







PERSONALISED LEARNING

Meeting the Australian Education Challenge

WHITE PAPER November 2011

TABLE OF CONTENTS

EXECUTIVE SUMMARY	03
ABOUT TELSTRA	05
INTRODUCTION	06
MAKING THE CASE FOR CHANGE	07
NET GEN AND GEN NEXT HAVE ARRIVED	08
GAME-BASED ONLINE LEARNING	10
CONNECTING LEARNING INSIDE AND OUTSIDE THE CLASSROOM – IN PRACTICE	12
SETTING CONTEXT FOR THE FUTURE	13
LEARNING LOCATION AND TIMING	14
LEARNING SOURCE	15
LEARNING MODE	15
LEARNING CONTENT	16
LEARNING ASSESSMENT	16
TEACHING AS A PROFESSION AT THE CROSSROADS	18
A 21ST CENTURY MODEL OF EDUCATION IS FUELED BY TECHNOLOGY	19
MOBILITY	19
COLLABORATIVE ENVIRONMENTS	22
	25
NAVIGATING THE NEW LEARNING LANDSCAPE TOGETHER	27
THE TELSTRA LEARNING BLUEPRINT	29
ABOUT THIS RESEARCH	31
ABOUT THE AUTHORS	32
REFERENCES	33

EXECUTIVE SUMMARY

As a natural outgrowth of the Telstra Education Roundtable discussions in December 2010, Telstra Enterprise and Government launched a "quick hit" qualitative research project in March 2011 to record real stories about how the education landscape is changing and to ask three key questions

- In what ways are educational needs changing in Australia?
- How might Telstra play a role in developing the preferred future for education?
- What might be fruitful areas for the Roundtable to engage in collaborative work near term?

We conducted in-depth interviews with representatives of Australia's public, independent and Catholic schools, TAFEs, universities, education agencies, ACARA and DEEWR, and were privileged to hear some remarkable stories about the innovative work occurring in the education space. This report is a summary of the specific insights gained through those interviews and amplified by secondary research.

While there were wide-ranging views and opinions offered on the future of education, a common thread running through our interviews was a universal "call for change". As often repeated, the industrial age model of education has outlived its purpose. For those who must now complete in a new global knowledge economy, the current educational model is not meeting the needs of today's students. The question is in what ways do we change this century-old model? Our respondents were clear. It starts with the learner and their changing expectations.

1. Today's student is different in meaningful ways and as a result is transforming education as an institution. Most of the students who are currently engaged in Australia's schools, TAFE colleges and universities share a defining generational characteristic; they are growing up in an environment saturated with technology. Unlike their parents, they are not passive recipients of digital media; rather they are active initiators, designers and collaborators. As digital natives, they fundamentally process information, think and behave differently than their parents; and as a result, the old broadcast method of teaching doesn't fit anymore. Today's student is looking for a robust learning ecosystem that is "learner centric", taking into account the needs, interests, and learning style of the student; and leverages technology in a meaningful and engaging way.

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- 2. In a 21st century model of education, learning can be liberated and enhanced in a technology rich environment. Technology gives our newest generation of students a public voice and the means to actively engage with teachers in the co-design and development of their own personalised learning experience. While we are still in the early days of pedagogical innovation, we believe that technology offers an opportunity to shape the relationship between the teacher, learning, and the student in unique and valuable ways:
- Learning location and timing: For students today, learning is mobile and often happens outside the confines of "school itself"; in terms of time and space. Technology offers the student a constantly connected environment that supports on-demand learning, designed to suit individual learning needs and styles.
- Learning source and mode: Students bring with them their own expectations of how and from whom they will learn. For them "school" operates as a design hub for learning that incorporates a rich network of learning collaborators. This enables teachers to act as partners facilitating the learning process; setting expectations, helping students plan their path forward, monitoring learning progress, mentoring and supporting their learning journey as they draw on a community of learning collaborators often facilitated through the use of technology.
- Learning content and assessment: One of the keys to next generation learning is creating a close alignment between content and assessment so that students receive instruction specifically tailored to their needs and interests. In a personalised model of education, technology can be a potent fuel, not just a tool for learning; assisting teachers in assessment, targeting specific learning needs, and using multiple modalities to engage students in different ways.

While there are many promising advances in technology as applied to education, our respondents identified mobility, collaboration and cloud computing as the technologies that were on their near-term watch list. In the body of the report we review each of these technologies in terms of its relevance for teaching or learning and how it is being applied in a variety of educational settings.

As ATC21S points out, "learning to collaborate with others and connect through technology are essential skills in a knowledgebased economy"

3. Twenty-first century skills should be the outcome of a 21st century education.

While reading, writing, mathematics and science are still the core educational touchstones of a contemporary education, today's students live in a world that requires additional capabilities. As ATC21S points out, *"learning to collaborate with others and connect through technology are essential skills in a knowledge-based economy."* Creating proficiency in these areas, however, requires a curriculum and learning environment that is conducive to the development of those skills.

- 4. Getting education right for the future requires a different approach to teaching and an on-going commitment to upskilling teachers for the very special task of designing and facilitating effective and engaging learning experiences. The biggest revolution in education needs to be changing the teaching profession itself. As respondents shared with us, even teaching professionals who are consummate technology users are not clear in their understanding of how to effectively transform their traditional classroom into a personalised learning environment. But this is a complex issue and is not solved by changes in initial teacher preparation alone. Transformational change will require robust on-going support and development for educators in a number of key areas if we want to address \ the education challenge in a meaningful way.
- 5. Transformation starts by building a partnership that can put in motion a set of disciplined experiments designed to form the building blocks for a new educational model. A learning strategy for this century cannot focus only on the school, it needs to incorporate a network of learning partners as part of a system wide approach to transformation. So where do we start? Respondents most often mentioned the importance of setting in motion a set of "disciplined experiments" around personalised learning: (1) how to translate what we know about the 21st century learner into meaningful classroom realities; (2) developing flexible content and delivery networks; and (3) building capabilities within the teaching profession.

Telstra understands the power Clearly we need to make changes in the way we approach the business of education. Respondents repeatedly told us that Telstra can play an important multi-dimensional role in educational reform as a thought leader and solution innovator. The Telstra Education Roundtable can provide an important forum where businesses, government and educators can collaborate in common areas of interest. Telstra understands the power of a personalised learning pathway and is committed to the on-going development and deployment of technologies that will inspire a new generation of learners and educators.

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About Telstra

Telstra is a leading provider of network-centric communication and managed services to large enterprise and government organisations in Australia and around the globe. Telstra serves over 200 of the world's top 500 companies through its international operations that facilitate access to over 240 countries and territories. Telstra offers superior value for money through its range of award-winning world class products and services.

INTRODUCTION

Many years ago, Robert Fulghum, author of "All I Really Need To Know I Learned in Kindergarten"ⁱⁱ, shared with us that all we really need to know about how to live, what to do, and how to be can be learned in kindergarten. Wisdom does not require graduate school, Fulghum says, it can be learned in the sand pit at school. He reminds us of simple lessons learned that had a powerful impact on how we learned to navigate our environment. Included in his list of early lessons learned are ...share everything ... play fair ... don't hit, and so on. For those of us who remember our early reading books, he reaffirmed that one of the most important words we learned in kindergarten was "look."

"Look" is still an important word and now there are new kindergarten tools to help our students look. Kindergarten today is not just about the sand pit, crayons, and finger paint. It's also about mobile devices and other tablet devices. Today's kindergarten wisdom now incorporates the new tools of learning. New lessons learned include, for example: (1) Check your fingers ... if there is glue or glitter on them, it's time to visit the sink; (2) carry your mobile device with two hands; (3) only use your mobile device with an adult present and (4) ask before you explore. ^{III}

Preschool and kindergarten teachers are now adding tablet devices to their classroom stocks of pencils and paints in an effort to hook young learners who have been raised in a technical world with constant connectivity. In the adult world, a tablet is about email, games, and music. For a kindergartner, a tablet offers an opportunity to learn maths, explore the world, and record learning. Technology does not replace the need to learn in the physical world. Techniques like tracing letters with your fingers or working with blocks when understanding basic maths concepts still have an important place in the classroom. But technology can serve to augment and extend a rich educational environment.

Interestingly, advanced technologies like the tablet, have moved into the classroom so quickly that the research has not yet caught up to measuring the effectiveness of the new learning tools. We know that students are different in some very profound ways, but the institution of education is changing slowly. Many government officials and educators believe that deep reform is needed. But at the same time, there is little agreement as to what a new model of education might look like. Opinions also differ as to how to make and measure progress. It is difficult to envision a profound change in a system that is as firmly established as the current education system is today. But as we look around, there are wonderful examples of educational innovation that give us glimpses of an exciting future.

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Making the Case for Change

For those who must now compete in a new global knowledge economy, the current model of pedagogy which sits at the heart of the educational system is failing to meet the learning needs and style of the newest generation of students The common thread running through our interviews was a universal "call for change." As often repeated, the industrial age model of education has outlived its purpose. As intended, the twentieth century model was an efficient and cost-effective manufacturing process designed to provide broad access to education. It leveraged a 'lock step' approach to learning, over set periods of time that resulted in effectively preparing students for known jobs. Teachers delivered one-size-fits all messages using a broadcast delivery method. Students, working alone, were expected to absorb and apply the content.

For those who must now compete in a new global knowledge economy, the current model of pedagogy which sits at the heart of the educational system is failing to meet the learning needs and style of the newest generation of students. The question is in what ways do we change this century-old institution? Our respondents were clear - it starts with the learner and their changing expectations.

"We know the massive pipeline of investment forecast in the resources sector in the years ahead will create unprecedented demand for labour and skills across a range of industries ... our challenge is whether we have enough Australians to do the high paid, high skilled work on offer ... We have a choice. We can meet this challenge by importing thousands of overseas workers or we can train and skill our own. Our priority is to train and skill our own ... The Australian Bureau of Statistics tells us that more than four million working age Australians need additional literacy and numeracy skills to be able to function effectively in the modern workplace and to participate fully in life. It is a barrier to employment, a barrier to improved productivity, a barrier to improved skills ... The Government is investing in a range of measures to ensure we are able to meet the skills challenge confronting the economy and share the benefits of our economic growth with all Australians."^{iv}

Senator the Hon Christopher Evans, Minister for Tertiary Education, Skills, Jobs and Workplace Relations

Net Gen and Gen Next have arrived

Most of the students who are currently engaged in Australia's schools, TAFE colleges and universities were born after 1977 and are either part of Net Gen (also called Gen Y or Millennials born between 1977-97) or Generation Next (also called Gen Z born 1998 to present). Like other generations, they have been exposed to and are being exposed to a unique set of events that influence their attitudes toward the world, learning, work and each other. While each individual within a generation certainly has his or her unique experiences based on socioeconomic status, parents' philosophies, race or ethnicity, gender, religion and a host of other factors, the prominent events they experienced in common via the internet give these generations some shared defining characteristics. ^{vi}

In a detailed study of 1,760 Net Gen youth aged 13 to 29 in the U.S. and Canada, generational expert Don Tapscott identified a set of common norms that explain how they are unique and in what ways they are transforming education as an institution.^{vii} These eight norms are rooted in their early life experiences particularly as it relates to technology. Unlike their parents, the Boomers, they are not passive recipients of media; rather they are active initiators, collaborators, designers, and authenticators. As a result of these experiences, they fundamentally process information, think and behave differently, and they: ^{viii}

- Want freedom: According to Tapscott, freedom is like oxygen to a Net Gener. They want freedom in everything they do, from freedom of choice to freedom of expression. They expect to be able to leverage technology to identify and choose the information or services that fit their specific need. Furthermore, they expect to exercise freedom in how, when, where and from whom they learn. Achievement-oriented and tech savvy, Net Geners want to be engaged as co-creators of their educational experience. Charles Leadbeater writes, "Learning is best done with people rather than to or for them. It is more effective when the learners are participants rather than merely recipients."^{ix}
- Love to personalise: Personalisation is an important corollary to the freedom norm. Net Geners have grown up in a digital world that allows them to customise their experiences as well as the products and services they receive. Personalised online space is now almost obligatory, as evidenced by the popularity of various social media spaces. The need to personalise now extends well beyond the digital world. Personalisation in the context of learning is characterised by being "learner centric"; creating a learning environment that takes into account the needs, interests, and learning styles of the student.

"Students are different, but educational practice and the materials that support it are changing only slowly."^v The 2010 Horizon Report.

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- Are scrutinisers: Net Geners have a high awareness of what is happening around them and want to know more. They use digital technologies to seek out the truth about things that interest them by reading information, blogs and reviews or visiting forums and consulting friends. They compare and contrast what they find online with their experience in the physical world. They "trust but verify," accepting very little at face value. Educational environments designed for the 21st century facilitate student learning through a technology enabled network of resources that extends beyond the boundaries of the school. Teachers act as facilitators and mentors by helping students learn how to effectively scrutinise this rich learning environment.
- Look for integrity and openness: The internet, combined with an array of technologies, strip away the barriers between the individual and the organisation and makes core values transparent. Net Gens are quick to disengage when their expectations are violated, but they are also quick to forgive when there are signs of genuine contrition. Net Gens expect teachers and administrators to be honest, considerate, and transparent; and to abide by their commitments.
- Bring a playful mentality into the environment: Charles Grantham, a principal at Future of Work, shares his perspective about Net Gens. "Their worlds bleed together," he says. "It is pretty useless to try to draw borders around different spheres of life for them." × And their "fun" tool of choice, of course, is the internet. This is a generation that has grown up on interactive experiences and brings them into all phases of their lives. Learning, therefore, is not confined to specific hours and places. It happens in school, on the bus ride home, on the soccer field, and late at night using a variety of devices, sometimes simultaneously. What Net Gens don't understand is why they can't use their favourite devices and apps while they are at school... – for fun and for learning – because in their minds "it's all connected". The challenge for educators is to effectively leverage this natural tendency to engage students in a meaningful learning experience.
- Collaborate: Today's youth feast on a steady diet of collaboration; in school, at work, at home and just for fun. And they bring this expectation of collaboration into the school environment. Here, they engage in collaborative learning, leveraging Web 2.0 tools to extract more value from informal networks. Blogs, wikis, video and social networks are increasingly available in educational settings; making the student both a learner and a teacher. Interestingly, Net Gens distinguish between collaboration and teamwork. While they appreciate the importance of teamwork, they would prefer to work faster on their own and be acknowledged for their individual efforts. Through collaborative tools, they are able to harness the value of the individual efforts to achieve a collective outcome that could not have been possible without technology.

This is a generation that has grown up on interactive experiences and brings them into all phases of their lives. Learning, therefore, is not confined to specific hours and places Today's youth feast on a steady diet of collaboration; in school, at work, at home and just for fun. And they bring this expectation of collaboration into the school environment From a pedagogical point of view, it is important to help them strike the right balance between teamwork and collaboration, as both are important capabilities in the world of work. It is also important to provide an educational environment that allows them to build a reputation for their identity and achievements; and recognises them "for who they are, where they come from, their goals, contributions and achievements".^{xv}

- Need speed: Speed is an expectation developed through interaction with their various digital devices. Rapid access to vast stores of information through networks is the norm for Net Gens. And because their worlds bleed together, they expect no less from their learning experiences and the technology environment that supports it.
- Innovate: In the Net Gen world, innovation happens quickly and all the time. As Tapscott comments, "their need to innovate challenges established norms, some of which will need to be adapted, and some of which the Net Gen will need to adapt".^{xvi} Educationally, we see tremendous innovation as a result of engaging this generation in their learning experiences. The challenge will be to integrate structured innovation into everyday learning.

Game-based online learning

Game-based online learning is not new, though educator interest has accelerated in recent years as a result of successful use in the military and business settings. Companies like Marriott International Inc., Siemens and Cold Stone Creamery use online gaming simulations as recruiting, on-boarding and career development tools for Net Geners. ^{xi} University educators are leveraging the gaming mentality to increase success rates in disciplines like maths, statistics, and foreign languages. Carnegie Mellon University's Open Learning Initiative offers flexible adaptive learning courses in 12 subjects. Course topics are offered in a building block fashion and delivered using web based features like animation, videos, and interactive diagrams. ^{xii} Likewise, Arizona State University's newly unveiled Knewton offers course content using a video-game-like interface. Using a sophisticated skill tracking approach, Knewton develops personal profiles for each student, tracking metrics including how long they take with each problem, whether they ask for help and what kind, whether they repeat lessons and so on; providing a personalised computer tutoring experience. As they master skills, students accumulate points and badges, in true gaming style.^{xiii} According to the 2011 Horizon Report, games can be applied effectively in many learning contexts, engaging students in ways that other approaches cannot. While gaming is several years away from being a mainstream educational practice, it is showing great promise for increasing engagement and enhancing learning in the classroom.xiv

As the Chronicle of Higher Education points out, "Today's high school students see their educational futures built almost entirely around technology" We are just beginning to understand the needs and expectations of Gen Next (sometimes referred to as Generation Z) as they move into their teen years. But it is our expectation that many of the norms developed by Net Gens will also drive the expectations of our newest generation. As the Chronicle of Higher Education points out, "Today's high school students see their educational futures built almost entirely around technology. And certainly computers will be even more central to the education of younger students rising through elementary and high schools." ^{xvii} Gen Next will expect to: ^{xviii}

- Use mobile computing devices to extend learning throughout all phases of their lives
- Use Web 2.0 computing tools as a normal part of their classroom experience. These tools will be used to support collaboration, social learning and self-development. In addition, they offer students an opportunity to act as co-creators of their learning experience.
- Use digital text books that will be designed to allow:
- Personalisation;
- Testing on demand;
- Connection to real-time data and/or experts;
- Access to classroom information;
- Exploration of key concepts through games and simulations;
- Video clips.
- Develop work-related transition pathways much earlier than other generations. As early as primary school, Gen Next will expect to get out of the classroom and interface with professionals in various fields of interest. By their teen years, they will have a much more grounded sense of and connection to a specific professional field of interest.

Net Gen and Next Gen learners are empowered and informed by voice and choice. The challenge is to find ways to leverage and enable their natural tendencies to facilitate learning. This will stimulate an evolution in pedagogy and see the birth of new teaching practices. As a result, educators hope that student satisfaction rates, retention rates and engagement with learning improve.

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Brooker Biology is a 1,438 page text book used by many university undergraduate science students. This autumn, this five pound book will be replaced by Brooker Biology for the iPad. Although digital text books are not new – CourseSmart for example has a fairly comprehensive portfolio - most are just scanned forms of the paper version. This offering from Inkling is more interactive. In this new version of Brooker Biology, a 3D diagram of the human heart can be rotated, complex topics like cell co-transport are explained with video and learning is reinforced with interactive quizzes. The iPad version is also social, allowing students to connect and share notes or highlighted passages. Furthermore, unlike other digital books, content can be purchased on an inexpensive by-chapter basis, allowing the faculty to select only those pieces that are relevant for the course.^{xix}

CONNECTING LEARNING INSIDE AND OUTSIDE THE CLASSROOM – IN PRACTICE

Vignette: Jimmy

"At the secondary level many students lose interest in STEM subjects and despite showing potential ... This is inconsistent with the needs of advanced technological society ... The key problems are: a declining proportion of students completing Year 12 in physics, chemistry, and advanced mathematics; insufficient numbers of highly motivated and trained teachers in STEM; uncertainty among school teachers about how to best teach STEM; and classroom experiences do little to simulate curiosity, problem solving, depth of understanding and continued interest in learning among students, or to encourage them to undertake advanced study in STEM at school and beyond." Engineers Australia **

Jimmy is a reasonably bright 16 year-old. And like many teens, he's got lots of friends that he interacts with using his mobile. Jimmy also loves cars, fixing them up, and understanding how they work. In fact, he spends most of his weekends fixing them with his mates. If he comes across a problem he pulls out his mobile and uses YouTube to search for a solution. This weekend he watched a two-minute clip on spark plug maintenance. Because it was on his mobile, he could watch it while he was working on his car and replay it as many times as he needed. Too bad there's no course like this offered at his school.

Being in Year 9 at a low SES school doesn't really bother him. Unfortunately, he's not doing too well, with school work that is. This is disappointing because back in Year 7 his NAPLAN results were above the state average. His teachers consider his literacy and numeracy skills to be adequate but now he's having all sorts of trouble at school. In fact, he often truants because he'd rather be working on his car than learning about the arrival of the First Fleet or how to write poetry.

Some of his teachers have noticed Jimmy's a bit disengaged. And if they took a closer look they'd see he's actually enraged. He's enraged because increasingly he can't see the relevance of the content he's being told to master in many subjects. In his view, he's wasting his time there. He's more focused and on task when working on his car a couple of days a week. In fact, Jimmy's rather clever in that he's designed his own local learning ecosystem. It comprises his backyard, his mates, the expert neighbor who helps out, and Jimmy's mobile packed with social media sites that know stuff about cars and school. The only problem is that his well-developed "learning eco-system" doesn't meet the requirements necessary for an academic credential.

How do we address those needs? Australia can't afford to lose talented students like Jimmy who are interested in the application of subjects like maths and science. In fact, according to Manpower, a global talent firm, the number one skill gap reported by employers in Australia is in the skilled trade area. Also included in the top ten are engineers, mechanics, and technicians. ^{xoi} What Jimmy needs is an alternative, like the students in the experimental program at Plumpton High School. Like Jimmy, these students are intellectually capable of building a bright future but are currently at risk of disengaging and/ or failing in the current school system. By engaging students in a different way, we can help them achieve their dreams. At Plumpton, these students attend school three days a week and work two days a week. Here they recognise that learning and education takes place outside the walls of the classroom, and those experiences are valued and acknowledged. Out of the 20 students enrolled in the specific program, about 75% are expected to get apprenticeships while the other 25% are expected to secure full time jobs. Plumpton is helping students build meaningful transition pathways to employment while they are still in school.^{xxii}

Jimmy could also benefit from a program like the "Open Badges Project" sponsored by Peer 2 Peer University and Mozilla.xxiii Traditional economically constrained academic programs at the high school level often do not allow students like Jimmy to pursue their real interests. Until now, Jimmy would not have had a way to gain credit or recognition for the skills he's developing outside of the classroom using his personal learning eco-system. Nor did he have a way to carry those credentials forward to his school or potential employer. Using the Open Badge System, any organisation can issue badges backed by their own performance criteria and seal of approval. Learners can collect badges from different credentialed sources and include them on their resume or transcript. By displaying verified skills that traditional degrees and transcripts leave out, badges can create a smoother employment transition pathway. The concepts of offering credit for demonstrated life skills and "badging" are not new. Organisations including Learning Counts and Knext assist learners to package their certification credentials to create portfolios to document their work skills. The TAFEs routinely recognise the skills and knowledge that students have gained through previous studies, work, and life experiences. Evidence of competence is arranged in a portfolio that is provided to a qualified recognition assessor. Companies using collaborative platforms use a combination of skill based badges, tagging and peer feedback for expertise location and performance recognition. And universities such as Arizona State are including skill badges on transcripts in addition to completed courses and final grades. The challenge of recognising knowledge and skills learned outside of the classroom "is an important one in K-12 schools, because it results in a lack of engagement in learning on the part of students who are seeking some connection between their world, their own lives, and their experience in school". xxiv

SETTING CONTEXT FOR THE FUTURE

Net Gen and Gen Next students know that as a tool, technology offers us the opportunity to shape the relationship between the teacher, learning and the student in unique and valuable ways Charles Leadbeater, author and innovation consultant, in his 2008 whitepaper on "What's Next" offers a compelling image of 21st century learning. xxxi What we know is that 21st century learning will be different in very profound ways. But as so many of our respondents commented, we are still in the early days of pedagogical innovation, with limited research on the impact on learning outcomes. However, as we begin to build a new philosophy of learning as expressed in technology rich environment, our respondents shared their thoughts about the key change themes and their implications for learning as outlined in Table 1 below. Net Gen and Gen Next students know that as a tool, technology offers us the opportunity to shape the relationship between the teacher, learning and the student in unique and valuable ways.

PEDAGOGICAL CHA	ANGE		WITH TECHNOLOGY RICH ENVIRONMENT
Learning Feature	Away from	Towards	Impact on learning
Location	Mainly in schools	Any time, anywhere	Offers a constantly connected environment for on-demand learning
Timing	In school terms	In life wide terms	Learning is no longer confined to the school; rather it is offered at different times and places designed to suit individual learning needs
Source	Teacher managed	Teacher facilitated through a partner network	Provides access to a broad network of learning collaborators including teachers, parents, other skilled adults, peers and other social networks
Mode	One way, instructor led	Multi-way, student informed	Provides a rich learning ecosystem that incorporates student voice in choice of learning modality
Content	Mass production style	Flexible learning pathways	Allows content to be tailored to meet the needs and objectives of the learners; making it relevant, engaging, and meaningful for the 21st century
Assessment	Assessment at end	Assessment throughout	Enables the use of rich assessment tools and techniques, so teachers can pinpoint learning gaps and fill them as they occur for more effective learning. Learners can seek feedback from a wider array of sources in a just-in-time format

Table 1: A new philosophy of learning in a technology rich environment

Adapted from Leadbeater based on research interview data xxvii

"Students have redefined what learning is and are leaving systems and teachers in their wake." Lindsay Wasson, Adjunct Professor, University of Western Sydney^{xxx} "Learning needs to be engaging, relevant, connected, and lifelong. And if schools don't adjust, students will go elsewhere because they can." Greg Whitby, Executive Director of Schools

Learning location and timing

"Learning needs to be engaging, relevant, connected, and life-long. And if schools don't adjust, students will go elsewhere because they can." Greg Whitby, Executive Director of Schools. ^{xxviii}

In some ways, the traditional classroom is a foreign place to the world in which today's students live. For them, learning is mobile and often happens outside the confines of school itself, both in terms of time, space and its collaborators. Increasingly, today's school is not just one place but many places - a main campus or school building, a satellite branch or facility, a community centre, a home setting and a virtual learning environment. Today, learning is a life-wide experience.

At the Catholic Education Diocese of Parramatta in Sydney, for example, teachers are often found working online with students because they know that learning doesn't just happen inside the classroom. Starting with what the student already knows, teachers create a personalised, age appropriate learning map and use technology to amplify the experience. Beyond the classroom walls, teachers encourage their students to take advantage of online resources, explore ideas and practice skills and interact with their extensive social network. ^{xxix}

And in reality, the notion of a standard school based learning experience has already become a thing of the past. Rapid advances in technology coupled with student demands are driving the development of new learning delivery systems designed to empower a new generation of students to learn anytime anywhere. Florida's Virtual School, for example, is a state-wide public school that serves K-12 students online. Students move at their own pace as they receive instruction on line, then complete assignments, quizzes and tests as required. "A student anywhere in the country can log onto a computer to discuss a project with an expert, participate in student activities and clubs, attend an on-line event about Shakespeare, or take an assessment that measures mastery." ^{xxx}

"Imagine a library that is not only bookless but is not necessarily tied to a building, one that takes its personnel and services to patrons rather than expecting it to come to it. Two projects – one now under way at the undergraduate level and one well established at a medical library – suggest where the untethered library is headed." xxxi Drexel University is building a Library Learning Terrace that will be open 24/7 to give students access to the library's digital resources as well as a place to gather. Students can make arrangements to have a librarian join them to assist on project based assignments. At Johns Hopkins Medical school there is no need to step inside the library as journals are available online. Embedded librarians work with specific user groups outside of the library itself. "People needed their journals wherever they were ... and they needed librarians on occasion. What they didn't need was a building." xxxii "We are slowly moving away from the model of teacher as the source of all knowledge. Parents may still think they are, but students know they are not. Students are moving to the centre of the learning process." Tom Urry, Regional Director for South Western Sydney Learning Source

As Tom Urry, Regional Director for South Western Sydney, so eloquently summarised, "We are slowly moving away from the model of teacher as the source of all knowledge. Parents may still think they are, but students know they are not. Students are moving to the centre of the learning process." xxxiii Today students bring with them their own expectations of how and from whom they will learn. Sometimes learning is a transaction, with a teacher instructing a student as they absorb and internalise specific pieces of knowledge. Other times, learning is the product of self-discovery or collaboration with others.

Many respondents emphasised that a learning strategy for this century cannot focus only on the school, it needs to incorporate a network or community of learning partners as part of the system wide solution. As Tony McKay, Deputy Chair of ACARA, articulates, in the new educational model, school operates as a sort of base camp or design hub for learning.^{xxxiv} Leveraging technology, students are able to extend beyond the hub; connecting to a rich learning network that is tailored to meet their personal needs and interests. These learning networks not only help students access the information they need when they need it, but to interpret it and maximise its value. Teachers act as partners, facilitating the learning process; setting expectations, helping students to plan their path forward, monitoring learning progress, mentoring and supporting their learning journey as they draw on a broad community of learning collaborators.

Learning Mode

Personalised learning is a dramatic move away from the 'instructor led mass education' that was provided during much of the 20th century; offering students an opportunity to learn in ways that suit their individual learning styles and multiple intelligences, often with extensive use of technology in the process. Now in its third year, The School of One, an experimental middle school maths program in New York, matches students with the learning activities that best suit their needs based on a diagnostic assessment of their previous day's performance. By managing complex student data via technology, teachers are able to target specific student learning needs using a portfolio of high quality, flexible and engaging content. A learning algorithm matches student needs to produce a "daily playlist of activities", including teacher led activities, online tutoring, peer learning and high-quality computer games.^{xoxv} In this model, technology can be a "potent fuel not just a tool" for learning; assisting teachers in assessment, targeting specific learning needs and using multiple modalities to engage students in different ways.

By managing complex student data via technology, teachers are able to target specific student learning needs using a portfolio of high quality, flexible and engaging content While reading, writing, mathematics, and science are still the core educational touchstones, today's students live in a world that requires an additional set of capabilities. Our educational system needs to prepare students for a world of work that has dramatically changed. Over the last several years, a number of organisations have independently developed frameworks for describing these 21st century knowledge and skills. ATC21S, an international research effort led by the University of Melbourne and sponsored by Cisco, Intel and Microsoft, has analysed these various frameworks and identified four broad categories that characterise 21st learning, including: ^{xxxvi}

- Ways of Thinking: Creativity, critical thinking, problem solving, decision making and learning
- Way of Working: Communication and collaboration
- Tools for Working: Information and communication technology (ICT) and information literacy
- Skills for Living in the World: Citizenship, life and career, and personal and social responsibility

Spanning all four categories are two essential skill sets: collaborative problemsolving and ICT literacy. As ATC21S points out, *"learning to collaborate with others and connect through technology are essential skills in a knowledge-based economy."*^{xxxvii} For students, proficiency in 21st century skills should be the outcome of a 21st century education, but that will require a curriculum and learning environment that is conducive to the development of those skills.

Learning Assessment

Learning needs to start from a different point, with what the student knows as opposed to what he or she needs. Using a different learning approach allows educators to tailor the curriculum and the approach to support the needs and aspirations of individual students. Leadbeater writes, "Learning is most effective when it's personalised; it means something to the learner. That happens when people feel they are participants and investors in their own learning, shaping what and how they learn, and able to articulate its value to them." xxxviii Instead of seeing schooling as a system of years and grades, students should be able to pace their learning and take tests when they are ready, enabling some to move on when core skills are mastered while allowing others more time to embed their learning. Personalisation is still a relatively new concept in education; and while very attractive, it still engenders some debate in the discipline. Educators do agree, however, that schools do need to become more flexible and adaptive in responding to the diverse capabilities and needs of today's students. And learning analytics can assist educators in analysing student information in a way that allows teachers to respond in real time with meaningful interventions.

As ATC21S points out, "learning to collaborate with others and connect through technology are essential skills in a knowledgebased economy" This next generation online system is integrating student, curriculum, learning and content management systems to allow greater interaction between students, teachers, and their parents In the Queensland Public School System, they know that a key to next generation learning is the alignment of content and assessment so that students receive instruction specifically tailored to their individual needs. Here they are building online systems that allow teachers to analyse student performance data, identify gaps and suggest teaching practices and resources to assist students. This next generation online system is integrating student, curriculum, learning and content management systems to allow greater interaction between students, teachers, and their parents. Here the student is truly at the centre of their own educational experience with a personalised pathway to learning.^{xxxix}

At Hodgkin Elementary School in Denver, Colorado, they are also trying a different approach to education, one that gets rid of class grade levels. Using a standardsbased learning model, students are grouped by what they know, not by age. So, teacher Jennifer Gregg's literacy class is made up of students aged eight to ten with four different reading levels. Their learning program is individualised so that every student in every class is learning at exactly the spot that they are supposed to and no one moves on to the next level without testing at the equivalent of a C grade or better. This is a school that was on the academic watch list for years. While state testing scores are still in the process of moving up, their discipline problems have dropped by 76% since the change and students are more motivated now. What started as an experiment in one elementary school is expected to roll out district wide for the 2013-2014 school year. Changing course wasn't easy, but they knew they needed to do something different.^{xi}

"Learning is most effective when it's personalised; it means something to the learner. That happens when people feel they are participants and investors in their own learning, shaping what and how they learn, and able to articulate its value to them."

TEACHING AS A PROFESSION AT THE CROSSROADS

Vignette: Yvonne

"Information technologies impact how people work, play, learn, socialise and collaborate. Increasingly, technology skills are also critical to success in almost every arena, and those who are more facile with technology will advance while those without access or skills will not. The digital divide, once seen as a factor of wealth; is now seen as a factor of education: those who have the opportunity to learn technology skills are in a better position to obtain and make use of technology than those who do not." The 2010 Horizon Report.^{xli}

Yvonne has a degree in Business Management. She's successfully run her own clothing company with international reach. In the process of making her business successful she has been able to put her interpersonal and financial acumen as well as her digital literacy skills to good use. But about five years ago, Yvonne was determined to make a career change by moving into teaching. She'd always wanted to teach, but now it had become a real personal passion. She was eager to work with young people who were engaged, tech-savvy and switched on to learning. So at age 35, she scaled down her business and finished a Bachelor of Education degree.

Given the importance that the Federal Government has placed on education in recent years, Yvonne had the expectation that schools would be fairly tooled up for the 21st century. She imagined that at university she'd have easy access to a range of modern technologies and be taught how to use them in her new discipline just like she did in her business role. When assigned to a school district, she thought she'd be technologically equipped for her new role. Just the usual – a laptop, a work smartphone, broadband and internet access. She thought she'd be able to have the students use a range of devices to capture data, take videos and pictures, record interviews, join lessons with top notch researchers on a virtual basis and upload their homework assignments so they could work remotely. And she, in turn, could use the technology to collaborate with colleagues, administrators, students, and their parents. All done through a secure platform that could be accessed anytime anywhere.

Imagine Yvonne's disappointment when she found at university that the discipline of teaching had not changed much and there was very little support for learning how to effectively leverage technology in the classroom. And when she was ready to take on a new teaching role, she found that mobiles were banned while students were at school, along with various social networking sites. There was great conferencing equipment and laptops were available for the classroom but they were mostly used for administrative work. And high speed internet – well, not at her school. What was valued was a style of teaching that she experienced some years back; teacher as the deliverer of knowledge, with an emphasis on student behaviour management. Yvonne knew it wasn't the same for all schools or for all teachers, but this was her experience.

Recognised authority on educational reform Michael Fullan writes that the biggest revolution in education needs to be changing the teaching profession itself. As one respondent shared with us, "even with younger (teaching professionals) who are consummate technology users there is not a clear understanding of how to transfer technology into the learning environment because of their own experiences. They come to university with very traditional ideas about teaching and learning. When they go out they see very traditional models of teaching and learning which just reinforce their current thinking. (At the university) we are committed to 21st century learning and want to see this embedded in how we are training teachers." xliii But as Fullan writes, this is a complex issue that is not solved by changes in initial teacher preparation alone. Teachers may work 30 to 40 years beyond their initial preparation; transformational change will require on-going support and development in a number of areas to meet the education challenge.^{xliv}

Getting education right for the future means ensuring school systems get high quality people facilitating the learning experience and deploying a sufficient amount of the right resources in a way that optimises the experiences for students in and out of the school environment. It also requires a different approach to teaching, an on-going commitment to 'tooling teachers up' for the very special task of designing and facilitating effective, engaging learning experiences. Fullan concludes and many of our respondents agree that, "(*the teaching profession*) needs reform in recruitment, selection, status and reward, redesign of initial teacher education and induction into the profession, continuous professional development, standards and incentives for professional work, and (most important of all, perhaps) changes in the working conditions of teachers".^{Xiv} While there are many promising advances in technology as applied to personalising education, our respondents identified mobility, collaboration and cloud computing as the technologies that were on their near-term watch list

With more than five billion mobile consumers worldwide and a massive global network, we are entering an era when everyone has access to anything, anywhere, at any time

A 21st Century model of education is fueled by technology

Our respondents told us that we need an education model that at its heart improves outcomes by customising the learning experience. But how do individual teachers deliver engaging learning experiences that are tailored to individual learning styles, knowledge levels, and personal interests? While there are many promising advances in technology as applied to personalising education, our respondents identified mobility, collaboration and cloud computing as the technologies that were on their near-term watch list. Fundamental to the personalised learning process is a superior telecommunications network that enables ubiquitous communication and collaboration as well as uninterrupted access to learning services and products when and where they are needed. Add to the mix a range of mobile devices and a myriad of applications managed on a single platform and we begin to see how one core system can be a robust personalised learning environment for each of Australia's five million plus learners.

Mobility

"Compared to the evolution of the Information Age, and its all-embracing technology ecosystem disciplines, going mobile is the most dynamically complex, compelling and potentially rewarding communication environment." Michael O'Farrell, President, The Mobile Institute.^{xlvi}

According to Michael J. O'Farrell, President of The Mobile Institute, we are witnessing the birth of the "Age of Mobility".^{xlvii} With more than five billion mobile consumers worldwide and a massive global network, we are entering an era when everyone has access to anything, anywhere, at any time. Within a very short period of time, these small mobile devices with significant computing power have become a routine part of day-to-day life and an indispensable part of the work environment.

Sitting at the centre of any discussion about mobile is the user. For many people, the mobile is the device of choice, often far cheaper than desktop or laptop computers. As mobile expert Russell Buckley writes, "One of the theories many of us have been writing about for ages now is that there's a whole bunch of people who are part of Gen MO. Or people who use the mobile exclusively. To be clear, this is not about cutting the cord and getting rid of landlines, but people who only access the web via their mobile phones. They don't have PCs, in other words, and are thus the first generation that are living in our mobile future. Until this point, the existence of Gen MO has been largely speculation. But now we have actual evidence and the surprise is that there's many more Gen MO than you might reasonably expect – given the new classes of mobile devices. Tablets, as they continue to mature, will present options for those who want more flexibility and power but don't want to carry a laptop or computer. Early adoption data indicates that these mobile devices are very compelling options for users. In Japan for example, 75% of all internet users tap their mobile as their access device of choice.^{xlix}

A 2009 survey of Australian children's usage of technology showed that 31% of children ages 5 to 14 had a mobile phone According to recent research from the Pew Centre, the age at which children in developed countries receive their first mobile continues to drop. A 2009 survey of Australian children's usage of technology showed that 31% of children ages 5 to 14 had a mobile phone.¹ The bulk of teens receive their first cell phone at age 12 or 13 as they transition into middle school.¹¹ Respondents tell us and research confirms that while mobiles have entered the mainstream of popular culture, the reality is that most frequently cited reason for not leveraging mobile devices in the primary and secondary classroom is policy related.¹¹

The number of mobile applications designed for educational usage is increasing rapidly. While there are many ways in which mobiles can be applied, these devices hold particular promise in the following areas:

Enhancing learning experiences

Mobiles are very simple tools that can be easily integrated into the classroom. It's not unusual to see instructors use Twitter, Poll Anywhere, or SMS texting on mobile devices as a simple way to enhance in-class discussions or as personal quiz response tools for gauging learning. Others use iPods and iPhones to allow students immediate access to information when and where they need it in the classroom; combining inquiry with interaction and experimentation.

Mobiles are also the ideal tool to enhance field based learning experiences. In 2010, the Centre for Learning Innovation (CLI) developed a GPS location-based application that allows students to gain physical and cultural context to information and artifacts. In partnership with Telstra, CLI and groups of primary school students tested the application using smartphone technology and the Telstra Next G[®] network. Supported by teachers who used a semi-structured discovery learning model, the students explored historical locations within the Royal Botanic Gardens in Sydney, NSW. From a suite of adventures, students were able to explore historic events right where they happened, developing their ICT skills as they encountered challenges and solved problems in real time.

Finally, mobiles offer robust functionality for educational users. A faculty in the Information Technology School at Queensland University have developed a system that permits students to receive lectures via mobile phones or PDAs. Lecture notes can be downloaded for off-line use. Students can ask questions by speaking into their device where they are then linked to a community platform where fellow students or the lecturer can answer the question.^{IIII}

Flipping the classroom

Thanks to the popularity of the Kahn Academy, the flipped classroom concept has gained increased press and credibility within education. Leveraging technology, educators like Karl Fisch, Jonathan Bergmann and Aaron Sams pioneered the flip process. Instead of using class time to lecture, they recorded their lectures on video and uploaded them to YouTube for their students to watch at home. With easy access and increased control over the selected content, the learner can personalise the lecture experience, pacing the viewing and reviewing as learning needs required With easy access and increased control over the selected content, the learner can personalise the lecture experience, pacing the viewing and reviewing as learning needs required. With an increasing amount of high quality content available online, learners are able to learn from, interact with, and leverage the perspectives of multiple experts as they engage in a personal learning journey outside the classroom. Class-time, then, can be used to work on high value instructor-led activities; for example tackle complex problems, conduct hands-on collaborative work with peers, or engage in directed problem solving.^{IIV}

Reinventing the textbook

As one respondent remarked, if you have a heavy book you don't take it out of your locker or room very much. But these portable devices make it possible to access not just a book but a whole library of books. Recent advances in digital textbooks, allow students to highlight and annotate content, take notes in the margin, view videos or listen to audio, take interactive quizzes and collaborate with others. New flexible screens that bend and fold offer large screen capability even though the device is small. Students toting heavy backpacks home from school may soon be a thing of the past.

While any number of educational institutions use digital books as an alternative to the traditional print medium, South Korea is the first to declare a country-wide plan to shift to digital textbooks by 2015. Leveraging a cloud-based environment, Korean students will be able supplement traditional content with multimedia on school-supplied tablets. "The government expects that the new educational plan will help students establish their own study patterns based on individual needs by giving them access to their lessons and other educational resources." ^w

Creating flexible learning environments

As Greg Prior, NSW Deputy Director-General, shared, "(21st century) learning does not necessarily mean four walls. If we are going to wait to change asset facilities, it will take too long to transform. We need to think now about how we can get mobile into our current asset environment. A learning society is mobile."^{Ivi} Using mobile phones and PDAs, TAFE programs are able to deliver on-demand learning resources and record performance assessments directly at the workplace.^{Ivii} These flexible devices are able to move with the learner, delivering just-in-time insight at the highest points of need.

As noted in the 2010 Horizon Report and reinforced in the 2011 report, "Over time, the vast potential of these devices for learning will begin to outweigh concerns about misuse that currently dominate most conversations about their use in school settings. It is the sheer power of these devices that makes them interesting, and that power lies in their ubiquity, their portability, the wide range of things that can be done with them, and their ability to access the internet nearly anywhere through the growing cellular network." ^{[Viii}

Using mobile phones and PDAs, TAFE programs are able to deliver on-demand learning resources and record performance assessments directly at the workplace

COLLABORATIVE ENVIRONMENTS

Our ability to collaborate and the benefits we can derive have grown in extraordinary ways thanks to rapid advances in technology, most of which have appeared only within the last decade "The value placed on collaboration in the workplace is high, and professionals of all kinds are expected to work across geographic and cultural boundaries more and more frequently. Teachers increasingly recognise the importance of collaboration skills, and tap into the perspectives of people around the world with a wide range of experience and expertise that differs from their own. As a result, collaborative environments and workspaces are gaining a great deal of traction and are poised to enter mainstream use in primary and secondary education both as supplemental and as primary classroom spaces." The 2010 Horizon Report

Fundamentally, collaboration is about bringing ideas together, sharing perspectives, insights and efforts for the purposes of getting something done. Our ability to collaborate and the benefits we can derive have grown in extraordinary ways thanks to rapid advances in technology, most of which have appeared only within the last decade. The technologies that support online spaces for collaboration range from single purpose tools to comprehensive platforms. As these technologies continue to make their way from personal use into the broader work and learning environments, they offer great promise for creating significant improvements in generating, capturing and sharing knowledge; tapping into different sources of expertise; co-creating new learning experiences; and engaging key stakeholders more deeply in the educational process.

Organisations, groups or individuals approach collaboration from different starting points. Moxie Insight research has identified ten specific roles that collaboration can play in the organisation.^{1x} Each of the forms of collaboration, as outlined in Table 2, has the potential to provide significant value; the challenge is to understand which form or forms of collaboration will have the greatest impact on the specific educational need being addressed. Each of the collaborative intents leverages a different implementation design – for the technology itself, as well as for the adoption and use strategies.

Table 2: Identifying your collaborative intent

COLLABORATIVE INTENT	OUTCOMES	EDUCATION RELATED EXAMPLES	
Connecting previously unrelated ideas	Consistent and effective innovation, amplified knowledge, new capabilities	Virtual presence technologies can enable the rich exchange of tacit knowledge. An example is British scientist Andrew Lang's visualisation of data from molecules and proteins in Second Life. These visualisations have been particularly valuable as immersive learning experiences for students as well as providing valuable real-life collaborative research opportunities for chemists.	
Co-creating products, services, experiences	Relevant offerings, increased engagement	The Ning in Education or The Finnish Virtual University are examples of collaborative platforms designed to support member's use of collaboration tools in their local teaching and learning environments. ^{[kii lxiii}	
		North Carolina State University is helping students "experience" what life was like in the Antebellum South. Teachers can access The Plantation Letters Ning to access primary source documents, view pre-prepared lesson plans or contribute their own, as well as view on-going university research. Students leveraging the platform can learn how to interpret historical primary documents as well as explore the moral dimensions of history in an engaging way. ^{biv}	
		Students in the Talented and Gifted program at Pleasant Street Primary School in Victoria used Voicethread and Ning to create a collaborative environment dedicated to the study of mathematics. ^{brv}	
Engaging stakeholders	Enhanced communication, engagement, and commitment to outcomes	Challenge.Gov was designed by the U.S. General Services Administration to gather citizen ideas on solving the government's most pressing challenges, including education. ^{Ivvi}	
Tapping people, expertise, or other resources as needed	On-demand insight and capabilities, increased flexibility and speed, reduced costs	MIT's OpenCourseWare makes the university's curriculum accessible to anyone anywhere for no fee. Educators, students and self-learners can download readings, view lectures, and participate in the communitu forums. ^{bvii}	
Coordinating in time and space Individual and group productivity, increased engagement, flexible and asynchronous work arrangements		The Mining Education Partnership is a joint venture that established a common undergraduate curriculum for mining engineering students across Australia. By leveraging innovative learning delivery systems they are able to deliver industry indorsed programming globally. ^{bxviii}	
		Stand-alone schools in New South Wales who cannot offer a broad curriculum based on student interest or teacher availability; are now provisioning curriculum through learning communities. By leveraging technology and a common timetable, they are able to "open up the curriculum" giving students access to learning opportunities that they could not obtain locally. ^{bix}	
Distributing work,	Specialisation, cost reduction,	Launched in 2007, Oxford University's Galaxy Zoo is leveraging the help of citizen scientists to help astrophysicists rapidly map the millions of galaxies that have been imaged with the robotic telescope in the Sloan Digital Sky Survey. By leveraging a broader pool of expertise, research scientists have been able to rapidly advance our knowledge of how galaxies form and evolve as well as identify a new celestial body. ^{bxx}	
Sensing emerging patterns	Identification of trends, opportunities, threats		
Pooling judgment	Increased accuracy in decision making		
Coalescing around an emerging consensus, after airing and debating multiple views	Increased engagement and commitment to action		
Polling to gather input or determine group-wide preferences	Increased knowledge sharing; fast and informed decisions	Instructors often use Twitter, Poll Anywhere, or SMS texting on mobile devices as a simple way of polling during in-class discussions. ^{boi}	

It would be a mistake to assume that the most productive applications of collaboration in education will simply emerge naturally as administrators, teachers and students use available technology tools or platforms

For teachers and students alike, collaborative environments can be a powerful way to "*learn with the world rather than just about the world*" It would be a mistake to assume that the most productive applications of collaboration in education will simply emerge naturally as administrators, teachers and students use available technology tools or platforms. Successful sustainable collaborative environments need to be designed around three major factors – usability, impact and readiness. With close attention to each of these, organisations can position themselves to harness the power of collaborative environments:^{boxii}

- Usability: Collaborative efforts succeed because of the discretionary efforts of those involved. Having a compelling user experience is part of encouraging participants to voluntarily invest their time. A well designed sustainable environment for collaboration needs to be so intuitive to use that there is no learning curve; and it needs to be so flexible that more advanced users can adopt it to their specific needs.
- Impact: Attractive user interfaces help draw people into the collaborative environment, but sustained use comes from useful content, the ability to connect, and incentives that align with knowledge sharing. Ultimately, any collaborative environment needs to answer this single question, no matter who asks it: "How will this help me?" More often than not, organisations focus only on the development of their use case and forget that there needs to be a compelling experience for the individual user as well.
- Organisational readiness: While organisations approach collaboration from different starting points, one thing is true for all organisations. Collaboration is sustained not because of the technology, but because of organisational culture. Research shows that there are a number of enabling factors that support collaboration: challenging tasks, trust based relationships, highly engaged and committed participants, leader behaviour and people practices that support collaboration.^{bxiii}

In the end, the key to finding value from collaborative environments is in the connections and interactions that are enabled. Arizona State University's Mars Education Program, for example, was designed to immerse high school students in an authentic research-based science experience while providing valuable resources to scientists as they analyse a large volume of data.^{lxxiv} Students engaged with this program have an opportunity to learn how the scientific process works, make real scientific contributions, and receive STEM-related career mentoring. Organisations like the International Education and Resource Network (iLEARN) and Taking IT Global use ICT to help middle schools students collaborate with peers on a global basis to accomplish meaningful tasks, solve problems, and learn new perspectives. "What better way to learn about such difficult subjects as war, natural disasters, child soldiers, and segregated education than from other students who are involved?"^{1xxv} For teachers and students alike, collaborative environments can be a powerful way to "*learn with the world rather than* iust about the world".^{lxxvi}

CLOUD COMPUTING

"Many of us use the cloud, or cloud based applications, without even being aware of it. In schools, use of cloud computing is progressing along a path that began with the adoption of collaborative tools for administrative tasks and that leads, eventually, to classroom adoption of cloud-based tools for learning." The 2010 Horizon Report ^{bxwii}

NASA hopes that everyone will want to "be a Martian explorer." In late 2009 they launched a cloud based application that makes decades of Mars data available to citizen scientists in the hopes that they will help drive future scientific inquiry. "We really need the next generation of explorers," says Michelle Viotti, director of Mars Public Outreach. "And we're also accomplishing something important for NASA. There so much data coming back from Mars. Having a wider crowd look at the data, classify it and help understand its meaning is very important."^{Ibaviii} By leveraging cloud technology, NASA was able to collect and store a large body of scientific data and support engaging educational simulations with flexible processing capacity; all without making a large up-front technology investment. Just as with NASA, cloud computing offers education a way to scale IT resources that is flexible and financially attractive.

In its broadest sense, cloud computing refers to the ability to deliver IT resources, infrastructure and support, over the internet as opposed to the alternative of offering those services locally, on a school or district network In its broadest sense, cloud computing refers to the ability to deliver IT resources, infrastructure and support, over the internet as opposed to the alternative of offering those services locally, on a school or district network. By leveraging these surplus computing resources, users are able to use cloud-based software applications, development platforms and massive computing resources for processing and storage. Cloud services and tools are an attractive option for option for educators for a variety of reasons including:

Cost Savings

One of the biggest attractions of cloud computing is economic; many technologies that were previously expensive or unavailable are now free to anyone with a web browser. Educators and students are already leveraging these free cloud technologies in the classroom in very creative ways. Despite this trend, the need for hardware, software, and services isn't being eliminated, but it is shifting from being supported locally to the cloud. By making this shift, cloud computing saves schools the investment costs associated with hardware, software, and IT support. Working on a subscription or pay-as-you-go basis, the institution pays according to how much and how often they need services. No longer does the institution need to invest in building infrastructure, with technologies that become outdated or underutilised, or spend hours on technical support. Educational institutions can achieve great economies of scale by leveraging technology services from a central source (the cloud) that are delivered efficiently from a great distance over a network.

Flexibility

Another key feature of cloud computing is its elasticity. It allows institutions to begin small and build over time, accommodate fluctuations in demand over time, and rapidly change technology as needs change. If the institution wishes to scale up capability, there is no need to purchase additional infrastructure that could take precious financial capital and time to install. Cloud computing is particularly appropriate for research or projects that require specialised services or significant amounts of capacity and storage for short periods of time.

Cloud computing also makes one-to-one laptop programs practical. With low-cost devices and the cloud, computers become virtually interchangeable. If the device is left a home or is in need of repair, you can easily substitute another. The only applications that the user needs to keep on the device are a web browser and various security based programs.

Accessibility

From a user point of view, accessibility is another key benefit to cloud computing. Individuals using a device with internet access can work, whereever they are located, without worrying about transporting files on flash drives, document control, or having the right software to open a file. Collaborative efforts around the development and sharing of work products have become easier using various cloud-based applications like wiki's or Microsoft Office 365. The key to accessibility is making data and services publicly available without sacrificing security. Educators need to ask tough questions about issues of data integrity, recovery, privacy and regulatory compliance before committing to a specific cloud vendor.

Enhanced availability

As technology becomes an integral part of the learning experience in and out of the classroom, system availability becomes another driver in the cloud equation. Budget constrained IT departments may not be able to provide the level of service, level of functionality, or level of convenience as a cloud provider.

In education, cloud-based applications have found a natural home in institutional administration; managing calendars, rosters, grade books and communication between school and home. Universities are seeing pockets of cloud services usage, particularly in the STEM space where access to vast amounts of computational horsepower are required. There are also interesting cloud-supported collaborations between university labs and K-12 classrooms. An example is the Arizona State University Mars Education Program, which enables students to work with university scientists on the collection and analysis of data downloaded from the Compact Reconnaissance Imaging Spectrometer for Mars.^{bxix} In a similar way, Northwestern University's iLab Central provides high school and college students with access to sophisticated scientific equipment that is not available in their own facilities. While the iLab is not a substitute for hands-on experience, it does a good job at teaching modern laboratory research concepts.^{bxx} In other applications, school districts are using cloud-computing to coordinate curricula and resources within and between schools as well as service remote students more efficiently.^{Lxxxi} While cloud computing has yet to find its way into the classroom in a significant way, it looks to be a "solution that can help fill existing gaps in school technology while making the most use of already available resources". ^{lxxxii}

Cloud computing also makes one-to-one laptop programs practical. With low-cost devices and the cloud, computers become virtually interchangeable

NAVIGATING THE NEW LEARNING LANDSCAPE TOGETHER

Educators and governmental officials have repeatedly told us that Telstra plays an important role in the future of education "Partnership is at the heart of our ambitious blueprint for the way we train Australians. This agenda demands a concerted and collaborative effort from all of us and we will only succeed if government and industry works together."^{Ixxxiii} Senator the Hon Christopher Evans, Minister for Tertiary Education, Skills, Jobs and Workplace Relations

Clearly we are going into an unpredictable future and need to make changes in the way we approach the business of education. Educators and governmental officials have repeatedly told us that Telstra plays an important role in the future of education. As Tom Urry, Regional Director, pointed out, "*Telstra's role is multidimensional. Being a provider of technology is by itself important but we are looking for Telstra to be part of the educational process in general, not just a supplier. If education is about an effective community, then Telstra is part of that community*".^{boxiv} So where do we start?

- Connecting key stakeholders: Based on respondent feedback, we believe that the Telstra Education Roundtable is an environment where business, government, and educators can collaborate on common areas of interest with regard to the transformation of education in Australia. In the December 2010 Roundtable meeting, participants confirmed their interest in continuing to explore opportunities for collaboration and called upon the Telstra Enterprise and Government organisation to take the lead in convening this set of key stakeholders.
- Investing in disciplined experimentation: Educational transformation needs to start somewhere. As Leadbeater points out, it takes an "*igniting* sense of purpose to propel innovation and encourage risk taking to develop new approaches".^{boxxy} In speaking with our respondents, they spoke of the importance of setting in motion a set of "disciplined experiments" that can form the building blocks of a new model of education. Common areas of interest included:
 - Personalisation: As Lindsay Wasson, Adjunct Professor at the University
 of Western Sydney, articulated, "If we are thinking about designing
 education without personalisation at the core we are missing the main
 game".^{boxvi} A critical part of personalisation is creating alignment
 between content and assessment so that students receive tailored
 learning experiences that meet their needs and interests. Continuing
 to translate what we know about the nature of the learner and the need
 to personalise learning pathways into meaningful classroom realities is
 a priority for Education Roundtable members.

As Lindsay Wasson, Adjunct Professor at the University of Western Sydney, articulated, "If we are thinking about designing education without personalisation at the core we are missing the main game"

- Flexible content and delivery networks: Our respondents and their organisations continue to experiment with ways in which learning can be liberated and enhanced through technology solutions. As one respondent shared, "there is a role for companies like Telstra to create new cost effective delivery systems and work with other organisations to provision and host an array of digital learning objects".^{boxvvii} If schools could leverage a secure technology environment with robust modular content available on demand, they would be in a stronger position to support educators, students, and their parents at their highest points of need.
- Building capability within the profession: Multiple respondents spoke with us about the need to "convince teachers that technology is an important tool in learning". We are not very good at educating teachers how to effectively respond to the needs of the 21st century learner in a technology rich environment. It's not enough to visualise simply a strong contemporary philosophy of teaching. We need to create a robust and sustainable development environment that enables teachers to experience a different way of engaging students by leveraging new tools and techniques.

Telstra is dedicated to the transformation of learning by providing ways to inspire a new generation of learners and educators. It is for that reason that we continue to invest in important advances in technology designed to benefit educators, students, parents and their communities. As Eric Jamieson, Principal at Plumpton High School reflected, "*The beauty of working with Telstra is that they are aware of future possibilities and so they bring with them a great understanding, great expertise, and great knowledge of where we can go in the future*".^{boxwiii}

THE TELSTRA LEARNING BLUEPRINT

Telstra Education Conferencing is a range of videoconferencing solutions enabling students and teachers to interact from multiple locations We understand the power of a personalised learning pathway. Working with our strategic partners such as Cisco Systems, Microsoft, Ericsson, Accenture and Alcatel-Lucent we continue to develop the next generation networks and systems. These selected examples show how the Telstra Learning Blueprint can be leveraged to support the transformation of the learning environment:

- Connected learning: With greater coverage and faster speeds, the Telstra Next G[®] network is the largest and fastest national mobile network. Together with the Telstra Next IP [®] network, it forms Australia's largest integrated national IP network, providing an integrated foundation for transforming teaching, learning and research.
- Telstra education conferencing: Invite parents to participate in their child's learning via Webstream. Or give students access to courses not offered locally. Telstra Education Conferencing is a range of videoconferencing solutions enabling students and teachers to interact from multiple locations, perfect for virtual field trips, broadcasting classes, and interactive sessions with experts or parents. By adding collaboration tools, such as instant messaging, slideshows and polls, teachers can test for understanding and encourage debate. Or personalise learning with online whiteboards and document sharing that lets students sketch ideas, annotate text and scrawl calculations during sessions. Telstra Conferencing also enables the delivery of professional development remotely and lets educators share ideas, work with mentors, or host and attend academic events on a small budget.

Peter Ryan, Director of Catholic Education, Diocese of Sale in Victoria, explains the problem. "*The challenges that our* schools face are exactly the same as those faced by schools in other systems. There's the question of distance, there's the question of resources, and quite simply a lack of scale that enables us to deliver the product that we should be delivering to these kids in our schools." Gippsland Education is now utilising the Telstra Next G[®] network and Polycom Video Conferencing to deliver trade training to students in rural Victoria who might otherwise not be able to receive it.^{boxix}

"High speed broadband is a key enabler for good education ... and what it gives these schools is access to a real live experience in the classroom" David Thodey, CEO of Telstra Telstra Unified Communications: This technology enables educators and/or students to communicate and collaborate with integrated instant messaging, SMS, MMS, email, fax, voice and video. Telstra Unified Communications puts rich interactive tools on desktops, laptops, netbooks and mobiles; all with an intuitive interface. Telstra specialists can help you integrate additional features such as audio, video and web conferencing, with a complete low risk solution available on subscription. This includes carriage via the Telstra Next IP® network, customer premise equipment and integration.

Through the deployment of a new high speed broadband fibre network to over 1550 schools across Australia, the Catholic Network Australia has been able to foster student engagement and collaboration, enhance teaching and help Catholic education harness the power of the digital classroom. As David Thodey, CEO of Telstra, points out, "*High speed broadband is a key enabler for good education … and what it gives these schools is access to a real live experience in the classroom. It could be coming in from the Vatican; it could be coming in from NASA; it could be coming in from London, but is about the learning experience. So that's what this partnership is about and what makes it so exciting".***

- Telstra mobiles for students: Mobiles turn phones into inspiring learning tools. While on the go, students can post pictures and comments to class wikis or blogs and use instant messaging to collaborate. They can also create photos, videos, or audio recordings to express ideas and share them on the spot with Bluetooth or mobile email. Learning is simpler with schedules, assignments and room changes sent straight to students' phones. It's easier to review for a test with podcasts and vodcasts. Mobile applications can also save time by registering attendance automatically, verifying via GPS. Off-the-shelf mobile learning applications offer engaging ways to learn. And with pervasive broadband, students can research and download information across Australia.
- Telstra mobiles for teachers: Teachers, academics, and researchers can collaborate using a range of mobile devices including smartphones, tablets, netbooks, and laptops. They can exchange videos, photos, and documents as well as participate in wikis, blogs, and develop ideas on the move. Or they can use instant messaging, video conferencing, and mobile email. Applications such as Twitter let them monitor and debate trending topics. Teachers can use smartphones to take attendance, record grades and book equipment with data uploaded wirelessly to a centralised system. Schedules sent straight to their phones make them more productive.

Plumpton Education Community (PEC), uniquely, is a community of five schools that has developed a Collaboration for Learning model. PEC utilises a hosted messaging platform integrated with learning management systems to enhance the learning experience for students and improve school administration. As illustrated in this example, Telstra is in the unique position of being able to extend services beyond a single school both geographically (school-to-school within a state, nationally and internationally) and cross-sector (e.g., school-to-university, school-to-TAFE, school-to-business). ^{xci}

Telstra Integrated Messaging (TIM): TIM provides an easy way to manage class registers, schedule changes and address truancy by sending an SMS to students, teachers, or parents. It also saves time by automating routine communications, such as event or meeting notifications. You can minimise disruption by advising students instantly when timetables, venues or teachers change, or provide effective warnings in an emergency. TIM lets you differentiate communication to parents and students who can subscribe to SMS updates on relevant topics.

Telstra's service to enterprise and government customers is internationally recognised for its high quality, including full International Customer Service Standard (ICSS) certification Our solutions developed and tested in close co-operation with our strategic partners and designed and deployed by Australia's largest and most qualified Professional Network Services organisation. Telstra's service to enterprise and government customers is internationally recognised for its high quality, including full International Customer Service Standard (ICSS) certification, backed by Telstra's Customer Service Commitments and delivered by one of Australia's largest and most qualified field and technical workforces, with a culture of continuous improvement. Telstra is a financially strong and reliable partner for large enterprise and government organisations who cannot afford downtime and use ICT solutions to improve productivity and drive growth in a sustainable way.

ABOUT THIS RESEARCH

In 2010, Telstra initiated and hosted the first Education Roundtable. The purpose of this ongoing roundtable is to provide a forum for key educators, government officials, and business representatives to discuss critical issues facing education and to identify areas of fruitful collaboration. This collaboration started with an engaging conversation with Don Tapscott, author of Growing Up Digital: The Rise of the Net Generation, Grown up Digital, and Macro Wikinomics, on reinventing the institution of education. As a natural outgrowth of the forum member discussions in December 2010, the Telstra Enterprise and Education Group launched a quick hit qualitative research project to identify fruitful areas for collaborative work in the near term. As part of the research, we conducted in-depth interviews with representatives of Australia's Public, Independent & Catholic schools, TAFEs, universities, education agencies, ACARA and DEEWR and were privileged to hear some remarkable stories about the innovative work occurring in the education space. We would like to thank the following Roundtable members for engaging with us in this endeavor:

Evan Arthur Group Manager, National Schools and Youth Partnerships, DEEWR

Andrew Blair Executive Director, Wesley College Institute for Innovation in Education

Stuart Campbell Pro Vice-Chancellor,

University Western Sydney

Pam Christie Deputy Director-General, TAFE and Community Education, NSW Department of Education and Communities

Peter Crosbie Manager, Learning Technologies, Association of Independent Schools, Western Australia

John Halsey Professor of Rural Education and Communities, Flinders University, South Australia

Kevin Harris Institute Director, Northern Sydney TAFE Institute, NSW Department of Education and Communities

Eric Jamieson Principal, Plumpton High School, Plumpton

Tony Mackay Deputy Chair, ACARA; Executive Director, Centre for Strategic Education

Peter Malcolm Assistant Director ICT Infrastructure and Support Services

David O'Hagan Assistant Director-General, Information Technologies, Queensland Department of Education, Training and the Arts

Mick O'Leary Executive Director, Web and Digital Delivery, Queensland Department of Education, Training and the Arts

Greg Prior Deputy Director-General, NSW Department of Education

Andrew Street Director ICT in Learning, Northern Territory Department of Education

Tom Urry Regional Director, South Western Sydney Region, NSW Department of Education and Communities

Raju Varanasi Director NSW CLIC, NSW Department of Education and Communities

Sheree Vertigan President, Australian Secondary Principals Association

Todd Walker Pro Vice-Chancellor, Ballarat University

Lindsay Wasson Adjunct Professor, School of Education, University of Western Sydney

Greg Whitby Executive Director of Schools, Parramatta, NSW

Steve Wilson Associate Professor of Education, University of Western Sydney.

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ABOUT THE AUTHORS



Susi Steigler-Peters

Susi Steigler-Peters joined Telstra Enterprise and Government in May 2008 as the National General Manager for Education, with the goal of providing an innovative education platform that actively engages students and teachers in all facets of learning for the 21st century. She has more than 25 years' experience in education as a secondary and primary school teacher, curriculum designer, policy advisor and business and strategy developer. Her current role focuses on thought leadership, strategic engagement, industry marketing and solutions innovation.

Prior to joining Telstra, Susi fulfilled a number of roles as Chief Education Officer with the NSW Department of Education and Training, including business development. In these roles, she led a number of strategies including the mindset shift with the innovative Partnerships for Learning strategy. Her work in this new role forged partnerships with leading corporations including Cisco, Intel, Microsoft and many other technology providers.

Susi has published a number of national and international conference papers about developing sustainable learning practices. Susi serves as a Board Member of the Greater Western Sydney Education Alliance; and by invitation of the education minister, served as a member on the NSW Community Languages Schools Board.

Dr. Margaret Schweer



Dr. Margaret Schweer is Vice President of Moxie Insight, a business strategy think tank that specialises in innovation and collaboration. Moxie Insight thought leaders include Don Tapscott, renowned author of 14 books including Wikinomics, MacroWikinomics, and Grown Up Digital. Margaret provides thought leadership for Moxie Insight's Talent Program. She has more than 20 years of experience as a senior executive, researcher, educator, and professional speaker. In her role with Moxie Insight, she works internationally with organisations including educational institutions, on their talent management issues. Her doctorate is in Sociology from Purdue University.

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