pedagogical approach to mathematics.

Alongside the improved student outcomes in terms of mathematical knowledge and skills, the students also exhibited an enhanced capacity to think mathematically and engage in authentic mathematical activity (see Burton 1998). To engage in deep mathematical thinking, students need to be given significant mathematical problems to solve and adequate time to investigate them. Indeed, Schoenfeld (1992) lamented the limited opportunities students had to really engage in significant mathematical thought when in most classes they are given 30 exercises to complete in 30 min. In this chapter we reported on an investigation where students were expected to engage in a mathematical investigation over an extended period of time. While this was difficult for students initially (who really just wanted to know *the* answer!), it enabled them to meaningfully participate in genuine mathematical practice, and develop a sense of resilience and perseverance. This also enabled them to be more willing to take and risk, as was illustrated in the complex pool design models discussed previously (and shown in Fig. 9.5).

Finally, we found that the students developed more positive affective views of mathematics and, therefore, they were generally more engaged in their mathematical work. To illustrate, one group of students built a model pool, but then decided their scale was not right, so they did their calculations again and then built another model with a better scale which also looked neater. Another group of students initially built their models from old cardboard boxes, but then decided after seeing

others that the models looked better when made from manila folders and so they made a new pool. Previously, these students would have completed the task and then been satisfied, whether it was a particularly good product or not. However, in this class environment with this pedagogical approach the students were more willing to engage in the mathematics and to persevere on the task. In particular, the use of appropriate technologies and hands-on resources were critical in facilitating student engagement. Furthermore, the technologies provided alternate ways for students to access the mathematical ideas and concepts, and these seemed to allow students to develop increased confidence with mathematics, as exemplified in the student journal comment below:

> I feel a little more confident. But I have learnt different things that are hard to understand and be confident about. So I feel more confident about things I learnt last year but not so about the new things.

This kind of outcome illustrates perfectly the "modest ambition" that characterises projects explored in this book. Whilst educational innovation and transformation is often conceptualised or discussed as earth shattering and life changing, from the perspectives explored in this volume, transformation is a day-to-day and ongoing process. There is no single "big bang" within which knowledge is forever secured and destinies are forever changed. Rather, modestly ambitious projects seek to develop, support and celebrate changes in students' relationships with particular bodies of knowledge. This happens in small ways and grows over time.

Having worked with these students over an extended period of time (Margaret was their mathematics teacher), the change that we saw in their attitudes and confidence is perhaps the key outcome of this investigative approach to teaching mathematics. Together with the improved knowledge and skill outcomes, it is clear that the students have stronger and more robust mathematical identities that they can draw upon in unknown and unknowable future contexts. This means that the students are more able to engage and cope with the mathematical demands they face in the future, whether in further education, work, or life in general.

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Chapter 10
Swimming Between the Flags: The *Pictures of the Floating World* Project

Craig Smith

Introduction

The *Pictures of the Floating World* project refers to a project tasked to create a suite of digitalised curriculum resources based on a series of Japanese *Ukiyo-e* (literally "Pictures of the Floating World") woodblock prints. Running through these *Ukiyo-e* woodblock prints is the silent but ever present element of water, informing an aesthetic sensibility attempting not only to pictorially depict stories of "old Japan," but also to bear witness to the transitory nature of existence.

Metaphorically, the notion of water also captures something of the fluidity, dynamism and transitory nature of education and innovation that the *Floating World* project was mandated to explore. Water, as an idea, conveys to us a range of contradictory experiences where by turns it can be both dense and vaporous, translucent and coloured, mediative and exhilarating, familiar and uncanny, and so on. The case study of the *Floating World* project outlined in this chapter also attests to a number of contradictory experiences, which for all of the project's successes, newness and shared excitement, kept returning to a certain sort of timidity that I would argue needlessly constrains innovation in education.

The timidity I refer to is best captured by yet another water metaphor. Tourists and locals to the Australian beaches are regularly exhorted to "swim between the flags." This refers to a clearly marked section of a beach judged by to be safe, which is patrolled at certain times of the year. The underlying principle is that by choosing to swim "between the flags," one can stay safe in the unpredictable and potentially dangerous ocean. However, underneath this notion of "swimming between the flags" is a convenient fiction that masks the absurdity that by planting two flags on a beach and declaring it a "safe zone" for swimmers, that somehow a rectangular

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section of the ocean has been domesticated. And so it was for the *Floating World* project. That is to say, the project did not get too "far out"; participants were under the alert and watchful eyes of those prepared to lend support if and when it was needed. And yet just as it is when one swims between the flags and still feels the enormity, exhilaration and power of the ocean, it was hard not to notice what lay beyond the artificially constrained world of the *Floating World* project: Namely, the vastness of the world-wide web with both its promise of learners playing, creating and sharing in this space and its potential risks.

In this chapter my goal is to recount the *Floating World* project as an innovation that sought to transform and perhaps transcend a number of traditions, such as schools' access to traditional art works, and the relationship between these art objects and their (passive) viewers, through the design and deployment of a technologically mediated space. In doing so, the *Floating World* project opened up new ways for information to flow, enabling a dynamic relationship between viewer and (art) object. The rub being, perhaps, that like the scenes the *Ukiyo-e* prints depict, these new "information flows and relationships" too were only transitory, bound by the formal frame of the project.

Origins

The *Floating World* project originated with the National Gallery of Victoria (NGV) based in Melbourne, Australia, who were looking to find innovative ways for an exhibition of Japanese woodblock prints to both remain in the public domain and engage a range of younger audiences. The solution they found involved creating a suite of digital teaching and learning resources, utilising a series of eighteenth- and nineteenth-century Japanese woodblock prints depicting life in the Edo period. A central feature of these resources was a scriptwriting game, where a "player" could appropriate the backgrounds, characters and objects depicted in the digitalised prints, to script and share an animated story of their own creation. The resources were supported by a professional learning community comprising of classroom-based teachers, content and curriculum specialists and the project team. The project team included software developers, who used a dedicated social networking site as the means to both connect the learning community whom were spread out across the state of Victoria, and to refine and adjust the scriptwriting game to better fit the diverse lived realities of teachers and students in their local classrooms.

The local education department wanted to test the usability of the project's digital resources in a variety of different, school-based information technology environments, and to investigate what (if any) influence design had in encouraging a "scaling up" of an education-based innovation. These aims are reflected in particular design choices the project team made, such as ensuring that the resources could be used across a variety of media platforms ranging from interactive whiteboards (with duplicate on-screen controls placed at the bottom of the interactive whiteboards within reach of little hands) to hand-held mobile devices; or, by

keeping the upload/download requirements to a minimum with student-made animations being stored on the NGV servers so that students were not having to download large data files. The guiding design principle was simple enough: actively involve the end-users as much as possible to ensure optimal levels of functionality, defined in terms of usability and accessibility.

The project team also wished to engender a range of experiences for the gallery's audiences by brokering a digitally mediated relationship between teachers and students, and the cultural, aesthetic and multimodal dimensions of the art works of the *Floating World*. Of particular interest to the project team was the question of how to open up these multi-layers of the *Floating World* to diverse groups of students who, for cultural, economic, or geographical reasons (and combinations thereof), would not otherwise have access to them. Hence the project team deliberately targeted not just small schools in regional Victoria but also schools in low socio-economic communities in culturally remote places like the outer fringes of Melbourne as partners in an open-ended conversation with the *Floating World*.

With these aims and ambitions, the *Floating World* project straddled the different "scapes" that the editors of this book bring to our attention (especially the media scape, techoscape and ideoscape). By extension it engages with the key question concerning the extent to which it is possible to attempt to future proof children for unknown and unknowable futures.

Clearly, the *Floating World* project did encourage learners (students *and* teachers) to engage with the new "mediascape" as a way to rehearse the skills and aptitudes needed to negotiate what is already a very complex and over-determined world. This is reflected, for example, in the project's deliberate and overt attempt to explore, learn and play with the web 2.0 economies of "read, write and share" in the classrooms not of the overhyped imaginary classrooms of the "twenty-first century" but rather of the classrooms of today, as we found them. And what we found was an emerging "technoscape" of online sites, wired classrooms, interactive digital whiteboards, broadband and the plasticity of digitalised art forms, intermixed with slow broadband speeds, IT support only on a Tuesday morning and $10 "monthly vouchers" for student internet access.

And this hybridity of the emerging new "school" intermixed with the administrative old school (literally!) was evident in other ways. That is to say, for all of the sense of radical change and/or "high tech" engagement that these "scapes" suggest, the *Floating World* project was on very familiar ground, with participants neatly ordered into that of "student" or "teacher", underpinned by the materiality of the classroom, of assignments, of assessments, of curriculum and so on.

The "ideoscape" that Arjun Appadurai (1996, p. 36) describes, with its assertion of globalisation as a continuation of the Enlightenment up to and including questions of sovereignty and the imposition of a normative Western democratic worldview, is a much grander canvas that the case study discussed here can possibly speak to. Instead this case study is firmly located at the local level, and as such can be no more than a narrative of the domestic and the everyday: an environment within which the ideology of schooling is so reified that it is all but impossible to experience "school" as anything other than a succession of familiar transactions.

In this bounded space subjects may transverse a globally resourced and expanded mediascape and an associated diverse set of ideological perspectives but can easily be returned back to their particular place, always and already circumscribed in the locale of "school" and the classroom.

Nevertheless, despite the constrained nature of any attempt at educational innovation, the *Floating World* project is an example of the kind of modest ambition outlined in Chapter 4. It explores the conditions which support twenty-first-century knowledge flows that are able to interrupt and (at least temporarily) transform very traditional nineteenth-century institutions, such as the public art gallery and the classroom. The physical and logistical constraints imposed by geography and time are challenged by frameworks and technologies that allow students to become publishers of their own work, online, to a potential global audience. What is yet to be identified – and what remains "outside the flags" – are ways for the project to take the plunge into this "global" aspect of the mediascape. This is to say, the fiction the project lived was that the network the project established only reached other schools in the state of Victoria, whereas in truth it had assembled both the materials and the infrastructure to transcend it.

Nuts and Bolts

As outlined earlier, *Pictures of the Floating World* had started life in 2005 as a NGV exhibition of over 100 Japanese woodblock prints drawn from the NGV's collection. The title of the exhibition, *Ukiyo-e*, was applied to the popular arts of painting, woodblock prints and illustrated books that depicted life in the great urban centres of Japan in the Tokugawa period (1615–1888).

These woodblock prints depict a moment of Japanese culture, with its attitude of responding to the transitory nature of existence of "living only for the moment… drifting along the currents of life like a gourd floating down a river."

The NGV digitalised *Pictures of the Floating World* exhibition and created a suite of online resources for schools that included

- high-definition images of the *Floating World* print collection with explanatory notes, with users being able to magnify visual elements
- a "how-to" step-by-step video of a Japanese artist creating a woodblock block print in the Edo-style
- a series of short video clips of musicians playing Edo-period instruments
- *Floating World* cards which students can print out and assemble, with images on the front and story ideas on the back.

These resources were tested with two schools but not initially taken to a wider audience. A commitment to taking the *Floating World* to a wider audience raised a number of questions such as: How could we make the suite of resources both appeal and work across the diverse conditions, environments and cultures of "the Victorian classroom" circa 2010? And what role could "Web 2.0" tools play in connecting practitioners to the online resources developers?

Across June and July 2009, through a mixture of networking, word of mouth, and internal advertising, the project team recruited 20 schools to participate in the *Floating World* project. By the project's end, 18 schools remained, represented by 43 classroom teachers and over 500 students. The 18 schools involved in the project were spread across Victoria, and included a number of very small rural schools such as Hawkesdale P-12 College and Toora Primary School in Gippsland, plus schools with high numbers of students from diverse ethnic backgrounds, based in lower socio-economic areas from greater Melbourne.

Participating schools were involved with the project over terms 3 and 4, 2009, starting with a face-to-face induction day, and supported by an online community of practice hosted on a Ning platform. The schools were compensated for a day of teacher relief costs and travel but, other than this, the project offered no inducements or rewards to those participating in the project and schools were free to withdraw at any time. The reasons why the project appealed to schools varied but a common thought was well expressed by a teacher who commented

> Anything that will partner us up and connect us with other community organisations I think is just fabulous for the children. Our students don't get to art galleries and if they do it might be once in their secondary career because we are just too far away. … [Most students come from farming families.] Some are in smaller feeder towns but again, no library facilities as such and no art galleries.

Teachers self-selected how and what learning areas they wished to use the *Floating World* resources for, with the resources being used for scriptwriting and narrative, dance and drama. Teachers also used *Floating Worlds* to assist them teaching art, ICT, multimedia, communication, technology and design, Japanese language classes and for integrated studies. At one of the outer-Melbourne schools, the primary school's Japanese LOTE (Languages other than English) teacher and the ICT teacher collaborated on using the *Floating World* resources as a fun way to teach both ICT skills and Japanese language skills. One of the teacher's summed up how they saw the resources:

> We're not just working with text, like with a word-processed document, they've got everything. They've got sound, they've got visuals, they've got movement – and that's what kids love.

At this school, Grade 5 and 6 students made their own animations using the *Floating World* scriptmaking tool, writing the dialogue in Japanese. Students would show the class their story on the class's interactive whiteboard, whilst providing the "voice over" for the characters on screen – in Japanese. Interviewing participants afterward, not only did the students talk freely about how much they had enjoyed using this approach to learning, but the Japanese LOTE teacher involved pointed out that by integrating the classes in this manner, the time she had with her students had increased from the allocated 1 hour per week to three, with commensurate improvements in her students' Japanese language abilities.

Whilst the majority of students produced their own animated stories, variations included screen-printed tee-shirts of *Floating World* scenes (an off-shoot of the woodblock printing process); mock-up tattoos using *Floating World* motifs; *Floating World* masks and costumes; and an elaborate filmed dance where students used a

blue screen to interact with the animated *Floating World* characters they had created. The wide array of students' work was genuinely surprising to the project team, as was the appeal of the resources to diverse cohorts of learners with little prior exposure to art galleries and the language of curated art objects, let alone the rarefied world of nineteenth-century Japanese woodblock prints.

The *Floating World* project formally concluded with an end-of-project celebration, held at the NGV, December 2009. The celebration centred on presenting samples of students' work and presenting students with awards for outstanding work, interspersed with the trio of musicians, who had provided the emotional leitmotifs on the scriptwriting game, playing traditional Japanese music.

Stories of the Floating World from the NVG's Perspective

> The *Floating World* project is an interactive interface to help and direct, scripting personal stories around a selection of artwork of the Pictures of the *Floating World*. The user can build their personal story but is also always passively redirected to the context of the artwork; title, period, description of the characters, images. The interface also enables online communication, dialogue and participation between users. (Jean-Pierre Chabrol, Director Multimedia NGV)

The Gallery was very interested in how the general public sees and interacts with the artworks, and was especially interested in questions such as: How could the NGV:

- enable the public to look at an artwork in a non-passive way?
- assist in bringing the story of the art work to the surface?
- make the collection more accessible?
- help the viewers to generate comments and dialogue with the artwork?

These questions were behind the push from the NGV to create the *Floating World* resources in an online environment where the central feature would be a scriptwriting game. In this "game", students could use various elements of the *Floating World* resources such as objects, music, backgrounds, and characters from the original woodblock prints to create their own stories of "old Japan". The interface needed to be friendly, intuitive and easy to use so that its target audience (9-year-olds upward) would be oriented toward an experience of exploring and creating their own "floating world," rather than being conscious of the enabling technology.

The game was crucial in meeting these criteria. Originally, the idea was to reconstruct a "virtual online Kabuki theatre" with scenes, characters, music and rhythm. However, the project team soon found that the unique constraints of Kabuki theatre were too restrictive for one of the project's aims of encouraging and enabling a creative process between the art work and a "generalist" audience. So they decided to design a "friendly" game, which assumed no prior knowledge of Japanese culture or protocols, and to create online scripting tools that used all the components of the theatre such as linearity of the story via a dedicated timeline; emotions represented through leitmotifs comprising of original music pieces played in the traditional

Japanese style; and actions to enable characters to dynamically develop relationships on screen and for the story to transition. The game activity also enabled students to share and review their digital stories with peers, teachers and others.

For the NGV, the *Floating World* project was

> a great communication enabler, a great open writing application in a very "channeled" environment. It has been an extremely enriching experience to explore the possibilities of interacting with the collection with a story telling activity. Many examples of successful stories from the teachers and students were great to hear and document. We used many examples and feedback to modify the application's interface design, instructional design or even its look and feel. (Jean-Pierre Chabrol, Director of Multimedia, NGV)

Stories of the *Floating World*: A Classroom Teacher's Perspective

When I was asked to come to an information session about the *Floating World* project, my first assumption was that it would be another half-hearted attempt to give a modern spin to an old-fashioned concept of education. I had already taken part in a Web 2.0 project with the local department of education and whilst there were many innovative ideas, their implementation often reverted to a very linear model of communication with the Internet functioning as little more than a digitised text book. However, this project seemed to have the potential for my students to use a real-world application of an educational network as well as engaging in rich content developed by the National Gallery of Victoria, and so I was cautiously optimistic.

My first impression from the initial meeting was that there were perhaps too many stakeholders for the project to realise its intentions. It seemed that the education department, the NGV, the local curriculum and assessment authority and Multimedia Victoria, each had a slightly different take on what the purpose of *Floating World* resource was, and when at one point the discussion turned to the censorship of seventeenth-century woodblock prints for a twenty-first-century classroom, I began to lose my optimism. But I left the meeting along with a number of other teachers determined that my class of year 8 media art students would understand what a panel of adults might not: This was meant to be fun.

And it was. Much has been written about the role of play in creativity, and I learned first hand how important it is to let students explore before trying to direct their learning. My first class with *Floating World* was, in a word, chaotic. One of the aims of the project was to test the infrastructure of the partnership schools, and I discovered that my school's ISP (it has since been updated) was not ready for the bandwidth of every student accessing the same animation creator at the same time. After a little patience however, the students were soon off and running, creating some stories that followed the tradition of Ukiyo, and some that definitely did not. But they got it, and the next lesson they wanted more.

One of best things to happen during the meetings about *Floating World* was the discussion we had about the need for a separate online forum to assist the teachers who were implementing the resource in their classes. A social network was created that became not only a place where we could contact the resource creators, but also a place where we could share our stories of the lessons we were running. Often – even in a big school – a teacher can feel a little like George Orwell alone in a Scottish farmhouse during winter writing *Nineteen Eighty-Four* with your publisher reminding you of deadlines, and the ability to connect with other teachers became a lifeline to sanity. Beside the troubleshooting of *Floating Worlds*, many people, myself included, found the social network became a place that gave cohesion to a trial that was a different experience for everyone that took part.

The multiplying uses we were finding for *Floating World* were celebrated on the social networking site, and whilst some were trialing a defined use of the online content, others began to turn *Floating Worlds* into an entire semester's worth of work. This saw the introduction of handouts from the NGV education staff and lesson plans from the curriculum and assessment authority, complete with tables and hard copy printouts of the images. Primary schools were using *Floating World* in their Studies of Society and Environment classes, and secondary schools were using it in their Language study. There was anxiety with some that this was all starting to get the dreaded "project creep" and that a lack of centralised control meant there were no boundaries on what the *Floating World* site was meant to be, but most were starting to realise that this might in fact be the point.

Yet all of us marched ahead with our classes, some using the exhaustive resources that were multiplying on the social network, and others letting the project develop with the students. After my first class, my students began to refine their animations, referring back to the curatorial content on the website and adding details that both gave their stories authenticity as well as possibilities they would not have otherwise had. Building on the idea that play is as important as directed study, some of my students took one panel of their story and decided to create their own print of the image. This idea caught on and so halfway into the project my class became a t-shirt-printing studio, with the class taking their Ukiyo narratives and turning them into high-street fashion.

As much as play can give birth to creativity, there is always the need for some kind of assessable result, and this is perhaps the real challenge of twenty-first-century education. We can all agree that resources like *Floating World* are crucial to a modern classroom, but without a guiding principle of what we expect students to achieve, many educators will be unwilling to use them. An assessment tool that is both ubiquitous in the digital age and can reign in the most chaotic of classes is video tutorials. No matter what outcome the students using *Floating World* chose to create in my class, each had to edit a narrated video tutorial of their process. These videos were shared via the social network, and became not only the assessable product of the unit, but also a valuable teaching aid for the class. This was so successful that I now use this as a standard assessment tool in most of my classes.

In the end, the *Floating World* trial was a fantastic project to be a part of. My students loved the chance to engage and interact with artworks of a culture that would otherwise have seemed remote and static, and I had the chance to become part of a team of educators exploring a process of teaching that is much discussed but rarely practised. Besides realising that digital tools can be used as standard practice and not merely gimmicks, I made connections with people in *Floating World*, who remain important collaborators and mentors to this day.

Holding It All Together: The *Floating World* Ning

A central feature of the *Floating World* project was the use of a "Ning," a dedicated social networking site, as a platform to create and maintain a professional community of practice. This was the project's place where all the participants bar students could share lesson plans, examples of student work and "work arounds," and seek support. For example, one teacher pointed to the value of the Ning as a site that enabled her to stay on top of the technical demands of the project:

I was in need of technical help on several occasions – little things such as loading photos onto the website or seeking help with not being able to save work. I sought help on the chat/forum thingy and it was invaluable. If this help wasn't forthcoming, the project would have been a complete flop.

The project team recruited a teacher who customised the generic Ning software to give it a "*Floating World*" look and feel. The software was free, the time the customisation took was negligible and access was by invitation only. The project team invited this teacher to act as both the Ning's facilitator and mediator, with a greater emphasis on the former role, to actively encourage teachers to contribute and become part of the emerging learning community.

The Ning was also invaluable for hosting a wide variety of photos, animations, short digital stories), SMS-style chats, and emails, and as a rapid channel of communication between the software developers behind the *Floating World* scriptwriting game and classroom teachers. At a practical level, through the Ning, not only were teachers accessible to one another and to the project team, but their feedback and trialling of the resources allowed the project team to rapidly improve and hone the resources to best meet the everyday conditions under which teachers and students were using them. By the project's end, 60 people were attentive users on the Ning, directly contributing to the suite of *Floating World* resources. For example,

> My class had written snapshots/descriptive pieces about one of the prints. They copied the picture of the fox into Word. We brainstormed descriptive language for the exercise and then wrote about it considering – What do you see? What is happening? What do you hear? What do you feel? What do you touch? What do you smell? What do you think? (Be there in it) I was really impressed with the emotive results and took some to the staff-room to share. (Ning post)

The project team also wished to engage teachers about the bigger questions the project wished to explore, by inviting reflexive pieces on the project itself (for example, see the thread below). What was genuinely exciting about the Ning was that it gave the project participants a place where they could meet, engage and exchange as equals in a virtual learning community, which, prior to the modalities of Web 2.0, simply would have not been possible.

Life Cycles of Innovation in Education (Excerpt from a discussion thread from the Floating World Ning)

> Is it really innovative putting resources online for schools? Cycling into work this morning (tail wind - makes you feel like Lance Armstrong in a suit) I couldn't help think that for all the clamour about online resources, that this by itself was neither very innovative nor indeed, very interesting. Likewise the promise of anywhere/anytime learning – and here I was reminded of the absurdity of this ambition, pushed to its limit, by a photograph of someone sitting in a cubicle, trousers around their ankles, typing away on their notebook.
>
> In fact access to online material in isolation, divorced from its social learning context, plays nicely to the long tradition of mass education understood as the place where standards are set and "learning" reduced to a process of (content) saturation, (students') retention, and (timely) regurgitation. Hence the drive toward the "seamless delivery of curriculum" becomes a quest to find the right technological solution – problem being, delivery of curriculum is a) probably never going to be seamless and b) involves highly structured **iterative** networks of relationships, i.e., there is an inter-subjective dimension to the relationships, which belong to neither party, and only comes into being via the interactions.

> What is innovative about the *Floating World* project then, is the project's attempts to open up the possibility of different types of relationships i.e., by inviting classroom-based practitioners to become part of the process that shapes and reshapes elements such as the initial online resources, the project is trying to establish a different relationship between end-users, developers, schools, the NGV, and so on.
>
> And, like all innovations, it can feel both messy and partial as these new relationships (what does it want of me? how much time etc. can I afford? what's in it for me?) are teased out. What happens if classroom practitioners don't wish to get involved? For like relationships in other spheres of our lives, one is always and already within a set of existing relationships ie prior allegiances, work habits, interests and so on. Key to the innovation—the ability to "recruit" others-will depend ultimately on the use-value *Floating World* has for each of the different actors. So what gap/issue/desire does *Floating World* offer to address or solve for you? What are your thoughts?

Afterword

As part of its quality assurance process, the *Floating World* project team commissioned an independent evaluator to follow the project from the start to its conclusion, to assess how successful the project had been in meeting its aims. What the evaluator found was that the project had employed and documented a model for developing online curriculum resources with and for schools. Furthermore, the evaluator detailed evidence how the project had stimulated new thinking about innovation and the role of a bureaucracy among the project partners. The evaluator also found that the project had been successful in showing how this innovation could be 'scaled up' through utilizing 'word-of-mouth' recommendations in a digital environment.

The success of the *Floating World* project was also recognised further afield, featuring in the US-based 2010 *Horizon Report* as one of three leading examples of the use of games in education (New Horizons, 2010).

> **The Arts**. Twenty schools in Victoria, Australia, used a drag-and-drop animation game to produce stories using backgrounds, characters, and objects from high-quality digital reproductions from *The Floating World,* the National Gallery of Victoria's collection of Edo period Japanese woodblock prints. The game was incorporated across the curriculum, touching on world language, cultural studies, English, and science as well as the arts. (Johnson et al. 2010, p.19)

The editors commented that education in general is still a few years away from embracing games as mainstream practice, but given the exciting results coming from game-based research, it is clearly a space to watch.

A large number of teachers recommitted to using the resources in 2010, supported by a smaller Ning, established with limited funding, until the end of 2010. However, to date, the NGV have been unsuccessful attracting funding to run new projects featuring other artworks, utilizing the same underlying software and design and pedagogical principles that guided the *Floating World* project.

Finally, it seems fitting to end a case study of attempting to future-proof learners with a piece ran in late September, 2010, in the *Herald Sun* which reads as something more akin to "back to the future." The "news" the paper reported was that:

> Victorian schools are falling behind the rest of the country in the rate of improvement made by students, according to an analysis of the latest NAPLAN data. Education consultant and mathematician Russell Boyle has used the data to compile a "Value Added Learning" (VAL) index, which compares the improvement made by students in each state and territory across any or all of the five NAPLAN scales. The index found Victoria was behind the national figure on all but two of the 10 categories. Worst were primary grammar and punctuation, which rated 119.6 on the VAL index, compared with the national figure of 123.9, and primary numeracy, which rated 120.6, against a national figure of 123.1.

Hence the conclusion and demand that here in Victoria, "we need to place a greater emphasis and spend more school time on reading, writing, spelling, grammar, punctuation and numeracy." Whilst these skills are no doubt important, there is much to refute about the argument and the conclusion drawn. But to leave aside these objections, the implied panic and sense of failure the article conveys regarding the state of schools in Victoria is completely at odds to what the project team witnessed during the *Floating World* project.

What we found (and who we worked with) were competent, professional and dedicated teachers keen to take on the "new" in the shape of *Floating World* schools, within the context of a "joined-up" curriculum. Students did spend time reading, writing, spelling, correcting grammar and so on, but in the act of doing something more meaningful and creative such as scripting their own films. As teachers in two of the rural P-12 schools commented, independently of each other, never had they seen their non-responsive and unengaged Year 8/Year 10 boys write as much as they did previously the *Floating World* project.

As for the students, a taste of their cleverness and creativity is conveyed via their mediated responses to the original artworks. Our impression, as we too "floated" through the very different world of school, was one of awe regarding the ingenuity of students and the patience and perseverance of their teachers. In another world, away from the business of selling anxiety and other sensations, the newspaper headline may well read "The water is fine. Come on in".

The *Floating World* website exists and is available for schools at no cost at http://www.ngv.vic.gov.au/learn/schools-resources/pictures-of-the-floating-world.

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Many individuals drawn from schools, the NGV, Department of Education and the Victorian Curriculum and Assessment Authority contributed to the project. Participating teachers brought with them a powerful sense of purpose and direction, along with a genuine sense of collegiality, feedback and enthusiasm, which in turn helped the project team refine a promising 'product' into a classroom ready resource. Their students created wonderful images and stories and showed us how the *Floating World* resources could be put to use in ways that were purposeful, creative and fun. To see the project team's hard work come to life in this manner was both exciting and rewarding, and without the students and their teachers, this project would not have been possible. Thank you.

Finally, there are some people whom I need to thank and publicly acknowledge my debt to. To Jean-Pierre Chabrol of the NGV and his team of very talented software designers and developers, Breton Slivka and Jonathan O'Donnell. It was their ideas, ideals and smarts that were the driving force that brought the *Floating World* project into being – thank you for letting me be part of it. To Travis McKenzie and Jess McCulloch, two leading teacher practitioners, many thanks for showing me what engaging, 'tech savvy' teaching looks like. To Chris Bigum, who as always, was a generous and inspiring interlocutor. And lastly but not least, to Leonie Rowan, for her patience, encouragement and support in helping me share some of the *Floating World* experience with a wider audience.

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Chapter 11
Whose Educational Futures? Widening the Debates

Mary Ulicsak and Keri Facer

Introduction

Visions of the future matter. They have the potential to shape our expectations and our aspirations. They provide limits on our ideas of what is possible and what is beyond imagining. They can serve to mobilise social change or to embed conservatism. The concept of "future proofing" at the heart of this book, for example, is premised upon the assumption that action in the present should be shaped by ideas of the future. As such, visions of the future are powerful tools in the process of social change. It is for this reason that these visions are hotly contested and widely debated and that such discursive, material and political energy is expended by those seeking to claim the territory of the future as their own.

Visions of the future are, however, merely that. Whether described by an academic drawing on impeccable evidence of past trends, or by a politician promoting an aspiration for which they will mobilise a nation, the future cannot be understood as predetermined. Any claims to inevitability – whether of radical change or continuity of the present – need therefore to be recognised as ideological, historically contingent and socially situated.[1] Indeed, discourses of inevitable futures have the potential to function in a profoundly anti-democratic manner, to close down the

[1] There is a substantial field of futures research that elaborates these arguments. Key sources would include Wendell Bell's "Foundations of Future Studies" (1997) or Inayatullah's (2008) "Causal Layered Analysis Reader".

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possibility of resistance and change, and have long been seen to play this role in education, as Giroux (2001) argues:

> in both progressive and conservative discourses, though for different reasons, schools [are] often viewed as being locked into a future that could only repeat the present […] Within these perspectives, teachers and students lose their capacities to become critical agents. (p. xxi)

To counter such discourses of inevitability we need, first, to open up the possibility of the future as a site of potential change and contestation. This has long been a central task of critical research both in education and beyond, whether in Gramsci's call to unsettle hegemonic discourses, in Giroux's demand for "educated hope," or in Erik Olin Wright's (2010) injunction to create "Real Utopias."

Second, we also need to critically examine who is involved in the practices of imagining such educational futures. We need to ask who should have a stake in researching, debating and designing education's futures. We need to question whether envisioning the future is a task only for experts or a democratic right for all citizens. We need, in particular, to ask whether an understanding of technological development is a sufficient basis for claiming insight into possible futures or whether alternative knowledges might also be both legitimate and necessary.

Without a critical reflection upon the people involved in the debate about educational futures, it is possible that existing power relationships will be reproduced and consolidated as dominant groups exert influence over the present through colonisation of assumptions about the future. A concern for social justice in any interrogation of the future must therefore include a concern for the origins of the ideas of the future that we are working within and towards.[2]

This chapter addresses this issue and tells the story of a series of inter-related attempts to diversify the groups usually involved in envisioning future education environments. It describes the experiences, pitfalls and lessons learned in seeking to mobilise digital technologies to assist in widening participation in educational futures research. It describes the tensions that accrue to such an endeavour around questions of expertise, insight and warrants to speak; and the many barriers to diversifying participation in these discussions. And it describes the responses of individuals and organisations outside the academic and policy-making arenas to the question – How should education futures be envisaged in the light of socio-technical change?

The Beyond Current Horizons Project[3]

The Beyond Current Horizons (BCH) Project was commissioned in 2007 by the UK government. It was tasked with producing a set of future scenarios for education in the context of socio-technical change to 2025 and beyond. The project was modelled on the UK Government Office of Science "Foresight" programs, and brought

[2] See, for example, the discussions on the importance of extending debate about educational futures to a wider public in Marie Brennan's (2001) keynote Debates on schooling: The futures we have to have or the futures we might stand up for?; see also *Classroom of the future: Orchestrating collaborative spaces* (Mäkitalo-Siegl et al. 2009).

[3] Full details about the project can be found at www.beyondcurrenthorizons.org.uk

together leading scientists and social-scientists to identify potential future directions and challenges to which education policy would need to respond.

Our[4] response to this brief was to seek to widen out the discussions beyond the academic and industry figures who usually constitute the respondents in this sort of exercise, and to attempt to engage a wider community of educational stakeholders, including those who may historically have been marginalised within, or excluded from, decision-making forums. In so doing, we were drawing on approaches to participatory design that had informed many of our previous curriculum design and software development programs.[5] We were also drawing on a series of arguments in the futures research field that make the case that understanding "the future" requires documenting not only emergent trends and historical precedents, but also the aspirations, hopes and fears that individuals and groups may have for the future (Inayatullah 2008; Boulding 1977; Slaughter 1996).

We felt, in other words, that it was not only ethically desirable to engage a diversity of voices, but that this would also provide a better insight into the developments that were likely to be accepted, resisted, welcomed or disbelieved, thus giving us more of a purchase on "the future." This aspiration, which might in previous years have been seen as a diversion from the core work of a Foresight program, was supported by a more recent acceptance in the UK and internationally of public engagement as a desirable part of policy making and ethical debates in science and technology.[6]

The BCH program had three phases[7] designed around Bell's formulation of mapping "possible, probable, and preferable" futures as a basis for systematic inquiry into the future (Bell 1997, p. 73). Phase 1 involved a program of consultation with academics, industry, policy and representative stakeholder groups around the key themes that would serve to focus the inquiry. Phase 2 involved mapping perceptions of "probable" and "preferable" futures for socio-technical trends through academic literature review, and face-to-face and online consultation. Phase 3 involved a set of activities to explore "possible futures" using creative workshops and scenario development.

The public and stakeholder engagement activity served three purposes in relation to the overarching program:

- It provided an ongoing balance to the academic research evidence and ensured that key issues of concern to public and stakeholder audiences were addressed in the review commissioning process.
- It acted as a mechanism for prioritising the concerns around which the scenarios were designed.
- It began to model how to overcome the often polarised and unproductive nature of public engagement with educational questions.

[4] The programme was run by a team at Futurelab led by Keri Facer in collaboration with the Department for Children Schools and Families. Mary Ulicsak, Jessica Pykett and Dan Sutch led the work on public engagement. Clara Lemon led the design of the engagement tools and Richard Sandford and Stephen Sayers led the academic and policy engagement.

[5] Sources we have drawn on to inform this perspective include: Kafai and Resnick (1996), Scaife et al. (1997), and Druin (1998, 1999).

[6] http://coi.gov.uk/guidance.php?page=283

[7] A full account of the project is available in Facer and Sandford (2010).

Engaging Participants in the Debate

Throughout the project we worked with a range of different organisations and individuals. First, we interviewed key individuals identified as having insights to offer in respect of socio-technical development or educational change (writers, thinkers and speakers recommended by word of mouth or reputation). We also reported to government strategy groups, participated in industry seminars with industry and visited leading technology research labs. We worked with over 200 organisations in total. We also blogged our thoughts and findings and produced a bi-monthly e-newsletter for the stakeholder network.

We also wanted to engage people outside the educational technology "intelligentsia" and to understand the views of educational stakeholders. Given education's potentially universal reach, however, the question of who counts as an educational stakeholder is problematic. Surely everybody – parents, children, teachers, those working directly or indirectly with schools, policy makers, employers, and society at large – is impacted by the education system? Engaging in a face-to-face "national conversation," however, was clearly beyond the resources even of a nationally funded project.

We therefore adopted two different approaches suitable for both wide scale engagement and smaller scale face to face activity: normative engagement, in which we provided no or a limited amount of information in order to encourage immediate, personal or emotional responses and which we adopted when seeking to engage as many people as possible through online consultation approaches; and deliberative engagement, where information was shared from the project within and preceding discussion to ensure that the responses from the participants were as fully-informed as possible and which we used for face-to-face interactions with selected groups in workshop-type discussions.

In our first year, in addition to an online survey which we promoted through our existing network, we also sought to gain insights from a more targeted set of viewpoints. Our primary concern was to explore the different views of people of different generations. As such, we sought to involve participants in discussions from a range of different age groups. We recruited parents of toddlers about to enter school; children, students and teachers; as well as a group of "baby boomers."

In this process, however, the extent to which participants in such studies tend to be self-selecting from particular groups became visible. Despite concerted attempts to run face-to-face activities with parents of young children in economically disadvantaged areas, the appeal to "get involved in a conversation about the future of education" perhaps understandably failed to recruit many participants from these areas. Instead, the parents and toddlers group could more reasonably be seen to represent a particular tranche of engaged, mainly white, middle-class parents. Similarly, the "baby boomers" group we ran in an economically disadvantaged area of another major city served to recruit a majority of those with time, resources and literacy skills. We saw very few people whose experience of education had been problematic. This difficulty of recruiting more diverse participants may reflect a number of factors: from the understandable unwillingness of those with negative

experiences of education to get involved in a discussion concerned with educational issues; to the esoteric nature of a request to debate "education's futures." Such an appeal does not necessarily lend itself as a pressing or appealing debate to those who might have more urgent concerns.

In our second year, therefore, we attempted a more representative approach, seeking groups who might "speak for" a more diverse set of experiences. We carried out a detailed online survey with an existing Citizens Panel. This panel had been set up by the local council to represent a cross-section of ages, gender, ethnicity and disability, and they already met regularly to share their views and ideas on a wide range of issues. Through this existing group, we were able to recruit successfully a more diverse set of people from different educational, economic and ethnic backgrounds. We also created a Citizen's Council whose members were representatives of charitable groups who played a role in advocating for different faith, education, employment, race, disability, gender, family, age and geographic location perspectives. In this model, however, we were already beginning to work at one remove from the diverse "voices" we had set out to engage with and were already speaking with advocates who were professionally concerned with speaking for and *on behalf of* diverse communities, rather than these groups themselves. Such representatives are often "successful" products of existing education systems.

Our online consultations engaged a significant number of people. There were responses from several thousand different respondents in over 100 countries. In an early decision we determined that we should create very few barriers to participation. Participants in the various online activities, therefore, were not asked for any information about themselves – nothing on gender, educational background, ethnicity or income. This clearly raises questions about our capacity to make claims about the diversity of participants that we actually achieved and the claims that the project can make to have truly widened participation in the educational futures debate.

What we hope to do, in the remainder of this chapter, is to talk to the wider concerns of this book by, first, describing our experiences of using digital technologies to "widen participation" in educational futures debates; and, second, by exploring the educational futures that the participants in our study envisaged in a context of socio-technical change. In so doing, we do not claim to provide a more "authentic" future vision than those offered by the educational intelligentsia. We do not wish to insert a new tyranny of the true "voice of the people"; there are too many examples from history of the futures that this tends to support. Instead, we simply want to explore some tentative steps towards both diversifying and disrupting the claims to universality that can be made about future visions.

Million Futures and Power League: Widening Participation

There are substantive debates about the use of online environments in public engagement (Price 2009). Key concerns include the potential for such environments to amplify social divides by operating through digital technologies; and whether such environments can offer meaningful dialogue. In contrast, some argue that online

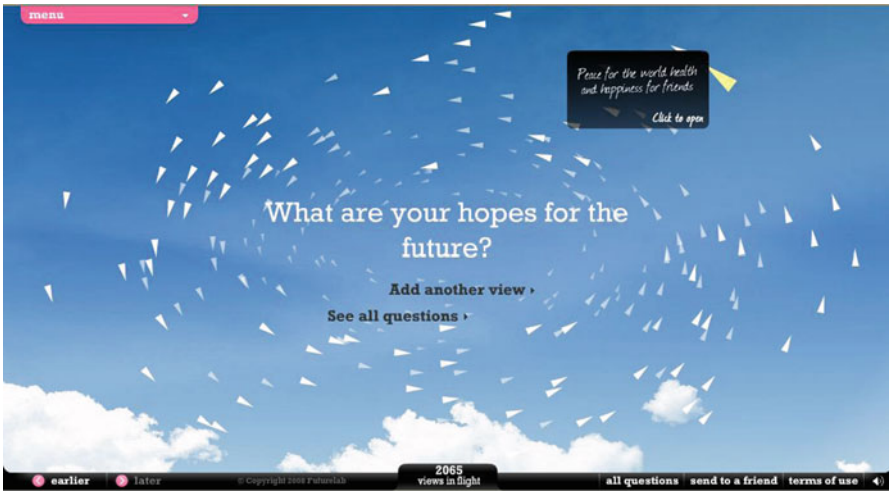

Fig. 11.1 The opening screen for Million Futures with one "plane" open to read response

environments may serve to reduce individual dominance of discussions, and produce more questions, self-disclosure and fewer unrelated questions than "real" meetings. We sought to make our online participation tools more engaging and inclusive than typical public surveys. The two tools we will outline here were designed specifically to encourage, in a playful, engaging and collaborative manner, a very wide range of possible participants without being reliant on substantial marketing campaigns. They were designed to try to build on the potential of digital networks to encourage viral sharing of information and to encourage people to participate in informal activities.

Million Futures: Playful Exploration

The Million Futures[8] website was inspired by the "wefeelfine" website,[9] which had been widely circulated without publicity and became very well known on the basis of its functionality and playfulness. Million Futures is designed around the concept of paper planes. Initially the site shows paper aeroplanes swirling around a question with appropriate sound effects. The visitors are prompted to write their responses to one of six questions about the future. Clicking on an aeroplane opens it up so they can view the contents of the other aeroplanes (all are anonymous) by question or display aeroplanes by keywords (Fig. 11.1).

[8] See www.millionfutures.org.uk – this tool is still live, and contributions can still be made to the resource and other people's contributions explored. The results are not, at the present time, being analysed.

[9] wefeelfine.org was created by Jonathan Harris and Sep Kamvar in 2005.

There were ten questions in total; the first two remained for the duration that data was being gathered. In the 11 months that it was monitored 1,539 paper planes were created with authors in over 100 countries – despite the absence of a publicity campaign. These questions, along with sample responses, are given below:

- What are your hopes for the future? (538 responses)
  - "that all children will get along and bullying will be put to an end"
  - "world peace and to stop poverty and every one to be treated fairly and my family and friends to have a better life…"
- What's your biggest worry for the future? (196 responses)
  - "That the world will become so full of rubbish that it will be impossible to live here"
  - "There is going to be more pollution and there will not be any more forests"
- What do you want your community to be like? (120 responses)
  - "Supportive, interactive and vibrant"
  - "A place where people share their ideas and work together for the benefit of the community rather than their own self-interests"
- What skills do you think will be important? (159 responses)
  - "Meta-learning skills. Coping skills – coping with information, knowledge and system complexity. These two are of course intricately connected"
  - "Skills with people will be at a premium"
- What should education be like for our grandchildren? (94 responses)
  - "Based on experience, not script. Focus on the basics of humanity/society=respect, resourcefulness, motivation"
  - "It should be free, it should be fun and it should be challenging. Children should be allowed to develop their creativity and interests from a very early age. They should learn in their own way, with teachers as guides and supporters"
- What do you want your country to be like? (42 responses)
  - "A place where members of various generations respect each other work and play together"
  - "Somewhere that everybody can feel safe. A place where everybody is equally respected and respectful"
- What would you not want to see in any future education system? (207 responses)
  - "A strong focus on teaching at the expense of a focus on learning"
  - "Education that does not inspire all children to continue learning. Education that does not make all children feel they have skills that are valued"

- What of today's education do you want to see in 2025? (106 responses)
  - "Dedicated staff who love teaching. Bright hopeful children who love to learn. And..... books books books"
  - "Support alternative thinking and entrepreneurship"
- In what ways might teaching be different in 2025? (65 responses)
  - "More creative, child centred learning that respects individual talents and interests"
  - "I think teaching should be available when ever I want it"
- What technology will be most useful to education in 2025? (12 responses)
  - "The Internet will be useful"
  - "Interactive writing tablets"

The advantage of this site is the ease with which questions can be responded to, and others' opinions can be examined. As the idea of paper planes is a fairly common cultural reference, there were relatively low barriers to understanding and participation. Reciprocally, a limitation to this approach is that the limited space for writing on the "paper aeroplanes" encouraged short responses. These responses provide a snapshot of wishes but the precise meaning of the individual author is open to a significant degree of interpretation. For example, the interpretation of a statement like "to build a better community" requires a degree of judgement on the part of the reader about how the author might define a "community" and what would be required to "make it better."

It is possible, however, to treat the responses in aggregate and to explore the themes that were emerging through the repetition of key phrases or the subject areas presented. Common aspirations for the future included getting a good job, having healthy children and possessing material objects. There was also a strong focus on more global issues, for example "world peace." Such aspirations are familiar from the futures research field, in which there is evidence of aspirations for wellbeing, fairness, justice, and community over at least 30 years.[10]

With respect to education the responses suggested desires for education to be fun, engaging, and relevant. For example:

- "Learners switched on to learning, where they see learning as a joy and teachers facilitating the development of the tools they need for happy, productive and healthy lives"
- "Fun. Diverse. Challenging. Have a high degree of choice but with lots of support and help. Involve real teachers where you learn real skills. Have interactions with other students but not necessarily of the same age"
- "More creative, child-centred learning that respects individual talents and interests"

[10] For example, Elise Boulding wrote about these issues in 1977 (Boulding 1977).

Suggestions provided for what education should not be are equally descriptive:

- "I would not want to see worksheets taking up the whole lesson with no context or interaction or discussion"
- "Being graded and compared to everyone else"

It is hard to disagree with such statements. And yet, such broad aspirations for education can usefully serve as a compass when confronted with the increasing techno-social rationality of educational environments. How far, for example, might certain techno-social developments support respondents' aspirations to health and wellbeing? How far might technologies of data management, surveillance and control be mobilised in support of these aspirations rather than others? In other words, if we take seriously the argument that socio-technical change is not determined by technological development, but by the social contexts, values and institutions within which it develops, then we might begin to use these responses to initiate ethical discussions about the use of technology in education.

This normative environment, in which there are no prompts or further information, also makes it clear that when asked general questions about educational futures, technology is not a high-profile feature of these discussions. Instead other issues, such as children's health and social wellbeing, tend to be fore-grounded. For example, only 75 responses about educational futures related to technological concerns. This contrasts with the discussions we were having elsewhere in the Beyond Current Horizons program with researchers, policy makers and leading thinkers. These educational expert groups were concerned, for example, with the implications of developments such as smart drugs and local fabrication technologies. When technology was mentioned by respondents in Million Futures, the familiar information and communication technologies dominated assumptions about educational change. For example in the future there will be: "cheaper and more reliable technology that is user friendly" and "all children will have their own computers."

The Million Futures tool surfaces all the strengths and weaknesses of such online consultation environments. It clearly can only have been a resource that supported those people who have themselves the resources (economic, educational, social) to get online and to want to participate in this sort of consultation environment. While its simplicity may be engaging, and its familiar cultural referents appealing to many, it is still, nonetheless, as much a potential tool for exclusion as inclusion. Its effectiveness in opening up the debate can only be judged in the extent to which it informed the wider program. In this case, we can argue that it effectively disrupted some of the dominant debates in the program by creating a rationale for paying attention to what could have been dismissed as "old-fashioned" or "unrealistic" aspirations for the future – namely, aspirations to wellbeing, social justice and progress. Such values informed the design of the scenarios work and shaped the discussions in the program over the longer-term recommendations arising from the debate. Whether this counts as a radical introduction of previously silenced voices in the educational futures debate, however, is far from certain.

Power League: Hard Choices

The second tool that we used was designed to help the program to elicit a set of priorities and aspirations for the future of education. This tool was designed around the principle of a Power League.[11] A Power League is an online tool that asks users to choose between two competing ideas or options, and gradually, as more and more users make their choices, a ranking (or league) is established that shows the overarching priorities emerging. The options are presented randomly and after a sufficient number of "wins" and "losses" are recorded, the software creates a league based on the relative popularity of the ideas. Such leagues present "players" with hard choices and encourage users to make decisions that are at times uncomfortable; both options may be desirable in different ways or present equally distasteful possibilities. In this project two leagues were set up to elicit insights into aspirations for (1) future educational goals and (2) future approaches to teaching and learning.

In the first league, users were asked, for example, to choose between options such as "Learners are assessed by demonstrable skills and a portfolio of work rather than exams" and "Extra resources are available to support disruptive learners." The 70 different options were developed by the Futurelab team on the basis of analysis of contemporary curriculum debates.

In total, the curriculum league generated 5,387 votes. The top three options voted for were:

- Developing confident individuals who are able to lead safe, healthy and fulfilling lives
- Creating learners who enjoy learning for its own sake
- Helping everyone to reach their full potential

The bottom three options were:

- Providing standardised and trusted accreditation of attainment
- Enabling parents to work
- Learning about religion

The question for the second league was: "How would you like education to happen in the future?" The "player" might have to decide between "Providing a safe environment in which to experiment" and "Creating a vibrant labour market for employers." In this league 1,452 votes were cast. The top three responses were:

- Education includes opportunities for learner choice and personalisation
- Education happens in a wide range of spaces – not just schools
- Learning should be enjoyable

[11] See www.powerleague.org.uk – although the leagues used for BCH are no longer accessible the full list of results can be found at http://www.beyondcurrenthorizons.org.uk/evidence/public-engagement/power-league/

The bottom three responses were:

- Drugs that enhance intelligence and support learning are used routinely in education
- Education is delivered by the private sector rather than the state
- No digital technologies are used in schooling, the emphasis is upon real objects and face to face relationships

The priorities reflected in these leagues are interesting. They reflect the concerns present in Million Futures with education as a resource to build young people's wellbeing and education as a process concerned with the person and personal development. They suggest that a preferable educational future should value children's individual skills and enable learner choice. The idea that learning should be fun emerges again as does the idea that students should be confident and happy. Again, the importance of human interaction also rated highly, as it did in Million Futures and in the face-to-face activities we will describe shortly. The priorities also reflect an interesting attitude towards "new technologies," with support (unsurprising given the activity was online) for digital technologies high. There was, however, active rejection of so called "smart drugs," a finding echoed in the recent study in Nature (Maher 2008) which argued that most parents would resist the use of such drugs for children under 16.

Future Visions of Technology and Education

So far we have described how we appropriated digital technologies to try to widen out the educational futures process. This section explores how participants in our face-to-face activities were encouraged to explore the potential role of technology in educational futures.

As discussed earlier, the first phase of the program involved the identification of a set of key challenges around which to focus the later stages of the inquiry. A "longlist" of possible areas for inquiry were developed through consultation with individuals in fields ranging from education policy to learning sciences, and with policy makers and industry representatives. A set of 11 "candidate" issues were identified which included themes as diverse as "changing childhoods" to "psychopharmacology/smart drugs" to "post crisis education".[12] These 11 themes were then used as a basis for discussion in two deliberative engagement workshops with parents and with teachers and students.

At the workshops, presenters talked through these 11 key areas for possible future socio-technical change and some of the expected developments or uncertainties that they might involve. This gave the participants a basis for decision making

[12] This longlist of 11 areas is outlined at http://www.beyondcurrenthorizons.org.uk/background/research-challenges/long-list-of-challenges/

about which they thought were most important and for a discussion about their sense of the potential implications of these possible developments for education. These workshops made visible the fact that, while everyone is involved in some sort of "futures thinking" all the time – anticipation, planning and projection are part of day to day life – potential socio-technical trajectories do not necessarily figure in such day to day futures thinking. Despite the popularity of science fiction and the growth of popular science programs, in general participants had very little knowledge of some of the emerging developments with which the research and policy communities were concerned. The participants were therefore highly reliant upon the materials presented in the workshops and upon the presenters' interpretations and views as a basis for their discussions. The influence of the mediator in structuring the workshop and presenting the possible risks/uncertainties and possibilities raises questions about the nature of the engagement with the debate, and positions the participants within the framework of future possibilities established by the workshop organiser.

Notwithstanding such concerns, an interesting set of aspirations for education emerged from the often very wide ranging discussions in the workshop with teachers and students. Teachers, for example, were particularly concerned to understand how childhood might change in future. The students themselves, however, were more concerned with their own futures. They saw education in highly instrumental terms. They argued that education should prepare them for the world of work, and that changes in the world of work should be matched by changes in education. Their priority, therefore, was understanding how economic and working futures might play out. Both teachers and students were only marginally interested in understanding more about how we might interact with each other and information *with* and *through* technology in future.

The parents' workshop saw less consensus. The parents had a more disparate view of what they saw as important. Their main area of consensus was their desire for information about how new technologies might influence our understanding of identity and community. Their most significant concern was related to new technologies; they feared interactions with technology would be prioritised above social skills and human interaction. The parents wanted their children to develop social skills. This was echoed in discussions about what they wanted to keep in schools – in all the groups parents said they wanted to keep social activities, that is, play times, fun lessons, sports, breakfast clubs, and outside activities. They wanted education to provide a nurturing environment to develop their children rather than being geared towards examinations or future employment.

While these views emerging from the workshops were in themselves interesting and echoed many of the views expressed or prioritised in the Million Futures and Power League activities, what is perhaps instructive for such consultations in future is that participants were particularly concerned with the future in so far as it affected their *personal* trajectories. Trying to find ways to explore personal future narratives, and explore how these play out in the context of different socio-technical developments, might provide a useful technique to pursue.

Fig. 11.2 Teachers talking around their models

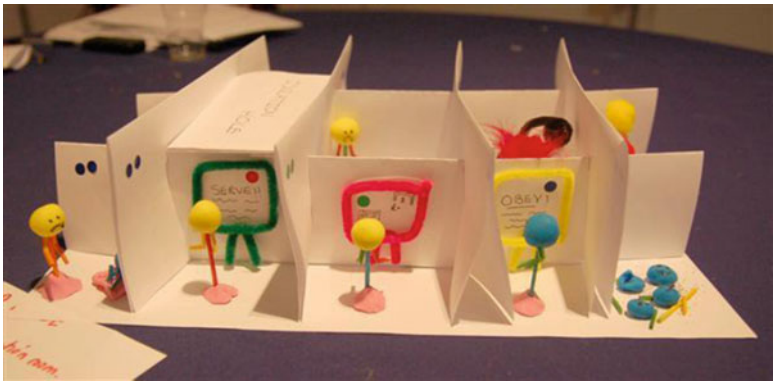

Fig. 11.3 A dystopian view of an education system by a student

All workshops concluded with an imaginative activity designed to encourage collaborative exploration of the future of education. Groups of six were tasked with building their best or worst learning environment using modelling materials, for example, plasticine, pipe cleaners, and post-its, as a means of presenting their aspirations or fears. Such model making clearly does not constitute a perfect representation of participants' ideas but as a technique to inspire conversation it is highly effective; it facilitates description of concerns, ideas and aspirations to other participants (Figs. 11.2 and 11.3).

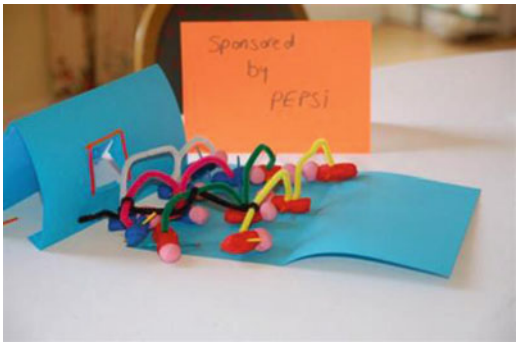

Fig. 11.4 Parents' fears for their young children

This approach also allows the participants to think about technology without having to have a technical understanding. The consequences of certain developments can also be explored – by creating computer cubicles or robots you can explore their implications for human interaction and space, for example, what sort of size would learning environments have to be? What would you do for exercise (jump up and down in your cubicle)?

Even participants who claimed no creative abilities tended to enjoy and explore possible futures when they had to make an environment rather than being asked to talk about futures in more general terms. And this more material technique very clearly helped participants to represent attitudes: for example, the parents' models focused on the desocialising aspects of the use of existing technology, while their discussions were about prioritising interpersonal and social skills. One drawback to this approach in exploring socio-technical futures is that it may lead to a focus on physical objects, rather than more "invisible" technologies. Although arguably, the sign "sponsored by Pepsi" in the model of one school showed that participants were able to make visible complex and often invisible power relations, when these were issues of concern.

Concerns about technology and dystopian educational futures were echoed in many of the models. Robots were represented as tools to punish those not learning; in these images, students were represented as chained to monitors. Parents also represented babies being monitored to determine what stimulates them, as a basis for the allocation of future career trajectories. These models could be dismissed as reflecting only the popular cultural heritage of a century of science fiction images, but taken in conjunction with participants' discussions, we might attribute more intention to these designs, and see them as reflecting the emphasis that parents place upon human interaction and wellbeing (Fig. 11.4).

Critically, however, despite the workshop leaders' discussions of how technologies and societies had the capacity to radically change institutional practices, the participants in these workshops, including all the students, tended to view learning environments as physical buildings frequently similar to what currently exists. Many of the "aspirational" models showed familiar classrooms, with caring human teachers, desks, and spaces for collaboration and personalised learning. Such images of the future represented technologies not as offering alternatives or radically new

ways of educating, but as amplifying existing social relations and structures. As one boy said, his ideal educational future would be "more interactive interactive white-boards". Such responses imply that it will take more than a 40-min introduction to possible socio-technical developments to help to deconstruct assumptions about possible educational futures, and provide insights into why, for all the rhetoric about educational revolution that so often characterises future visions, these are so rarely realised in practice. As Laurillard (2008, p. 1) observes "education is on the brink of being transformed through learning technologies; however, it has been on that brink for some decades now."

Reflections on Public Engagement in Educational Futures

These workshops, online consultations and the wider range of public engagement activities in the BCH program were hugely influential in shaping both the early direction for the project (prioritising areas of interest) and in shaping how the final scenarios were developed. A set of key aspirations for the future of education also emerged from these activities, which may assist those of us concerned with rethinking educational trajectories in shaping our research agendas and in prioritising how we mobilise digital and other technologies for learning. Broadly, there were four repeated aspirations:

- For education systems that promote understanding, social interaction, caring and co-operation
  - This aspiration captures concerns of participants in the program about the potential for social breakdown, loss of social cohesion and the potential for both digital technologies and changing patterns of migration and population ageing to cause cultural fragmentation. It is a positive aspiration expressed in response to significant fears about future demographic, environmental and technological development.
- For education systems that address socio-economic inequalities
  - This aspiration reflected a simple repeated concern that education should be "fair" and aspire to successful outcomes irrespective of student background and income.
- For education systems that offer the highest quality learning experiences for all, with the quality of human interaction as central to these experiences
  - This aspiration reflects, in many ways, a resistance to the idea that technology should replace human interaction. Participants wanted education to be of the highest possible quality in its teaching and learning design, but not at the expense of human relationships. This suggests that building human relationships may, for these participants, have been of higher importance than, or at least equal importance to, learning as an educational goal.

- For education systems that prepare individuals for the world of work
  - This aspiration was mainly voiced by students rather than parents and teachers in the first year of the study (2007); by 2008–2009, however, and the emergence of the banking crisis and subsequent economic disruption, it was an aspiration being voiced more widely by participants in the study. This shift shows the way in which ideas about and fears for the future are shaped by the present. The aspiration might be understood more broadly as ensuring future economic wellbeing in face of a growing anxiety that such economic security might be hard to achieve.

These aspirations emerge from a complex mix of fears and hopes for the future. They challenge us to ask whether the ways in which we seek to appropriate socio-technical change in education are complementary to or challenging of such aspirations. They may act as a benchmark for judging proposed developments. We might ask, for example, of any proposed future trajectory: How far will it really build and sustain the sorts of meaningful human relationships and social solidarity that are being asked for here? We might ask, for example, whether a proposed trajectory is likely to amplify or challenge socio-economic inequalities. In examining these aspirations, it strikes us that it is quite possible that the "failure" of education institutions to appropriate new technologies in the ways we might expect over the last 20 years may be a product less of an inherent conservatism in educational institutions, than of a desire by teachers and parents to protect human relationships and values that they see as being threatened by the appropriation of some technological practices.

As such, these aspirations open up an opportunity for reconceiving our role as researchers and educators to be one of creating future-*building* rather than future-*proofing* schools.[13] Rather than positioning schools as needing to adapt to futures designed elsewhere, these aspirations could be used as a starting point around which to design new educational futures. If we start, for example, with the question "How can we promote social understanding, caring and co-operation?" and then explore all the social and technological resources we might have at our disposal over the next 20 years to answer it, we may begin to generate a new bottom-up set of designs for educational futures. Such a shift in emphasis returns agency to teachers, to students and to communities as potential authors of their own futures. Such a shift in emphasis begins to map out a way in which we can harness technologies to the goal of working with students and schools to transform education to enhance social justice.

As well as these substantive issues, there are a number of methodological issues that merit reflection from these admittedly imperfect attempts to build what we came to understand as "public engagement in educational futures."

First, supporting people to think about the future is hard. Incredibly hard. Despite the fact we are constantly thinking about our own futures – from what we will do in the holidays to how we can afford to retire when we wish – engaging with the possibility that the future might be different from a "slightly more negative" or

[13] For a longer discussion on differences between "future-proofing" and "future-building" schools see Facer (2011).

"slightly more positive" version of the present is profoundly challenging. There is already a body of literature here that can provide insights into potential strategies but, in practice, this field is emergent and there is room for significant methodological and conceptual development.

Second, there is little "latent" public understanding of the potential of digital and other technologies to radically change education. Despite the familiarity of participants with popular science fiction, it would appear that developments such as cognitive enhancement or cloud computing are often seen as just that, science fiction. Building a bridge from the "presentist" model of education that predominates (one which also, it should be noted, seems to obscure recognition of historical educational change) to potentially transformative technological developments requires more than a one-off engagement. Instead, ongoing dialogue and discussion is needed to build both technical understanding and critical engagement with the assumptions that it engenders. This has significant implications for the sorts of methods likely to be useful in this field and implies that sustained relationship building rather than one-off consultation is likely to be important.

Third, we need to recognise that, as with any research, questions of translation and mediation are brought to the foreground in attempts to engage in debates about the future. In attempting to work across diverse groups there are significant challenges of translation and language. The meaning of "assessment" or "education," for example, profoundly differs across different groups; a 13-year-old student may interpret the importance of preparing for work differently to a baby boomer. These real challenges of interpretation can be attended to in very different ways. Just as attempts to enable "student voice" in schools can be characterised either by a deep commitment to disrupting power relationships and building meaningful dialogue or by a superficial commitment to corporate consultation, so the attempt to engage a wider range of people in the debate about educational futures can also be truly subversive of existing power relations or a superficial gesture towards consultation. Really enabling people to question and reframe the futures that they are being offered, after all, is a profoundly disruptive activity and requires researchers to be good, careful listeners. We fear that in the BCH program, we have only just begun to learn what that role might involve in educational futures work and that we have been a long way from successful in really engaging those people who are most at risk in some of the contemporary visions of the future.

This book poses many questions, including to what extent it is possible to future proof children for a largely unknown and unknowable world and what role can educational technologies play in this project. Our work suggests that "future-proofing" should not be understood as simply equipping people to adapt to a predetermined socio-technical future, but should rather be thought of as a broad goal centred on a desire to enable those whose voices are rarely heard to explore the futures that are being built by today's social, technological, political and economic trajectories and to make a case for the alternatives that they might want. Such an agenda does not mean presenting the future as infinitely open and manipulable by any social actor. Rather, it means confronting the futures that may be in development today and equipping people to explore where, when and how alternative trajectories might be

built. This is particularly important when we consider the likely costs to the already most vulnerable and marginalised of some of the economic and environmental futures currently in development.

Unsettling dominant futures and seeking to engage a more diverse set of voices in the debate is not, therefore, intended to perpetuate the myth that the future is open and uncolonised by existing interests, that it is simply a question of imagining and working hard at more desirable futures. Instead, it is an attempt to make visible precisely the partiality of the futures that we are being offered, and that will bring such costs to so many, and to begin to rebuild the capacity to build alternatives.

The future, after all, is not shaped by technology "itself" but by the people who design and use it. Perhaps it is now time to recognise that building the future cannot be a task for "experts" alone, but that, if we really want to transform education in pursuit of social justice, we may need to begin to work with precisely those groups who have historically been excluded from the debate.

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Chapter 12
Feedback Clickers in Plenary Lectures: A New Tool for Formative Assessment?

Rune Krumsvik

Introduction

This article focuses on if, and eventually how, feedback clickers (TurningPoint®) can be used to overcome some of the challenges lecturers have in large plenary lectures at universities. This has become more pressing as a result of the Bologna process (1998, 2005, 2007) with the new degree system (Bachelor/Master's degrees and Diploma Supplement), the European Credit Transfer System (ECTS, Bologna process 2007), The Quality Reform Ministry of Knowledge (MOK), 2006, the establishment of the Norwegian Agency for Quality Assurance in Education (NOKUT 2005), The White Paper 16 (MOK 2006) focusing on lifelong learning, Tuning Educational Structures in Europe (Tuning 2009) and the new Frame Work for Qualifications (MOK 2010). All of these demand that student curricula in Norway be more specifically formulated around learning outcomes as well as the use of Information and Communication Technology (ICT) as a tool in teaching and student learning processes. This demand implies a higher awareness of the increasing diversity among university students which creates a need for innovative ways of engaging students who might have previously experienced educational alienation.

These new educational streams and policy regulations create a situation which calls for a revitalisation of pedagogy in general, and the more specific term *didac*tic[1] (which means the art of teaching). In this debate one has to elaborate how new concepts, *digital didactics* (Krumsvik and Almås 2009) and ICT (more specifically feedback clickers), can function (or not) as remedies to fulfil some of these new policies and also how well they can overcome some of the well-known pitfalls in

[1]Didactics in the Nordic countries has long traditions within pedagogy and has a meaning other than the English language definition of this concept.

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plenary lectures. The aim of this explorative case study was to examine the perceptions of psychology students on the use of feedback clickers in plenary lectures in relation to their own learning processes. The question considered by this article was: What perceptions do psychology students have of feedback clickers in plenary lectures in relation to their own learning aims and learning outcomes?

The chapter works as a supplement to the previous chapters with their focus on predominantly school-based educational experiences. Its role in the context of this book is to demonstrate how the same critical approach to conceptualising and responding to challenges associated with technological change *and* student diversity that can inform 'modestly ambitious' innovations in mainstream school contexts can and, indeed, should, be used to re-think some of the most institutionalised and taken-for-granted practices in university education. In other words, the chapter shows the ways in which a particular mindset for conceptualising the relationship between student diversity, pedagogy and technology can create spaces within even the most formal, defined and "bounded" educational practice: the plenary university lecture. Throughout this chapter I explore the ways spaces that are historically associated with lecturer-centred pedagogy can be re-defined by uses of technology to give diverse students a genuine voice: a strategy which allows those who have made the transition from school to university to continue to see themselves in a positive relationship: not just with knowledge or technology, but with university life more generally.

Background

Every university lecturer has experienced the same problem: how to reach the students in plenary lectures when there are several hundred students. Lecturers have tried different remedies throughout history, such as prompting questions and raising hands, for example, but in large classes, like plenary lectures, there are several disadvantages with these kinds of traditional strategies:

- Many students feel uncomfortable raising their hands in large plenary lectures because they are afraid of giving wrong answers (Caldwell 2007).
- Another aspect of the same issue is that the students "will vote with the majority" and not give their honest votes or answers in plenary lectures (Caldwell 2007).
- The minority of students who want to speak up can very often be mistakenly seen as representatives for the majority of students (Caldwell 2007).
- Increased diversity among university students makes it necessary to engage students in more creative ways in large plenary lectures.
- The average human attention span is no longer than 20 min (Burns 1985) and there is a mismatch between this fact and traditional "chalk and talk" lectures in universities.

Several of these factors have always existed as hindrances to interactions in plenary lectures, making it difficult for lecturers to give meaningful lectures. Even if we

still have many of the same problems and challenges with plenary lectures today, the digital revolution over the last 10 years has altered some of the underlying conditions for teaching and learning. Lifelong learning and an increasing diversity among university students has presented university teachers with new challenges and possibilities which have pedagogical implications. To describe this situation in conceptual terms, a new concept has been devised: digital didactics, which takes into account the digital revolution and the alteration of didactical terrain lecturers and students facing universities today. Digital didactics is defined as "an instructional theory of technology which puts a special focus towards the art of teaching in technology dense learning environments" (Krumsvik and Almås 2009, p. 14.). It is clear that when revitalising pedagogy and didactics for plenary lectures at universities, one has to give particular consideration to the structures which have the strongest impact on the professional development of lecturers of today and the learning outcomes of the students. It goes without saying that assessment is one of the strongest "steering instruments" concerning these issues and it has to be specifically highlighted in this context. Therefore, this case study focused on how feedback clickers can be used to handle (first of all) formative assessment, but also how clickers might to contribute to elements of summative assessments in the learning processes of students.

The Danish author Laursen defined didactics as a field of educational theory that provides guidelines and tools that are used to develop the practice of teaching (Laursen 1994). Didactics is therefore a way of concretising teachers' work. The term didactics is, however, almost absent from the English language (Schnack 2004) and the issues it addresses are presented in the different frameworks of "curriculum and methods" and "curriculum and instruction" (Hopmann and Riquarts 2000). Hopman and Riquarts state that *Didaktik* is the most important tool for planning, enacting, and thinking about teaching in most of northern and central Europe (Hopmann and Riquarts 2000). The didactical focus in my research was chosen because it places an emphasis on the lecturer and the way s/he performs her/his plenary lectures. Therefore, in the following section I will briefly explore how this approach has been the underpinning framework for the use of feedback clickers in plenary lectures.

Digital Didactics as a Framework for Feedback Clickers in Plenary Lectures

When we attempt to revitalise general didactics within the Norwegian context, there are two important factors that must be considered: the digitalisation of society and schools over the last 10 years and the new demands in policy documents (mentioned in introduction), which give a more goal-oriented curriculum.[2] These factors have

[2]There have been many discussions in Norway concerning this issue because many university teachers think that this development reduces their autonomy and is a step in the wrong direction.

altered some of the underlying conditions for teaching, learning and knowledge so that even though many of the former conceptions of general didactics are still valid, we find it necessary to revitalise general didactics to take into account the new didactical streams we are facing today. To incorporate this situation into conceptual terms, I find it appropriate to present a new concept: digital didactics, which takes into account the didactical terrain university teachers and students are facing in digitised universities. In the same way as general didactics has the adjective *general*, which focuses on general didactic elements in teaching, our concept has the adjective *digital*, which puts a special focus on digital didactic elements in teaching. The definition of digital didactics adopted for this chapter is: "an instructional theory of technology which puts a special focus towards the art of teaching in technology dense learning environments." It becomes clear through this definition that the didactical or pedagogical reasoning of university teachers must be understood in a broad framework of educational practice.

However, it is quite clear that when didactics for digitised universities are revitalised, one has to give particular consideration to the structures which have the strongest impacts on the professional development of teachers today. Several Norwegian studies (e.g., Krumsvik 2006a, 2008a) found that ICT has an impact on teachers' practice and willingness to achieve better digital competence only when it is clearly attached to the vital structures of the organisation: assessments and exams, and the curriculum and syllabus. How then are these structures reflected in the revised curriculum for psychology students? Below, I will first illustrate the five structures which constitute the different elements in the digital didactic model (see Krumsvik and Almås 2009, for a more detailed description). In particular, the project "Teach as we preach" (Krumsvik 2008b) has been important in relation to this issue, where university pedagogues elaborated the possibilities of using such didactical models as a backdrop for their planning of plenary lectures, and where feedback clickers were an integrated part of their ICT use. The digital didactic model is a leap from traditional didactic models because of the new directives and demands that university teachers are facing today in a digitised society and in universities, and which are important steering instruments, even though this kind of goal steering is similar to the Tyler (1949) rationale of the past. The model is illustrated below and the descriptions of the different parts will be examined in an empirical analysis in order to bridge the model with the empirical focus areas.

Feedback Clickers in Plenary Lectures

Feedback clickers used in this study were TurningPoint® (TP). The TurningPoint® clicker is an audience response system (ARS) that allows students to participate in plenary lectures by submitting responses to interactive questions in real time using feedback clickers (small keypads handed out to each student by the lecturer before the lecture starts). Using feedback clickers such as the TurningPoint® clicker can provide a new gateway for the participation and interactivity of students in large

plenary lectures (100–500 students), and they can make data collection for the lecturer about the knowledge status of the students simpler. The feedback clicker is also a formative assessment tool that can be used to follow up the students' learning processes in new ways.

Methodology

Since this was an explorative study in quite a new terrain, I will use some extra space in this chapter to methodically describe how the case study was carried out, and how the feedback clickers were actually used in this study.

The methodology that was used in this study was the case study (Merriam 1998; Yin 1994). The case study method has been described as "In general… the preferred strategy when *how* or *why* questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context" (Yin 1994, p. 1). The present case study has both descriptive and explorative characteristics (Merriam 1998), with some *heuristic*[3] elements.

I chose to follow Merriam's guidelines for case studies and *triangulation* (Mathison 1988) with relevant material from "live surveys," surveys, small tests, written documentation, and observations to evaluate the use of clickers and to identify elements that seem to be of vital importance. A *thick description* (Geertz 1976; Merriam 1998) was used to present the main findings.

The Sample Selection

A sample group of psychology students (n = 75) was taken from a total of 480 students in their first year of a psychology Bachelor's degree. Purposeful sampling was carried out based on three factors:

- Because there were only 100 handheld clickers available in the plenary lectures, the number of students who could actually participate in the study was limited.
- Therefore, a criterion in the sample selection was that the informants must have had used TP actively in at least 5 of the 8 h of the course on qualitative methodology (this course is 8 h of lectures altogether).
- The informants had to answer both "live-surveys" during the plenary lectures as well as an internet-based survey (on learning platforms (VLE)) after completing the course.

[3] A "heuristic" characteristic in case studies can be described as searching for background and cause, trying to explain what went wrong, discussing alternatives that have not been used, and summing up and evaluating the situation.

The PSYK102 is an obligatory course in qualitative methods and is based on a curriculum with a clearly defined learning outcome for the students. The exam in this course consists of 90 multiple choice questions (retention part) and an essay part where the students are given the opportunity to elaborate their knowledge within certain areas of psychology (transfer). Students will achieve a Bachelor's psychology degree when all the courses (over 3 years) are completed.

Instruments/Data Collection

To increase the internal validity in qualitative research projects such as this study, it is important to ask questions concerning how congruent the findings are with regard to the experience. Are we able to reveal what is there, and are we studying what we believe we are studying? Collection, selection, and reflection are therefore fundamental elements of the case study process, and "The key concern is understanding the phenomenon of interest from the participants' perspectives, not the researcher's" (Merriam 1998, p. 6). In order to try and emphasise this and to increase the internal validity, I utilised in this case study one of the six basic strategies endorsed by Merriam (1998): triangulation.

Paper and Pen (Written Documentation, Documents, Field Notes, Logs and Reports)

In this portion of the fieldwork I followed Merriam's (1998) classification of this type of data in the case study:

1. Public records, "(…) the ongoing, continuing records of society" (Merriam 1998, p. 113). In this case study, public records included Bologna-process documents, parliamentary white papers on education, the curriculum for the Bachelor's degree, program censor assessments, teaching plans and grade statistics. The very fact that the University of Bergen has placed a great deal of emphasis on fulfilling the requirements in the Bologna process (1998, 2005, 2007) and in the Norwegian Quality Reform (2007) when quality assuring the curricula means that these types of documents are representative of what is going to be handled in plenary lectures (because of the detailed descriptions of learning outcome). Therefore, it would be interesting to find out whether there is an agreement between the arenas of formulation and realisation in this field, both from a student perspective and from lecturers in their everyday practice.
2. Personal documents "(…) refer to any first-person narratives that describe an individual's actions, experiences, and beliefs" (Merriam 1998, p. 115). In this case study, such documents were particularly related to reflections from the program censor, who was the external and neutral evaluator of the course. The documents were based on visits, meetings with staff throughout the year, interviews and

survey data from the students. The program censors are employed specifically to ensure the course follow the regulations from the NOKUT (2005), and to give the employees the necessary autonomy to develop their courses.

3. Physical materials "(…) consist of physical objects found within the study setting" (Merriam 1998, p. 117). Often, physical materials are called artefacts and, in this study, one can extend this to include both "digital artefacts" and "digital objects." Several of the artefacts in this study fell within these categories (which one can consider as both mediating artefacts and online data). As Merriam (1998, p. 128) said, "To some extent, then, online data collection offers an electronic extension of familiar techniques, widening the scope of data available to the researcher." The feedback clickers and live surveys (multiple choice) used in the plenary lectures, the multiple choice tests on learning platforms (VLEs) after the plenary lectures and the high degree of multimodality in the plenary lectures were important "digital objects" (online). The digital objects gave me good insight into the students' learning processes because of the expanded possibilities TP gave for monitoring their knowledge construction throughout the course.

   Online digital objects can also be challenging, as described by Merriam (1998, p. 130): "The web page cited today may be gone tomorrow." Collecting statistics during the live surveys (using TP) in the plenary lectures did not present a major problem and one could still monitor the students' learning processes without the online data from the multiple choice test.
4. Researcher-generated documents "(…) are documents prepared by the researcher or for the researcher by participants after the study has begun" (Merriam 1998, p. 119). In this case study, these were my own observation notes and logs from the plenary lectures, with a special focus on students' behaviour during the live surveys. Such texts are important retrospectively, particularly when attached to attempts to document significant events in plenary lectures. Consequently, these observational notes and logs combined with the other data sources (live surveys, multiple choice tests, and student survey) were important and functioned in a complementary way (triangulation).

Surveys/Questionnaires

The intention of the different surveys in this case study was to shed light on the characteristics of using TP in plenary lectures from the students' point of view. These data were collected before, during and after the course.

The first survey of the students was conducted (by me) in the start of the first plenary lecture (students using TP to answer); it consisted of five questions and focused on the students' perceptions and attitudes with regard to reading recommended literature before the lectures, their expectations of the learning outcome of the course and their motivation for the course, for example.

The second survey of the students was conducted (by me) in the last part of the second plenary lecture (students using TP to answer); it consisted of five questions

and focused on the students' perceptions with regard to using TP actively in plenary lectures, their expectations of learning outcomes from the course and their motivation for the course.

The third survey of the students was conducted (by me) after the course was finished (students using learning platforms (VLEs) to answer). This was the largest survey and it consisted of 12 questions (structured and open ended) focused on the students' perceptions, attitudes and experiences with regard to using TP throughout the whole course. This survey specifically focused on students' experiences attached to interactivity in the lectures, their motivation for the course when using TP (compared to not using TP), their attention during lectures, their experience of feedback using TP, their experience of anonymity using TP and their experience of learning outcomes when using TP (compared with not using TP).

The live survey in the plenary lectures (conducted by me, using TP) included other questions with a special focus on the subject matter. The students (in the plenary lectures) were encouraged to respond with the TP clickers to these questions. They could choose between four very similar alternatives, and thus the format of the questions was identical to the format of questions they would get during their multiple choice exam after the course. Using TP clickers during the plenary lectures gave an immediate picture on the TP slide of students' answers to the questions. Sometimes students had an opportunity to discuss the answer before responding with the TP clickers and at other times they responded immediately and individually. After the students responded I gave them the right answer or I gave them the opportunity to discuss it with their peers and then answer again.

The multiple-choice tests (five tests) after the plenary lectures consisted of the same type of questions as in the live surveys and in the multiple choice part of the exam. Here, the students used their own computers and the university's learning platform (VLEs) to answer the questions. They received the answer book after they completed each of the tests.

The idea behind all these surveys, which had the same format as the multiple-choice exam, was to give the students many opportunities to receive feedback and a formative assessment of their understanding of concepts in plenary lectures, after the lectures and as preparation for the next lecture. The use of multiple-choice tests throughout the semester may also have prepared the students for the exam situation.

The survey served as an important data source for the focus of this study. By combining the surveys with other methodological entry-points such as documents and observations (triangulation), I was able to put the results into a larger context, which was a strong point in this case study. However, as my sample was relatively small, it had some limitations (e.g., the Hawthorne-effect, etc.).

Live Observations

As a lecturer on the course, one can always question when you are a lecturer and when you are an observer. Very often these two roles are intertwined in lectures. However, in the few minutes during which the live surveys took place in the plenary

lectures, I mostly acted as an *Observer as participant* (Merriam 1998). The first observations in the plenary lectures were conducted in February 2010 using Merriam's summary of six strategies[4] for observations in fieldwork (Merriam 1998). There were 12 other plenary lecture observations during the course-period of 6 weeks which focused on how the students acted when responding to the questions, how they discussed the lectures with peers, how attentive they were and the general impression of their motivation for using TP clickers. The observations were conducted with the help of field notes.

The observations contributed to a deeper understanding of how students actually used the TP clickers in the plenary lectures. In retrospect, this was valuable when considering the other data collection methods.

Stills Presentations

These included the use of software such as TurningPoint®, which was quite a powerful tool for monitoring students' knowledge (and knowledge retention) at different time points during the courses. This can be useful for revealing changes in scores during the course, and it can help supplement other methodological gateways.

Validity and Reliability

Arguments concerning validity within and generalisability of case study research are well-known. The type of generalisation one can carry out from case studies does not imply statistical generalisation, but analytic or systemic generalisation instead (Yin 1994; Kvale 1996). Analytic generalisations are based on the assumption that what happens in one situation can support an inference of what might happen in another situation. In other words, the results from one study can be a guide for other similar studies. A related point is that, through reading the case study, other interested parties or researchers can recognise themselves through the descriptions that appear in the materials, often called *thick descriptions* (Merriam 1998). Thus, reader generalisation (or an analytical or qualified generalisation) is a possible outcome of the study.

Empirical Analysis

The digital didactic model (Fig. 12.1) was used as a lens in this case study and focused on the most relevant elements that teachers at universities need to consider in plenary lectures. Thus, it was based on the new regulations in policy documents

[4]These are: The physical setting, the participants, activities and interactions, conversation, subtle factors, and your own behaviour (Merriam 1998, p. 98).

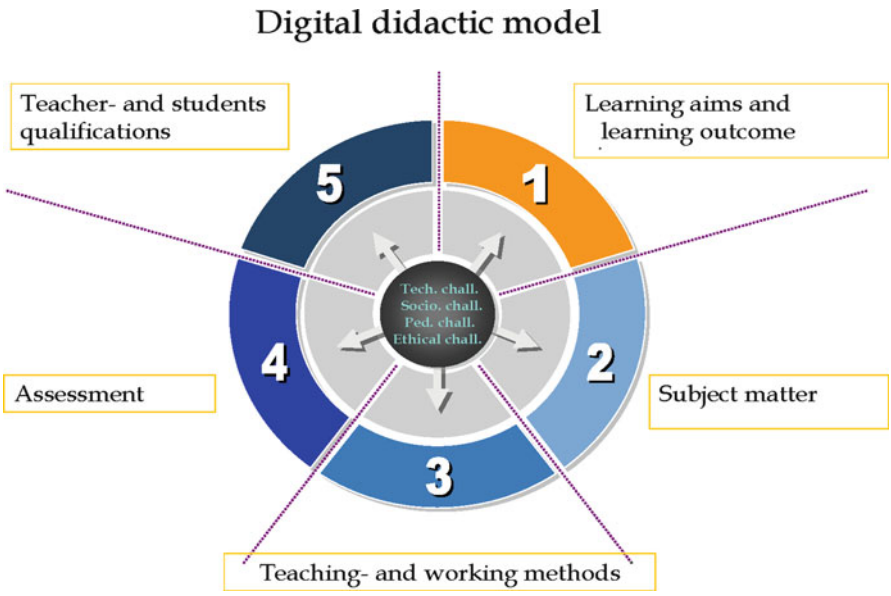

Fig. 12.1 Digital didactic model (Krumsvik and Almås 2009)

such as the new framework for qualifications (MOK 2010), Tuning Educational Structures in Europe (Tuning 2009), and curricula and learning outcomes for psychology students (Krumsvik 2006a). In addition, my own research (Krumsvik 2006a, b, 2007a, b, 2008a, b; Almås and Krumsvik 2007, 2008; Krumsvik and Almås 2009; Krumsvik 2011) within this area was used to embed this new didactical terrain in the model. The digital didactic model probes how ICT influences each of the elements in the didactic model and below I will examine my empirical data in light of this.

Learning Aims and Learning Outcome

In the first part of the model (discussed in Fig. 12.1) the learning aims and learning outcomes were visualised, and these are examined below.

At the University of Bergen each subject following the psychology curriculum is structured into main subject areas for which learning aims and learning outcomes have been formulated for the students. This means that there has to be more of a thread between the syllabus, the content of plenary lectures, the learning aims and outcomes and formative and summative assessments. Use of digital tools such as feedback clickers can provide a new gateway for monitoring students' perceptions concerning this issue, and this is especially important for the teacher because he/she is responsible for organising a learning environment where the students can achieve goals, in both the physical classrooms, such as plenary lectures, and in "digital

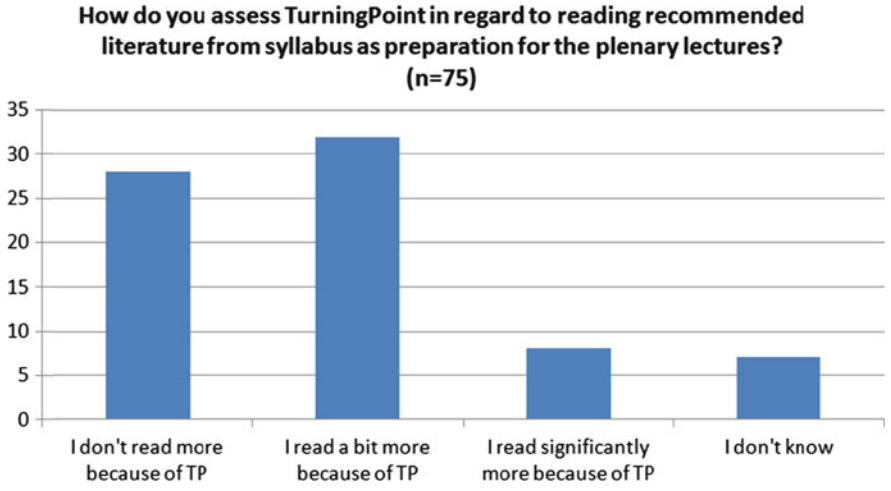

Fig. 12.2 Students' responses to TP and reading of the recommended literature (n = 75)

classrooms," such as learning platforms (VLEs). This means that university teachers need to integrate both (quality-assured) textbooks and digital learning resources in the syllabus and in teaching lessons to fulfil the requirements of the national authorities. As a consequence of this, I integrated questions from the recommended parts of the textbooks on the syllabus in each plenary lecture in the actual lectures to observe whether the students read the recommended literature to a higher degree when they knew that questions from the textbooks would be asked during the plenary lectures using TurningPoint®. The first question in the students' survey dealt with this issue and the second question with their perception of learning outcome (Fig. 12.2).

The results show that 37% of the students said they did not read more because of TP, whilst 42.6% said they read a bit more of the recommended literature because of the use of TurningPoint® in plenary lectures. The live surveys in the lectures asked a similar question (whether students had read the recommended literature for each specific lecture), which supported these findings. One reason for this was that if a student had not read the recommended literature for the lectures, there would have been a larger threshold for answering the TurningPoint® questions correctly. Therefore, it could be observed that when the student realised this connection, there was a tendency for more of them (but not all, of course) to read the recommended literature.

Knight and Wood (2005) found similar tendencies and that the use of feedback clickers to check whether students had read the recommended literature made the students more responsible and active in preparation for the lectures (Fig. 12.3).

These results show that the majority of the students said they had a better learning outcome when using TP.

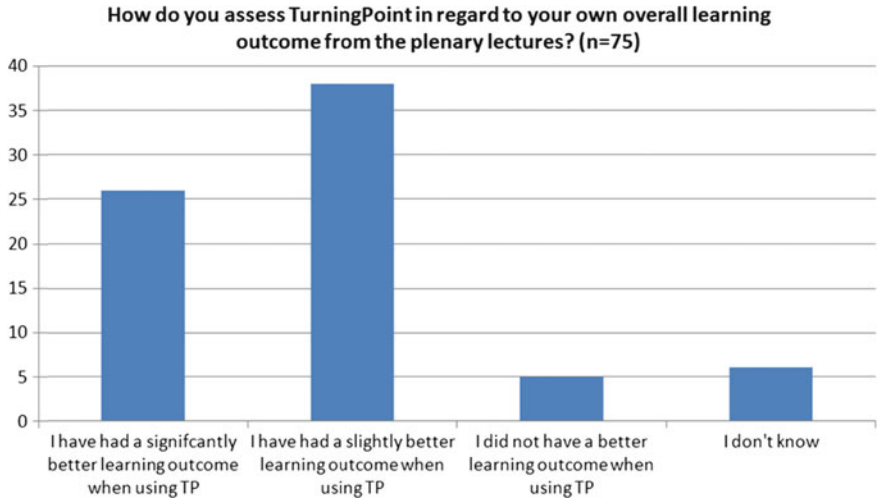

Fig. 12.3 Students' responses regarding learning outcome and TP (n = 75)

In the lectures I observed that the students seemed to be more motivated to do the course than in previous years and that their attention was better but the scores from the live surveys could not be compared with data from previous years. However, the final exam at the end of the year showed slightly better scores in this course than in previous years. Of course, this could be explained by variables other than TP.

Roschelle et al. (2004a, b) found that feedback clickers altered the learning climate in lectures because the students became more active participants and they also recognized that they were not alone in their misunderstanding of concepts and subject content, amongst other things. In her review of the studies on feedback clickers, Caldwell (2007) found that several authors and studies reported the use of feedback clickers improving students' understanding and learning, and in some studies it even improved achievements in exams. However, Caldwell (2007) underlines at the same time the need for more in-depth research concerning this issue.

Subject Matter

In the second part of the model (Fig. 12.1) the subject matter was visualised, and this is examined below.

In the former curriculum for the first year of the Bachelor's psychology degree, we found that there was less goal-oriented teaching, and the university teacher had a higher degree of autonomy. In the new curriculum for psychology students, the subject matter of university teachers' teaching is more than ever attached to the learning aims and outcomes. The didactical pillars which underpin all teaching – *why*, *what* and *how* – are not sufficient in today's digital terrain in and out of the universities and

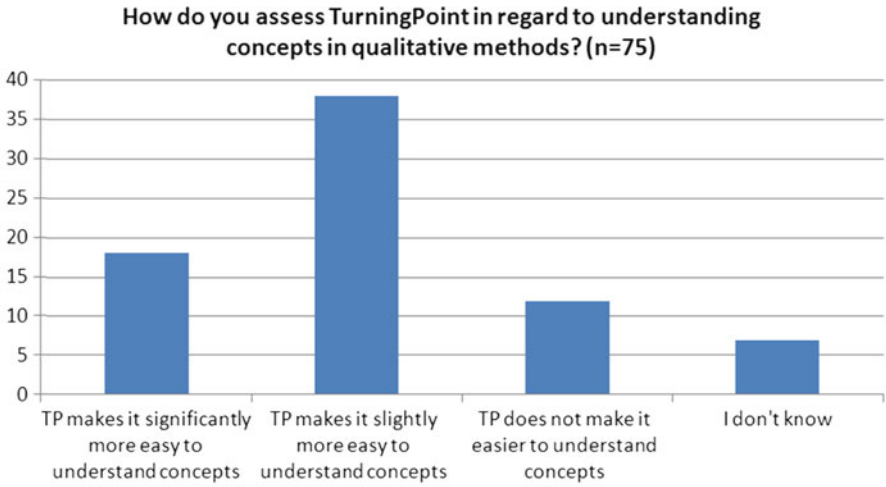

Fig. 12.4 Students' perception and understanding of concepts and TP (n = 75)

needs to be complemented by *when*, *where* and *who*. This gives a reason for considering how university teachers teach subject matter in the *physical classroom* (plenary lectures) and how this should be carried out in the *digital classroom* (e.g., when using learning platforms (VLE) in study time, student seminars, homework and leisure time). A consequence of this is that teaching in the physical, plenary lectures continues in the digital classroom after ordinary plenary lectures are over. This means that university teachers must prepare themselves for teaching the actual subject matter in textbooks, digital textbooks and digital learning resources. In particular, the complementary aspects of multimodality and multimedia learning (Mayer 2009) gives new didactical possibilities for teachers to teach in general, but also for them to visualise subject matter and to stimulate students' understanding of concepts and trigger attention and reflection in new ways. These issues are discussed below (Fig. 12.4).

This student survey shows that 24% of students said that TP makes it significantly more easy to understand concepts, whereas 50.6% said that TP makes it slightly more easy to understand concepts. When they were "trained" in definitions of the concept both before the lecture (recommended literature reading), during live-surveys with TP in lectures and through the multiple-choice questions before/after the lecture on learning platforms/VLE, they got several opportunities to understand the concepts. This might have influenced their opinions concerning this issue.

Wood (2004) found that feedback clickers can provide information to the lecturer about students' misunderstandings of concepts, for example, therefore allowing the lecturer to correct these misunderstandings. In this way the students get feedback through TP regarding whether they have understood the concept correctly and, if

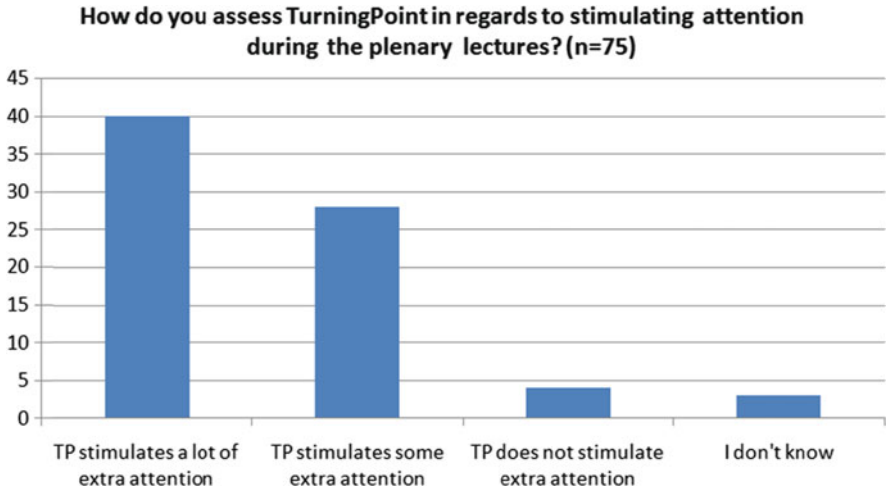

Fig. 12.5 Students' perception of attention and TP (n = 75)

not, an immediate reason from the lecturer or their peers for why the answer was wrong (Fig. 12.5).

This student survey shows that 53.3% of students said that TP stimulated a lot of extra attention and 37.3% said that TP stimulated some extra attention (this question was followed up by asking the students why they thought that TP eventually stimulated extra attention during the plenary lectures, see below). The fact that so many of the students (90.6%) said that TP stimulated attention to any degree can be supported by my own observations in the plenary lectures. Compared to previous years, the attention level among students had increased. In relation to the points explored throughout this book, this is a highly significant finding. One of the key challenges facing educators in the contemporary context is the scarcity of "attention." When the social and political significance of tertiary qualifications is considered alongside longstanding rates of educational success and failure the ability to attract and keep attention is a significant outcome.

Burnstein and Lederman (2001) found similar results in their study on physics, where students were noticeably more alert in lectures. Middendorf and Kalish (1996) found that feedback clickers could "restart the attention clock" during lectures and that they could, to a certain degree, keep attention more stable throughout the lectures.

Of the sample selection (n = 75), 68 students answered this more qualitative part of the survey and some citations from the most typical answers of these 68 students are presented below (person a, b, c, etc.). The question posed for the students was: "If you answered "partly" or "yes" on question 3; what would you say is the reason that the use of TurningPoint® increases your attention during plenary lectures? (please describe it briefly in the box below)":

(a) "Because TP gives variation during the plenary lectures – it is more easy to have attention on the content."
(b) "TurningPoint includes the students to be more active in the lectures. TurningPoint asks for aspects that are relevant for the exam."
(c) "Normally I have good attention in lectures, but TurningPoint creates more interest and I really looked forward to these lectures."
(d) "I get the opportunity to get feedback on how much of the content I are able to handle and if I have understood the things that are presented by the lecturer."
(e) "I get a direct reason to maintain higher attention in lectures, because I risk being tested several times during the lectures."
(f) "I remember more when I am being active and have to make choices. I have been "forced" to actually reflect on the questions. And it is nice to get a check on the recommended literature for the lecture and answer concrete questions attached to this."
(g) "After the first question I expected a new one to come and this increased my concentration. This might be because if you see that you have answered correctly, it gives a good feeling – the feeling of being satisfied with oneself."
(h) "I become more active and have to reflect more. It is exciting to see if I have answered correctly and it is nice that one can be completely anonymous."
(i) "The interactivity TurningPoint gives, gives me an immediate motivation."
(j) "It gives more variation in lectures, but it must not be overestimated!"
(k) "I follow the lectures with better attention, because the content that is presented with TurningPoint is closely connected to other parts of the course and this makes the content more understandable."
(l) "I like TurningPoint, but the question could have been better."
(m) "I like it, because then I see how many of the students got it right and compare my own achievement with them."
(n) "It gives the opportunity for discussions with fellow students and one can get a perspective on the content problem that one has not been thinking of."
(o) "You are more active – you can't rest."

This student survey shows that 40% of the students said that TP stimulated a lot of extra reflection and that 45.3% said that it stimulated some extra reflection. From my observations in the class it is hard to say whether the students had any deeper reflections when I used TP. However, both this survey and the open-ended question attached to Fig. 12.6 (above) indicate that students reflected more when using TP in plenary lectures.

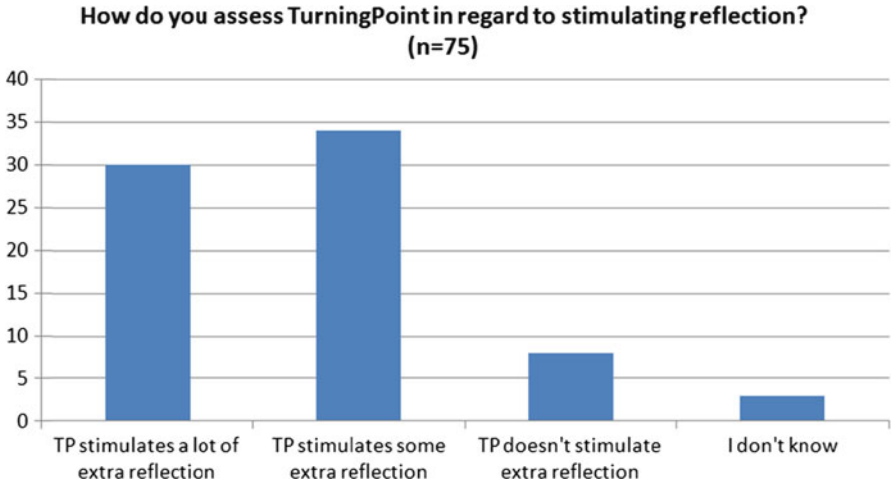

Fig. 12.6 Students' perception of reflection and TP (n = 75)

Cutts et al. (2004) also found that using feedback clickers stimulated the students to problem solve and increased reflection.

Teaching and Working Methods

In the third part of the model (Fig. 12.1) the teaching and working methods were visualised, and these are examined below.

In the revised curriculum for psychology students based on Tuning Educational Structures in Europe (Tuning 2009), there is of course a certain methodological freedom for university teachers and this opens up the possibilities for university teachers to use a broad spectrum of teaching methods in plenary lectures. ICT opens up this free space even more and gives university teachers the possibility of meeting the Millennium Learners (Pedro 2006) on their "home ground" and in their online existence. In the physical classroom (plenary lectures) this is possible by using different kind of methods and ICT-tools, but it can also be complemented by the "digital classroom" as well, where learning platforms (VLEs) have become an important structure in today's universities. These learning platforms have been widely implemented; a learning platform is primarily a "digital classroom" on the internet, accessible from home and universities around the clock, with lecture material disseminations, evaluation mechanisms, discussion forums, chat rooms and tools for collaboration and response writing. Learning platforms merge with the physical classrooms (plenary lectures) and it is quite clear that such complexity needs a more expanded view on pedagogy and didactics than traditional "chalk and talk" lectures.

This situation establishes new challenges and triggers new questions that university teachers have never dealt with before. When do we, as university teachers, read the students' emails and SMS? How can we utilise students' digital self-confidence in plenary lectures without losing the subject focus? How can we make the different

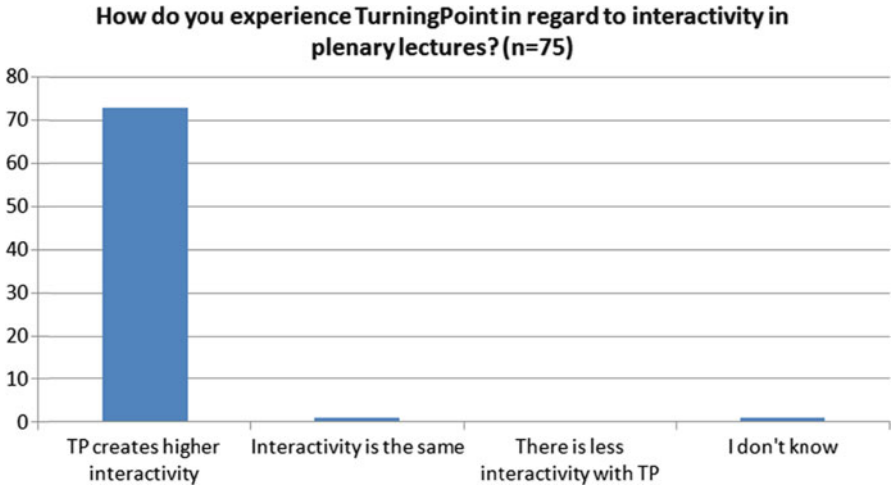

Fig. 12.7 Students' perception of interactivity and TP (n = 75)

classrooms (physical/digital) complementary and meaningful? Several dilemmas are present and it is quite clear that it is more time-consuming to check the homework on the learning platforms (digital classroom) and give written feedback to students on their text through learning platforms, than it is to do a quick oral and superficial check of whether the students have read the recommended literature for the plenary lectures in the physical classroom.

The use of feedback clickers can give a quick, but more reliable, overview of whether the students have read the recommended literature, how they understand concepts, et cetera. We can also ask whether university teachers should have to strive for communication with students on the students' communication channels (MSN, Skype, SMS, Facebook and Twitter, for example) or whether students should keep their communication channels to themselves. All this presents new dilemmas and possibilities concerning the kind of teaching and working methods that university teachers should/should not use when plenary lectures merge with virtual arenas. At the same time, it is important to obtain knowledge about how the students perceive the implementation of new ICT tools; do they give the intended and expected outcome? Do feedback clickers invite the students to interact more and to discuss topics in plenary lectures, or is it still the "chalk and talk" and the lecturer's monologue which dominates plenary lectures? Below we find the students' answers to these questions (Fig. 12.7).

This student survey shows that 97.3% of the students said that TP created higher interactivity in plenary lectures. This result is supported by my own observations being a lecturer using TP throughout the whole course, and consequently there is little doubt that TP creates greater interactivity in large plenary lectures.

Other studies showed that feedback clickers increased interactivity (Caldwell et al. 2006). Cutts et al. (2004) found that when the interactive teaching with feedback clickers was associated with grading and assessments, the students took it more seriously (Fig. 12.8).

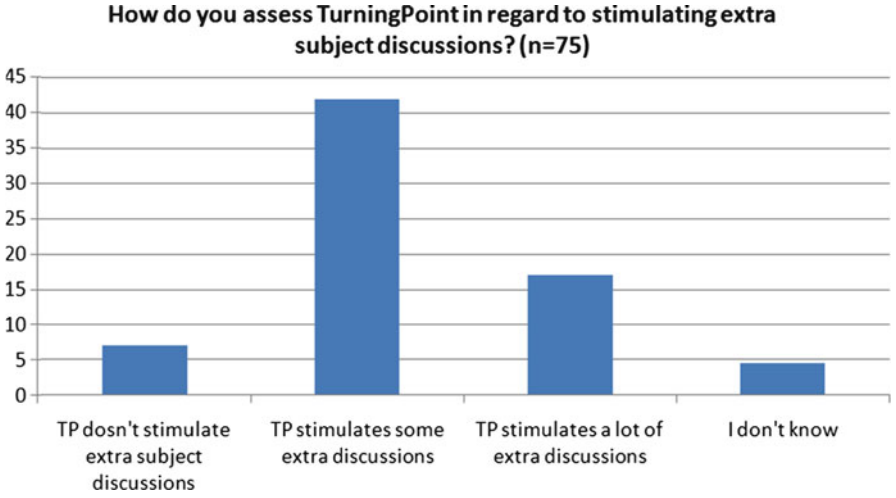

Fig. 12.8 Students' perception of discussions and TP (n = 75)

This student survey shows that 22.6% of students said that TP stimulated a lot of extra subject discussion and 56% said that it stimulated some extra subject discussions. From my observations I recognized that this effect varies throughout the student mass. Many of the students were active discussers during the live-surveys, and a minority sat by themselves as before, without participating in the discussions. Other studies, such as the study by Wood (2004), found that the use of feedback clickers stimulated greater responses and discussions among the students.

Assessment

In the fourth part of the model (Fig. 12.1) the assessment was visualised, and this is examined below.

The assessment element has to be considered in relation to the other elements in the model and it is maybe the most important issue in today's ICT use in Norwegian universities. During the 1990s, ICT operated on a side track in the Norwegian educational system, where assessment issues were not properly considered as part of the ICT implementation. Over the last 5 years this situation has considerably altered and ICT-based exams now show us that assessment and ICT are becoming increasingly woven together in the Norwegian educational system.

In the revised curriculum for psychology students, the formative assessment and the *assessment for learning* have especially been highlighted. One of several reasons for this is that this curriculum is quite goal oriented, with clearly defined learning aims and outcomes. In relation to the formative assessment, this implies that students should be given *feed forward* in how they can achieve goals in relation to the learning aims. This constitutes a situation where formative assessment, assessments for learning and feed forward have been given a lot of attention as part of the

Bologna process; and the Quality Reform, in the curriculum can produce a summative assessment, better than previously.

As a consequence of this, the digital assessment element in the digital didactic model highlights three concepts that I have considered didactically in the study in light of the new demands on the curriculum, which was inspired by Hattie and Timperley (2007). These are: *feed up, feedback* and *feed forward.* They are described in more detail below:

1. *Feed up.* This concept is based on the question "Where am I going?" (Hattie and Timperley 2007), and in this context is attached to the revised curriculum's learning aims. The former curricula were criticised for vagueness about what the students should actually learn in different subjects and we might say that the learning aims are a remedy for the former pitfalls in the curricula. The most important steering instruments for "Where am I going?" (feed up) in Norwegian universities are the summative assessment forms, which for these psychology students involve a 6-h multiple-choice test (retention) and an essay (transfer).
2. *Feedback*. This concept is based on the question "How am I going?" (Hattie and Timperley 2007), and has very long traditions in all kinds of schooling. This important issue has, however, been given new conditions in today's digitised society and universities. While one originally had to physically be at university to receive feedback from the university teacher, today the physical classroom is complemented by the digital classroom (learning platforms, e-mail and e-tests, for example), which considerably expands the possibilities for receiving feedback. This constitutes a situation whereby I, as a lecturer, can give and receive feedback on subject matter anytime, anywhere and to/from anyone, which of course fuels the possibility of succeeding with, for example, individual feedback and personalisation (if this is utilised). In this case study I elaborated on this to a certain degree (described in the methodological section).
3. *Feed forward*. This concept is based on the issue of "Where to go next?" (Hattie and Timperley 2007), and underlines how assessment for learning (formative assessment) is very important for the *assessment of learning* (summative assessment). The Evaluation of the Quality Reform (NIFU-Step 2007; MOK 2007) revealed several positive tendencies for Norwegian students, but still they receive too little feed forward attached to the learning aims and expected learning outcomes in their education in general. This area might have been under communicated because of the strong position feedback has had in the Norwegian educational system, which might have given the feed forward a less important position. This calls for stronger focusing on how one can more systematically facilitate both feedback and feed forward in plenary lectures in light of the learning aims and outcomes (feed up), and in this case study I attempted to fulfil this aspect. The survey question below examines if, and eventually how, TP can contribute to this issue (Fig. 12.9).

This student survey shows that 48% of students said that TP gave a lot of extra feedback and that 49.3% said that TP gave only some extra feedback. My observations in the plenary lectures, as well as statements from the students (associated

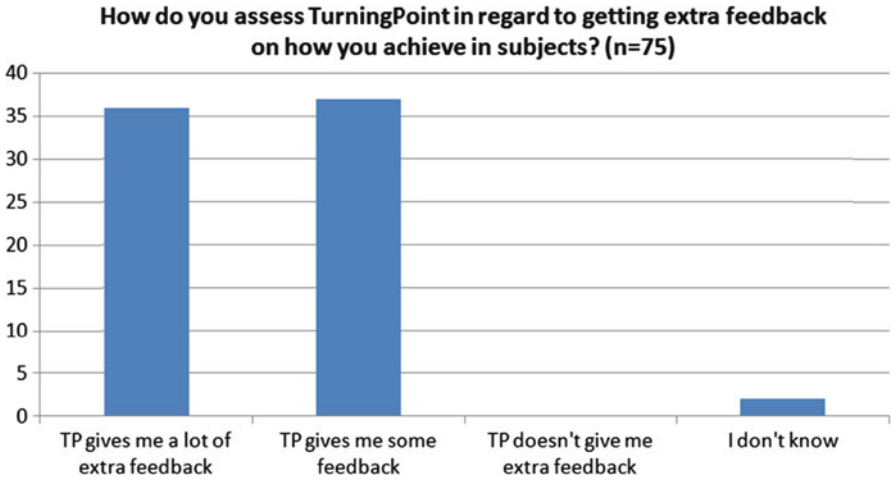

Fig. 12.9 Students' perception of feedback and TP (n = 75)

with Fig. 12.6), support the survey results above: TP gives feedback and formative assessment in new ways. However, the kind of feedback TP contributes to is associated with the definition of concepts, laws and rules, and very seldom to more knowledge (transfer) and deeper learning. Other studies, such as the one by Roschelle et al. (2004a) underlined the finding that feedback clickers expanded the possibilities for formative assessment for the instructor (Fig. 12.10).

The student survey shows that 85.3% of the students said that they appreciated being able to answer anonymously with TP and that 13.3% said they appreciated being able to answer with both TP and in the ordinary (oral) way (raising hands, etc.). My observations in plenary lectures, as well as the opinions stated in the open-ended part of the survey (attached to Fig. 12.6), gave the clear impression that students see the added value of anonymity when responding in such large plenary lectures. Other studies, such as the one by Simpson and Oliver (2006), found that asking for class opinions in the traditional way (lecturer prompting oral questions) always results in certain biases because many students find it stressful to answer, and a small number of students can give the impression that they speak on behalf of everyone in the class. Raising hands when voting may prevent completely honest votes (Caldwell 2007) and, in general, one can assume that students struggle with being completely honest when different traditional voting systems, where they cannot be anonymous, are used by the university teacher.

Teacher and Student Qualifications

In the fifth part of the model (Fig. 12.1) the teacher and student qualifications were visualised and are examined below.

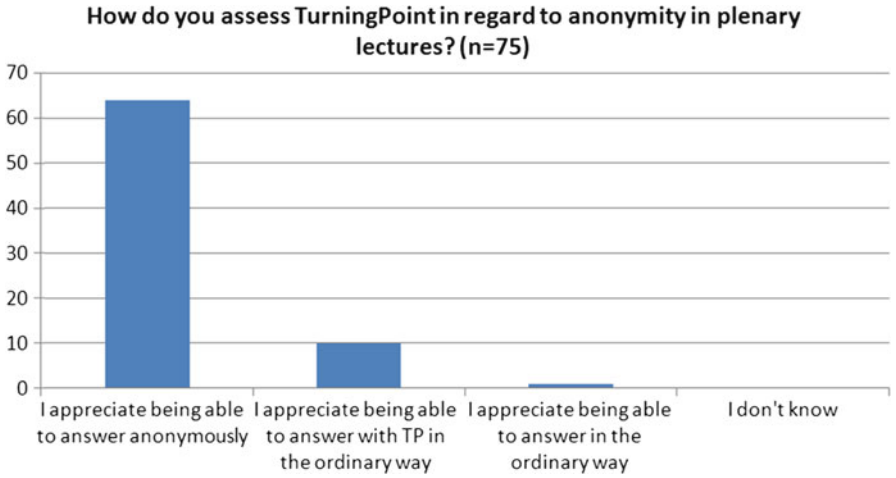

Fig. 12.10 Students perception of anonymity and TP (n = 75)

The digital native students in universities today have been exposed early to technology but, as many of the previous chapters in this volume have demonstrated, this early exposure does not necessarily mean that students have experienced a positive relationship with technology or knowledge. Indeed, it is possible to argue that many students have little experience with the combination of learning and technology. Thus, the use of technology in education presents new conditions, including challenges, dilemmas and possibilities. The students' *technical*, digital competence provides new opportunities for the university teacher to utilise students' skills as a gateway to knowledge building and learning. Such competence also requires, however, that the university teacher has the necessary digital skills to actually utilise this potential. At the same time, the students must be aware that in teaching and learning the *subject use of ICT* (e.g., quality-assured multimodal resources) is the priority, rather than the *ritualistic ICT use* (e.g., entertainment and use of social media, see Krumsvik and Almås 2009). Here, we can observe that a premise for developing such *subject use of ICT* is that the students develop an *interpretation competence* (and not only a tool competence, which is also quite good), as part of their digital competence. At its best, this can give new forms of differentiation (e.g., high achievers/low achievers) in teaching which capture different needs and abilities of the students in a better way than in the pre-digital era. But can we see any tendencies of this in the material from the study? Can TP stimulate motivation in plenary lectures? The survey question below deals with this issue (Fig. 12.11).

The student survey shows that 20% of the students said that TP provides a lot of motivation for them to attend, 41.3% said that TP provides only some motivation for them to attend and 28% said that TP did not motivate them to attend plenary lectures. From my observations, I have the impression (because we cannot have any absence protocol in such large groups of 4–500 students) that the attendance level this year (using TP) was slightly higher compared to earlier years. If we relate these vague

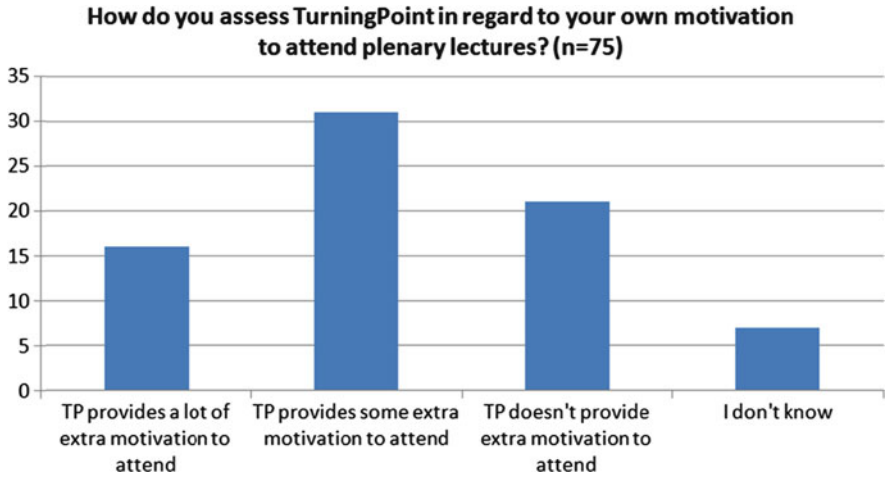

Fig. 12.11 Students' perception of motivation and TP (n = 75)

tendencies to other studies, Cue (1998) and Jackson and Trees (2003) found that when features like TP are linked to grades and used on a regular basis (daily) in the classroom, student attendance increases.

Question 12 in the survey was an open-ended question about whether students had anything to add, positively/negatively, about the use of TP, and below I will present some of the typical comments from the students concerning this question (4 students of the sample selection (n = 75) responded to this open-ended question and below the main tendencies are mentioned. These are described as student 1, 2, 3, etc.):

(student 1) "TurningPoint creates more engagement among the students and I feel more "valued" as a student, even if the student group is very big."
(student 2) "The lecturer must be more precise in telling why one answer is correct and the others are wrong. I think this has been missing."
(student 3) "Very good! I remember the concept better even if I answered wrong in the lectures."
(student 4) "The learning outcome would have been better if the questions had been better".

Implications

The aim of this explorative study has been to examine psychology students' perception of the use of feedback clickers in plenary lectures in relation to their own learning process. As such, it contributes to the broader agenda of this book which is to identify "modestly ambitious" examples of the use of technology which improve

student participation and engagement, and work, by extension, to create positive relationships between diverse students, knowledge and achievement.

The case study has shown that:

- TP increases interaction because it allows all students' "voices" to be heard, and initiates discussions which require interaction with fellow students. It has also been possible to collect votes after discussions and this can give fuel for new discussions after the lecture.
- TP makes it possible, if students are reading the recommended literature for each and every lecture, to pose questions about this homework and monitor the students' preparation for the lectures throughout the course.
- TP gives the possibility to find out more about students' attitudes by asking for students' thoughts about the tempo and pedagogy in lectures, the relevance of content, and the feedback clickers, and their level of understanding at a given time in the course.
- TP is important for formative assessment, because lecturers can assess students' understanding of the lecture content during the lectures, and identify student misunderstandings. Lecturers can also monitor students' understanding of the multiple-choice tests located on the learning platforms (VLE) which consist of the same kind of questions used in the lectures (using TP) and final exam. TP also gives a kind of feedback that allows the students to assess their own level of understanding (metacognition).
- The use of TP tests in lectures can monitor whether students are paying attention, preparing for class, keeping up with homework and actively reflecting on the subject matter.
- TP can motivate students and make lectures more enjoyable.
- TP gives the possibility to be anonymous and active in new ways, which many students appreciate in large plenary lectures.
- TP can help lecturers respond to the increasing diversity among university students in a better way.

The article has focused mostly on higher education, but has raised several questions that have consequences for education at all levels. The European Common framework for Lifelong learning (European Common 2008), the Organisation for Economic Co-operation and Development (OECD) studies "Understanding the digital divide" (2001) and "Education at a glance" (2003), and the PISA study (OECD 2010) indicate that both higher education and schools have to elaborate the possibilities ICT can give to meet the increasing diversity among students and pupils. In several European countries, for example, schools still perpetuate social inequalities based on a traditional epistemology, conservative teaching methods and exams. Creative use of ICT in teaching and in assessment has the potential to help succeeding with the principle of providing education suited to the individual students and pupil (personalisation). The challenge is how this can or should be done in order to provide the greatest possible benefit to the greatest number of students and pupils in the specific educational contexts. The study has shown some examples related to how this can be carried out in a university context, but we need more

research at all levels within education to quality-assure future proofing of curricula, assessment forms and teaching methods.

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Chapter 13
Imagining Futures

Leonie Rowan

Introduction

Throughout this book we have sought to draw attention to two contextual challenges facing contemporary educators. On the one hand we have widely cited evidence of a world much changed by technological developments: change that is seen in every aspect of contemporary life and raises serious questions about how teachers and school systems might best conceptualise both the content and the processes of their work. On the other hand, there is disturbing data that demonstrates the persistence of patterns of educational success and failure: patterns that also raise serious questions about the purpose and processes of contemporary schooling.

Both of these patterns are clearly intertwined and raise challenges for every level of education. At the beginning of this book we put forward the concept of future proofing to signal an interest in exploring what it might mean to attempt to respond to this range of contextual challenges. A future proofing agenda, as outlined in Chap. 1, is best thought of as a series of questions that can be directed at any educational initiative, environment or practice to reflect upon the extent to which it is (only) helping children get good at doing school, or alternatively (and far more importantly) the ways in which it is helping diverse kids get good at doing *life*. From this basis we raised questions such as: to what extent, and in what ways, is it possible to future proof children for a largely unknown and unknowable world? What would 'future proofing' curriculum, pedagogy or assessment actually look like in practice? What kinds of relationships underpin this future proofing project? And what role can educational technologies play in a broader project designed to change students' relationships with knowledge?

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In the case based chapters contained in book the various authors have addressed these questions through description and analysis of a diverse range of environments and initiatives. While there is enormous variety in the way the particular challenges addressed by each author are understood and responded to, they are bound together by similar sets of ideas and dispositions each of which further our understanding of where a future proofing agenda can take us, and what it might look like, in practice, in various real world classrooms. Our goal in this concluding chapter is to capture the particular kinds of mindsets explored through the previous chapters that have usefully underpinned transformative and creative attempts to respond to the long-standing educational challenges relating to both schools use of ICTs and the pursuit of educational justice. It is important to be clear that we are not attempting to provide any kind of checklist or tick box approach to the conceptualisation and implementation of educational reform. Any such attempt would contradict the recognition of complexity that is central to the ideas explored. Our desire at this point, rather, is to paint a picture of the kinds of mindsets or sensibilities shared by the authors of the previous chapters and to illustrate, in this process, how these mindsets can support a transformative educational agenda.

In putting together this overview we are conscious that there is a long way still to travel for those interested in developing detailed, robust, sustainable responses to longstanding educational challenges. In this final chapter, therefore, we briefly outline five key perspectives, attitudes or mindsets underpinning the work explored in the various chapters of the book in order to provide the basis for further and ongoing cross-domain conversations about the pursuit of educational transformation and the role of ICTs in this agenda.

Dispositions for Transformation

The first idea is simple, but, perhaps because of this very simplicity, particularly important to acknowledge explicitly: changes to the way schools respond to long-standing patterns regarding diverse students and ICTs are both necessary and possible. Patterns of success and failure for diverse children in education systems have been widely documented. Patterns of engagement with ICTs are similarly well known. The life long and life wide consequences of educational failure mean that educational systems need to change if there is to be any hope that the diverse kids in schools around the world can share more equitably in the benefits that flow from quality education. As well as this the ubiquitous nature of technology in the worlds beyond and around schooling means that educators need to find ways to combine an understanding of educational justice with mature understandings of how ICTs can contribute to a broader transformative agenda.

The chapters in this book also make it clear that things don't have to stay the same: individually and collectively educators throughout the world can imagine, create and celebrate projects that pursue change. This is clearly illustrated in Chap. 5 where McGrath and Rowan outline the ways in which children who had previously

been seen as disadvantaged and at risk, were given opportunities (through simple uses of technology) to demonstrate expertise: an opportunity which fundamentally changed how these at risk students were seen and positioned in the classroom environments. Reflecting on the impact on one particular student known as John, the teachers noted that his peers acquired a new found respect for John, and that there was "an acknowledgement of the fact that John knows some things and has the skills that the others don't… it's great for him".

John's changed relationship with schools, knowledge, and his educational peers illustrates the simple but vital point that the kinds of experiences that reproduce patterns of success and failure *can* be disrupted: change is possible. It also highlights the second key mindset underpinning the work of this book: the centrality of relationships to any project of educational reform. As we have argued consistently throughout this volume, every educational experience has the potential to reinforce or transform relationships: relationships between students and teachers, between students and each other, between students and their family, between students and their communities, between students, communities, schools knowledge and technology. When computers or related technologies are bought into school things change. Whether or not they improve or damage the relationships listed here depends upon how they are used. A key premise for this book is that any future looking educational agenda needs to position students not as the passive consumers of a predefined set of 'curriculum truths' but as legitimate *participants* in various knowledge communities and, potentially, as the producers of new knowledge. One feature of this commitment is a rejection of 'schooled' forms of knowledge in favour of 'real world' information. This is the distinction between teaching kids to be good at doing school versions of science, or maths, and teaching them to be mathematicians. It is the difference between pretend tasks and authentic tasks that have value, currency and credibility beyond the artificial settings of school. It is the difference between helping kids to be good at doing school and helping them be good at doing life.

Following on from the beliefs that change is both necessary and possible, a commitment to transforming relationships is thus the second key mindset associated with the future proofing agenda of the book. We argue further that projects attempting this transformation can usefully be conceptualised as both modestly ambitious (in terms of what they seek to achieve) and supportively sceptical (in terms of claims that are made about the learners and/or technologies). Together these concepts provide a third platform for conceptualising and sustaining educational transformation and both ideas are worth discussing in some more detail here.

Modest ambition, discussed at length in Chap. 4, is a third key component of the transformative educational agenda illustrated through this book. An attention economy and a time-poor environment can all too easily generate a sense that the only things educators can really afford to pay attention to are those that operate with a grand agenda and offer guaranteed pathways towards sweeping educational reforms. This attitude is not, in the end, very helpful. Unrealistic pressures to 'solve', 'fix' or 'transform' any long standing problem—be it related to equity or technology or student engagement or parental involvement—within too limited a time frame results in projects that are doomed to failure. This, in turn, easily leads to a cycle of

disillusionment, disinterest and disbelief: a sense that perhaps there is no way to address the particular problem at hand.

Overly ambitious projects are particularly dangerous given the well recognised fact that cultural and political attitudes towards differences (including attitudes relating to such factors as gender, socio-economics, religion, cultural background, language, and geography) are exceptionally difficult to change. Reforms in any of these areas never exist in isolation and while one set of interests works to expand understandings of what it means to be a good student, other discourses are continually fighting back: working to reassert narrow and hegemonic understandings of 'good student', 'good learner' and 'good citizen'.

This can be illustrated by looking at one simple example. In the past 30 or 40 years an enormous amount of effort has gone into broadening social understanding of what it means to 'be' a citizen of the United Kingdom. During that time we have seen widely celebrated examples of "Britishness" that go well beyond the kind of white, middle class, heterosexual, Christian imagery that held sway for so long. Within that broader set of changes dominant discourses around masculinity in the UK have been challenged through texts as diverse as *The Crying Game*, *Four Weddings and a Funeral*, *The Full Monty* and *Billy Elliot*. *Little Britain*, *The IT Crowd*, even Jamie Oliver's diverse cooking shows have all included and valued images of masculinity that go well beyond dominant and familiar stereotypes. Taken together, these kinds of texts allow us to say "look around, we include difference, we celebrate difference, we are a tolerant society".

But this transformative story telling and meaning making does not go on in isolation. Alongside these texts are day-to-day environments where the non-traditional boy is highly likely to be bullied, harassed and insulted. Boys who conform to dominant discourses are more likely to be safe, valued, rewarded. Boys who depart are at risk. This is paralleled by active and ongoing attempts to demonise vast sections of society when they step out of the boundaries ascribed as 'acceptable' or 'tolerable'. This has been most powerfully illustrated in the last 10 years by the widespread demonization within Western media of immigrants, refugees and, increasingly, those from non-Christian families.

The point to be made here is that the complex processes associated with the production, contestation and naturalisation of narrow and limited representations of difference make it all the more important for real world educators to be given permission to set themselves—and their students—modestly ambitious goals. Longstanding patterns of discrimination and alienation will not be undone by any single project. However, multiple projects working in multiple ways to disrupt, transform and celebrate positive relationships between diverse children and educational success do have much to offer. This is powerfully illustrated in the chapter by Marshman and Grootenboer which shows the ways in which modest mathematical agendas were able to re-engage at risk boys with a discipline area and knowledge base highly valued in and beyond schooling.

Sitting along side the notion of modest ambition, is the linked concept of supportive scepticism. Supportive scepticism is not meant to signal a cynical or pessimistic perspective. Rather it is an attitude that recognises what is being attempted but helps

us maintain a healthy scepticism when it comes to setting goals and objectives. It represents people who are (rightly) sceptical about overly grand ambitions or inflated claims about what will be achieved through any particular initiative: whether the project in question is related to attitudes towards difference or assumptions about technology. Supportive scepticism is an empowering position for it allows educators to 'be real' in terms of what they set out to achieve. This is harder than it may sound. In an environment that encourages the identification of 'quick fix' off the shelf solutions to complex social and educational problems 'over claiming' has become a common practice. This impatience is also seen, of course, in the kind of increasingly popular TV programs that offer instant solutions and miracle cures for whatever problems we may experience with our houses, budgets, bodies, pets, or even badly behaved children. A modestly ambitious, but supportively sceptical agenda, therefore, gives educators permission to set realistic goals. However, this is not a way of saying that anything goes in educational reform. Rather a sceptical approach to evaluating educational reforms also demands that progress towards these goals is measured in terms of the mindset explored earlier: that is, in terms of the relationships that result. This relates both to the relationships between diverse learners and learning that are created and nurtured and also the relationships between diverse learners, schools and technologies.

This is a tough criteria to perform against. As Bigum, Gillespie, Walker and Smith all note throughout this volume, schools have historically shown themselves to be places that are both difficult to change, and overly impressed by activities involving the domestication of technologies. This is a point particularly well explored by Craig Smith in Chap. 10. In telling a story of one set of technologically mediated educational interventions, Smith highlights the tension that always existed between the kinds of educational practices that were imagined by those seeking to change the relationships between learners and artistic knowledge, and the more bounded set of practices that were expected by many 'watching over' the project. The tendency, as Smith notes, was for the institutional structures surrounding schools to bring pedagogical practices back into familiar, 'safe' territory: when what the challenges of the twenty-first century really require are learners who are able to swim safely through difficult, changing and dangerous waters. This awareness, however, did not eliminate the possibility for the project to achieve important goals: rather, being aware of the tendency for mainstream or conservative positions to attempt to anchor or restrict educational reforms allowed the participants to ensure that they stayed focused upon their primary goal: engender a range of potentially transformative educational experiences for the gallery's diverse audiences by brokering a digitally mediated relationship between teachers and students, and the art works of the *Floating World*.

In a context where 'solutions' are scarce and persistence is key, the value of combining modest ambition with a supportive scepticism cannot, therefore, be overrated. Such a combination allows teachers who may well be struggling to juggle competing demands and diverse agendas to draw comfort and energy from the successes they achieve along a journey towards a different kind of educational environment rather than feeling burdened to exaggerate the scope and extent of their

agendas, or depressed by an inability to achieve transformation overnight. The positive nature of this combination is illustrated by Pam Hook in Chap. 8. Working with students who could easily be labelled as at high risk of educational alienation and failure, teachers were able to provide the students with skills that enabled them to see themselves as people who were good at learning: not simply good at doing some particular version of school. Commenting on the SOLO Taxonomy they were introduced to one young child said: "It helps us to learn. It helps you to think and do a few things that you want to do. Because it helps you connect ideas and learn and think in your head". This, of course, is the very basis of the future proofing agenda outlined in this book: a focus on creating opportunities for students to be good at learning for life, not good at learning-about-how-to-do-school.

Read from a position that recognises just how difficult it is to disrupt long standing patterns of educational alienation, these achievements can usefully be conceptualised as modestly ambitious. Realistic. Grounded. Practical. All three of those labels are correct. The achievements, however, are also, and most importantly, optimistic (but not naïve) about what children can achieve when provided with opportunities to develop skills with value and currency in diverse learning contexts.

The first, second and third mindsets that support ongoing pursuit of educational equity and technological reform are, therefore, fundamentally linked. Change is necessary. Change is possible. Projects designed to generate change can usefully be conceptualised as both modestly ambitious and supportively sceptical with a focus on the relationships that are being constructed, contested, disrupted or transformed providing a valuable mechanism for reflecting upon the extent to which they are meaningful for diverse children in diverse contexts.

Taken together, these mindsets lead to a further vital acknowledgement: the project of educational reform is ongoing—ceaseless in fact—and dependent upon diverse and multiple initiatives. This diversity is beautifully illustrated by the different starting points, objectives and agendas of the various chapters in this book. Consider the different challenges faced by McGrath, van Aalst, Chan and Krumsvik. The student populations were varied. The resources and technologies adopted were diverse. The pedagogical strategies were different from teacher to teacher. But each project in its own way worked to create positive relationships between their particular students and a particular educational environment. In this process each student has access to a set of experiences: in the case outlined by van Aalst and Chan outline, diverse learners experienced the benefits that flowed from being part of a group which students could have fun, care for each other, *and* be focused on learning.

Recognising and celebrating the power of diverse approaches to designing and implementing educational reform is not, however, the same as taking an 'anything goes' approach to dealing with either ICTs or diverse learners. The impact of any initiative on relationships remains a defining feature in terms of a projects claim to significance. This is linked, in turn, to the ability of the project to look beyond essentialist representations of technologies or learners. Anti-essentialism is, indeed, the fifth key mindset informing the kinds of reform work explored throughout this book and it is important to discuss this in more detail here.

As the chapters throughout this book have demonstrated, much of the history of schooling illustrates the multiple ways in which educational systems and practices have consistently worked to reproduce domesticated versions of technologies and narrow and limited understandings of students. Underpinning these understandings are essentialist perspectives about what technology really is, and who students really are. Throughout this book authors have shown the value of looking beyond these narrow, bounded, limiting understandings and embracing the possibilities of anti-essentialism. Anti-essentialist frameworks are associated with vast body of scholarship across a large number of fields—gender studies, actor-network theory, queer theory, post-colonial theory—and it is not our intention to review these here. The key point to be made is that to be anti-essentialist is to reject the idea that there is ever a single, universal 'truth' waiting to be uncovered about any particular context or any particular challenge. Rather, an anti-essentialist perspectives highlight the ways in which meanings are produced, stories are told, and some versions of reality acquire more status and authority than others, largely as a result of their ability to attach themselves to existing, powerful, familiar stories about life, learning, identity.

In relation to social justice agendas anti-essentialist perspectives reject frameworks that argue that groups are in any meaningful or fundamental sense homogenous. This is not to say that groups do not have commonalities: all of the students starting school together in one Danish classroom, for instance, share a certain kind of bond. But there are as many differences within groups, as there are between groups. An anti-essentialist perspective recognises differences at three levels. Between groups (such as between the way society generally positions men and women); within groups (such as the differences within a group of Australian women, or British men); and within an individual (that is, people are not static or fixed in terms of how they think about and respond to the world, and can 'be' quite different in different places and different locations). This is a concept that recognises that for many of us there are 'multiple mes' who perform different roles, in different locations at different times. This multiplicity is clearly acknowledged in the chapter by van Aalst and Chan who unpack and problematise the notion of 'a' Chinese learner, and also by Hook who looks beyond the stereotypes associated with Maori learners to explore diversity and multiplicity.

Taking an anti-essentialist approach to equity reforms, therefore, means rejecting any claim or initiative that proceeds from the belief that all members of a particular group—such as men, women, Muslims, Islamic women, Afghani men, indigenous boys—are fundamentally the same and that they can, by extension, be educated, engaged or motivated in the same ways and for the same reasons. This perspective informs and explains the commitment to multiple pathways to reform outlined above.

While anti-essentialist perspectives on equity are relatively well known, anti-essentialist perspectives on technology have perhaps had less attention. Bigum has argued elsewhere the importance of looking beyond the labels such as 'learning technology' and 'information technology' to see all technologies as multiple.

Every technology brought into a classroom-be it a computer, a white board, a textbook, or chalkboard—exists in a relationship with the other things—human and non-human—in that environment. This means that there is no 'real' or 'essential' value attached to, for instance, an Ipad. There are simply a range of ways in which that technology could be performed in a particular context. This perspective challenges claims that technologies (of whatever sort) automatically increase engagement, or improve attendance, or motivate the at risk learners. In an anti-essentialist mindset nothing is taken for granted and attention is focused on *how* and in *through what moves* does a technology 'succeed' or 'fail' in terms of a set of intended outcomes.

Brought together, anti-essentialist perspectives on equity and technology support readings of classroom contexts and educational innovations which emphasise the need to look beyond quick fixes and innovations based upon limited or stereotypical understandings about students, learners or technology. This draws attention, once again, to the need for educators to find multiple ways to engage multiple learners. From this perspective, the innovations with the most to offer are those that provide multiple ways and diverse spaces within which students can experiment, engage, and succeed.

To summarise, then, the kind of project work explored throughout this book recognises that any attempt to recognise and respond to both what has changed (including technology) and what has not changed (patterns of educational success and failure and cultural contexts which routinely position some students in a more positive relationship with schooling than others) can be usefully informed by the following combination of ideas. First, change is conceptualised as both desirable and possible. Second, emphasis is placed on the transformative potential of changing relationships between diverse learners and knowledge, learning and society. Third, pursuing the transformation of these relationships takes place through projects characterised by modest ambition and supportive scepticism. Fourth, these projects must be diverse in size, scope and methods but united in their commitment to developing positive and transformative relationships that reject simple and essentialist understandings of either technologies or learners.

There is one, final, point to be made. Representing and understanding the value of modestly ambitious, supportively sceptical, anti-essentialist and relationship centred practices can be easier to say that to do. In the challenging, draining and demanding contexts of education, access to ideas and insights to support and enrich our work are vital. The final mindset we wish to put forward recognises the need for educators to always be looking for ways to support their own professional learning through the pursuit of cross domain conversations.

Conversations across traditional and familiar boundaries is valuable for all discipline areas but perhaps particularly vital when we consider the difficulty of dealing with issues relating to educational equity and ICTs in the same (limited, contested) spaces. Despite common agreement that both new technologies and perspectives on equity need to be embedded throughout an entire curriculum it is common for both of these contemporary educational challenges to be treated (in practice) as rather separate and distinct areas of concern. By extension, responsibility for addressing the two contexts is often allocated to different groups. Thus, although technology

usage is an expectation for all curriculum areas, leadership in this field is often assigned to academics or teachers who are technological experts. Similarly, while many educational contexts state their commitment to principles of equity, analysis of social disadvantage and conceptualisation of equity based interventions is often allocated to a different group of scholars: those with interests in social justice and, often, backgrounds in the humanities, literature, sociology, critical theory, feminist and post-colonial critique.

This division is not, of course, hard and fast and there is significant evidence of research and teaching initiatives where both concerns are given equal attention and hundreds of scholars who work consistently across both domains. Nevertheless it is possible to argue that people who have social justice as their primary agenda, and people who have technology as their primary agenda often come from different intellectual 'homes' and tend to work in different ways: focusing on different issues, talking to different groups of colleagues, seeing and attending to different imperatives and demands. With both technology and social justice able to stake claims on the time and resources of educators who are already crisis rich and time poor it is almost inevitable that responsibility for each area will be delegated to those who are already experts within, and committed to one field or the other. Thus, many conversations about technology and equity take place within communities that share a similar language, history and commitment. Conversation across the domains is minimal at best.

Perhaps the key challenge facing those of us with a commitment to both social justice and educational technology is recognising that our own work in this field will be enriched if—like the learners discussed throughout this book—we are able to develop new relationships with the knowledge the exists within and across domains. The active pursuit of cross domain conversations can support our attempts to develop modestly ambitious projects that make creative use of ICTs in ways that are appropriate to the 'real worlds' beyond school walls and to concentrate, at the same time, on ensuring the relationships we build between schools and knowledge are equally and equitably experienced. This point was powerfully illustrated in the chapter by Mary Ulicsak and Keri Facer who tell the stories of their attempt to widen conversations about education to include those who very often do not have a voice that is heard. By opening up the dialogue and embracing new conversational possibilities, they generated new ways of thinking about, talking about, and working towards educational futures appropriate for diverse and diversifying contexts.

Each of the chapters in this book have contributed to an opening up of conversations about the relationship between diverse students, ICTs and educational equity. None of the chapters, individually, lay claim to any single, simple one-size-fits all approach to conceptualising and performing quality teaching in the twenty-first century. Together, however, they outline a set of mindsets and dispositions, a set of attitudes and expectations for working on the edges of educational and social practice, which work not only to open up conversations and educational possibilities in their own specific locations, but provide the basis for many further conversations about possible futures, and our pursuit of what they have to offer.

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Helena is committed to raising the profile of learning technology in education and her teaching is strongly linked to her research in this area. She is closely involved with ITTE (The Association for IT in Teacher Education). Helena has a leadership role in developing teaching and learning across the range of Undergraduate courses in EDU and has recently published a book on Science for Primary School Teachers.

Peter Grootenboer Peter worked in schools for 12 years as a teacher, senior teacher and Dean before moving into the tertiary sector. In 1997 he received a *Jim Campbell Award* – a national award for teaching excellence in mathematics in New Zealand. Peter completed his MEd and EdD through the University of Waikato focussing on mathematics education and educational leadership. Recently Peter's research has focussed on Indigenous education, and issues related to equity and identity in mathematics learning and teaching.

Pam Hook Pam Hook is an educational consultant (Hooked on Thinking), who works with New Zealand schools to develop curricula and pedagogies for learning to learn. She directs and facilitates Ministry of Education Information Communication Technology Professional Development (ICTPD) cluster contracts. She has written curriculum material for government and business and is co-author of two science textbooks widely used in NZ secondary schools. She is known for her educational blog, Artichoke and is a popular speaker at conferences.

Rune Krumsvik Rune Krumsvik is professor of education at University of Bergen, Norway. He is Head of the Department of Education and Head of the research group Digital Learning Communities (http://www.uib.no/rg/dlc).

Carmel McGrath Carmel McGrath currently works as a primary school Principal in Queensland and has over 25 years experience in both primary and secondary sectors in various roles including classroom teacher, Education Adviser, Head of Department and Deputy Principal. Carmel's current work has been the major focus of her PHD studies at Deakin University.

Margaret Marshman Margaret Marshman worked for a number as of years as a physicist modelling the behaviour of first electrons in atoms when irradiated by laser beams and then protons in nuclei when irradiated by radiofrequency fields. After she received a PhD in magnetic resonance imaging she spent a number of years in the classroom teaching mathematics, science and physics at a number of different Gold Coast schools before becoming a Head of Mathematics. She then became a lecturer in mathematics and science education at Griffith University (and is now a senior lecturer in mathematics and physics education at University of the Sunshine Coast.)

Leonie Rowan Dr Leonie Rowan is a Senior Lecturer in the School of Education and Professional Studies at Griffith University. Her research interests relate to the broad fields of equity and social justice and she is particularly interested in the concept of relationship centred schooling as a framework for disrupting traditional patterns of success and failure in diverse educational and cultural sites. Leonie has

long worked to draw attention to the multiple ways in which schools – through their partnerships with caregivers, children and members of their community – can either reproduce and naturalise or contest and transform dominant understandings of what it means to be a 'good student', a 'good learner' a 'good parent' and a 'good citizen'. She specialises in working with pre-service and in-service teachers to problematise the taken for granted practices of schooling that have for so long produced uneven educational outcomes and works to identify productive, do-able ways for real teachers in the real world to work towards social justice in their communities on a daily basis.

Craig Smith Dr Craig Smith been interested in innovation, technologies, change and education for many years. He has worked closely with schools and other education providers primarily as a researcher, for both university and government organisations. Craig's background includes a strong grounding in political philosophy and social theory with a particular interest in the politics of emancipation, and philosophy, which he taught at Deakin University for several years.

Mary Ulicsak Dr Mary Ulicsak has been conducting educational research for the last 10 years and, as Senior Researcher at Futurelab, was responsible for a range of innovative research projects exploring digital games in education, participatory design and computer supported collaborative learning. She has worked extensively on European projects, including the ongoing Innovative Technologies for an Engaging Classroom (iTEC). Her publications at Futurelab include: Gaming in Families, Serious Games in Education, and Teaching with Games.

Jan van Aalst Jan van Aalst is an associate professor in the Faculty of Education, the University of Hong Kong, where he teaches graduate courses in science education, research methodology, and the use of ICT in education. His current interests are in various aspects of knowledge building, including pedagogy, assessment, and teacher education.

Rob Walker Rob Walker is an adjunct professor at the University of East Anglia in England where he has a number of interests. He is a member of the teaching team for the MA in Higher Education Practice, which is a professional development program provided for newly appointed academic staff. Rob is also part of a research project (Ensemble) that is investigating the potential of semantic tools for case-based learning in higher education. In the wider world Rob is interested in the design of educational spaces (actual, virtual and hybrid) and I is writing on the theme of 'Journeys into Spaces' – connected case studies that are looking at the architectural design and pedagogical occupancy of educational spaces (classrooms, screen-scapes and curricula spaces). Rob also has an informal role supporting action research for the charity 'Red Balloon' which works with students who have been severely bullied at school.

Author Index

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