

New Skills for a New Age

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The industrial revolution reshaped society in the late 18th and early 19th centuries. It was primarily caused by the development of steam powered machinery and mass production methods. It influenced the way people went about their daily lives, their jobs, social structures, transport and of course education.

People needed new skills to work in factories and fuel the revolution. Changes in attitudes were needed – people could no longer be tied to the land and in one place; they needed to move to cities. They needed to be literate and to turn up to work at prescribed times and follow rules and routines. The response to this was a ‘factory model’ for education, where students were trained to follow rules and routines, to move around at prescribed times and to be literate and numerate. The school curriculum was changed from its previous focus on the classics, such as Latin, Greek, grammar, theology and religion to a curriculum more closely resembling that in schools today with an emphasis on science, maths and English. This was seen as essential knowledge for the progress of society in the ‘new world’.

In recent times there has been a digital revolution caused by the ability to represent data and information digitally and enabling it to be stored, transmitted and manipulated by computers. This has fundamentally changed the way we live and work. The past 30 years has seen incredible change; a short trip down memory lane, to the not too distant past, should reinforce this. In my latter years of schooling, I was fortunate enough to attend a school which was one of the first to offer Computing as a subject. We bravely and excitedly explored the new frontier with a PDP8 computer¹, and were greatly excited at doing such things as getting it to add two numbers together. It seems almost incomprehensible that in such a short time I can sit today with a handheld device that can access almost the entire knowledge of the world. Our data and programs at that time were stored on cards or paper tape, laboriously marked by hand or with a tape machine. Now I carry a thumb drive that carries many billions of times that amount of data. The few supercomputers in the world at that time were not even close to being as powerful as the computer I, and millions of others, have on my desktop today. Information resided in encyclopaedias which, as a student, we believed contained the extent of human knowledge. How exciting it was in recent years when Microsoft Encarta and other encyclopaedias appeared on CD! Information could be accessed so much more easily, and we were amazed at the twenty or so video clips the first CDs contained. Even more recently Wikipedia and Google have taken the world by storm, rendering both book and CD encyclopaedias relics from the past.

Our maths and science calculations at school were completed with slide rules and log tables, while today we carry more calculating power around on keyring calculators. Research had to be conducted amidst the long, dark and dusty shelves of the reference library, a stark contrast to today where I can search worldwide databases of research papers through online university libraries or Google Scholar. Once research was completed, it had to be laboriously typed up on a typewriter. How did we ever manage to construct an essay without the ability to drag text around to restructure our paragraphs?

¹ The PDP-8 was the first successful commercial minicomputer, produced by Digital Equipment Corporation.

Movies were watched on reel-to-reel film, something revolutionised by video tapes, while today kids carry around personal DVD players and pocket sized MP4 players. Correspondence with penpals on the other side of the world was a slow, laborious process, with weeks or often months between letters. Email has revolutionised this, but even that is now outdated apart from use in the workplace. Instant messaging has become the dominant communication tool, where you can chat with text, or even video and voice, with people from around the world. The telephone has progressed from being an infrequently used communication tool, fixed in a place of honour on a special 'telephone table', to a multifunctional mobile device that is a permanent attachment to most teenagers' bodies! This device frequently also contains a person's entire music library, replacing CDs or the stacks of vinyl records lovingly collected and treasured over many years. Choosing which book to take with you on a trip is no longer a problem as entire libraries can be transported easily in your pocket with an ebook reader.

We now use Google maps, or better still a satellite navigation device to find our way in our cars, but if we do manage to get ourselves lost somewhere in the world it is not computers that will find us, but human searchers, possibly from all around the world, coordinated by computers and using satellite imaging to conduct searches for us. We use swipe cards instead of keys to get into our offices; our banking is conducted at automatic teller machines or online rather than queuing to get cash from a banker behind a grill. Cash itself is disappearing rapidly as we use various digital forms of currency, even extending to the school canteen where children have cards indicating how much they can spend and on what types of items. No longer do you have to queue at the supermarket. In what is almost a reversion to old times, after placing an order online, you can have your groceries and vegetables delivered to your door by a person who knows you as a regular customer. What's more, the online ordering system remembers what you regularly buy, and can remind you of things you may have forgotten. Similarly, the online taxation system remembers all your data from the previous year and can access information from social security and your bank to save you the trouble of looking for all your paperwork and filling in a paper-based tax form.

Children's teddy bears that growled when they were squeezed have become walking, talking, demanding pets; 'cops and robbers' has become online computer games. Handwritten, secret diaries have given way to blogging for the entire world to read. Online bookstores track your purchases and suggest other books you may be interested in reading, and replacing that rare item that your puppy has destroyed becomes simply a matter of logging onto Ebay. You can sit back and relax with your child as your robotic vacuum cleaner goes quietly about the process of cleaning your house for you. Google recipes will solve the problem of what to cook for dinner tonight with the remaining three ingredients in your refrigerator. But make sure you have a good command of technology, because controlling your entertainment system, along with all the other electronic devices in your life, is no longer a matter of pressing a button or clicking a channel dial. You need to be able to understand and navigate complex menu systems giving a plethora of possibilities to enhance or manage your life in other ways.

The emergence of the personal computer and high speed fibre optic cabling around the world has lead to what Thomas Friedman describes as the 'flat earth'². Competitive playing fields between industrial and emerging market countries, such as China and India, have been flattened. Large amounts of work can now be done from anywhere in the world, call centres being an all-too-familiar example of this. So the labour market has effectively been joined by 3 billion more potential

² Friedman, T. (2006), *The World is Flat*. Penguin Books

workers, prepared to work for extremely low wages. In addition to the market getting a massive injection of workers, at the same time we are also seeing more and more work that can be done by machines, leaving less and less jobs for lower-skilled workers. According to the US Bureau of Labor figures, jobs requiring science, engineering and computer science degrees are growing at five times the rate of other jobs, while at the same time in Western countries the number of graduates in these areas is declining. Significantly though, these areas represent 60% of Chinese bachelor degrees, twice the number of those in the US. The most recent Trends in International Maths and Science Study results for grade eight show the top five countries in international maths scores to be Singapore, Hong Kong, South Korea, China and Japan. This is not by accident, but rather from a massive commitment and valuing of mathematics education, both on an individual level and at government level. From where will companies source their highly skilled technology employees in the future?

Population demographics are changing rapidly, and we are seeing an increasing urbanisation of the world population. United Nations data shows that for the first time in history, more than half the population of the world (3.3 billion people) is living in urban areas. Where urbanisation is occurring is also significant. In the near future the largest cities in the world will not be Tokyo or New York, but places like Lagos and Dakar, as more people surrounding these areas move to cities to join the digital workforce.

Some of the changes which have occurred have made life easier for us, some have made life more complicated, and many may feel that our quality of life has been reduced; this may or may not be the case. But what is certain is that the ability to represent so many aspects of life as ones and zeros has had, and continues to have, a profound impact on the way we live and work and interact socially with other humans. The explosive expansion of speed, power, capability and connectivity of digital devices, coupled with continual downward pressure on prices, is driving the changes at an ever-increasing rate. What will life be like in another thirty years? What will there be left for people to do? It is without doubt a revolution, possibly the largest in human history and we are living through it. Business and industry have embraced the changes. If they did not, they would not survive. Education must also embrace the changes, or risk becoming irrelevant in the digital world.

The terms 'digital natives' and 'digital immigrants', often attributed to Marc Prensky³, are used to explain why it appears young people born into this time seem to be able to adapt and adopt technology much more easily than those of us who represent the baby boomer generation. This is often used as an excuse by teachers not to struggle to adopt technologies in the classroom. There is an underlying assumption that the 'kids already know it all' and can easily adapt to any new changes. As technology becomes increasingly ubiquitous it is apparent that just being young does not automatically ensure that you can use it effectively and to its fullest extent. Many older people are more than capable of using technology extremely effectively, while many young people's use is restricted to low level, superficial activities. Age becomes irrelevant as many people are actively involved in digital communities where they operate on an equal footing, not as natives and immigrants. To use computers as the powerful tool they are, just as with all learning, a person needs the cultural capital and connections to a digitally enlightened community to continue to develop beyond superficial use. While many young people have access to the hardware, they lack the cultural capital to be able to use it to enhance their lives, instead being reduced to using it as little more than a telephone or the trivial use evident on many sites such as MySpace or YouTube.

³ Prensky, M. (2006), Don't Bother Me Mom – I'm Learning. Paragon House.

At the same time, many others, and they are not just young 'digital natives', are actively involved in supportive communities. These may be families, friends or online groups who encourage each other to use technology to the fullest extent possible to create, learn, connect and explore.

Despite the dramatic changes in the business world, where we see companies like Ebay and Amazon totally revolutionising the way we buy and sell things, and the impact on people's personal lives, schools have remained largely unchanged apart from superficial tinkering at the edges. Schools still very much reflect the industrial age where students come in at a certain age and progress as a group year by year through the system. Secondary schools have systems of bells or sirens, again reflective of the industrial age, where, at allotted times, students stop learning one subject and move to another place where a teacher directs what they will 'learn' for the next hour or so of the day. There is little flexibility provided for the student who may become so captivated by their learning that they want to continue beyond the time the bell goes. This, however, is such a rare problem that it is not really an issue! Usually students aim to get away with learning as little as possible and rush to escape the classroom at the earliest possible moment. As the world of school becomes increasingly disparate from the digital world in which students live outside of school, many young people are becoming increasingly disengaged from school. There is little evidence of students wanting to learn about something from genuine interest or enthusiasm for a subject – they want to learn whatever it is that they have to learn to get good marks at the end, no more, no less. They are learning to play the 'education game', but learning little else of value.

We hear of widespread community concern about educational standards dropping as more and more is crammed into the school curriculum and students become increasingly disengaged. To counter this, we see increased calls for standardised testing from governments to somehow guarantee that all students will reach a certain minimum standard. But a minimum standard of what? Testing can only cover a very limited range of learning. It is very difficult to test and measure such things as innovation and creativity, widely recognised as demands of the 21st century, but very simple to test knowledge of facts. As teachers are increasingly called to be accountable for their students' success or otherwise, there is increasing pressure to 'teach to the test', as all teachers want their students to be successful. But how worthwhile is it teaching and testing for knowledge that can be easily obtained from a five minute search of Google?

What is it that the 21st century student wants? Constant communication and connectivity is top of the list for many. Most could not exist without being attached to their mobile phone and instant messaging. Yet while we talk about collaboration being a strong focus for 21st century education, we ban or restrict use of communication devices or social networking tools at school. Kids want to customise and control every aspect of their lives. Yet at school we lock down computer systems so students cannot customise them for their own look and feel. They want self direction, so we tell them what to do, how to do it and when to do it. There is strong evidence that teenagers need different sleep routines to adults, yet we insist on linking school hours to times that suit bus schedules rather than the best times for learning. Some people may think better in the morning and others in the evening, but we insist that all students in a class study mathematics at the same allocated time. Self expression and thinking for yourself is something we have promoted and encouraged in the modern generation of young people, but when they do express themselves we frequently disapprove and label it as 'inappropriate'.

Much of this is apparent in the dramatic growth of blogs over the last few years. People want to have an online identity to express themselves digitally. Blogs provide a venue for this, but equally can be used as a valuable learning tool for collaborative learning and problem solving. But once again, in many schools they are blocked. Online video sharing sites are an invaluable resource, but

because some of their content may be unpleasant or offensive, we ban them from use in schools. There are books that contain unpleasant or offensive content, but we do not ban books from schools. Schools have a vital role in educating young people about how to access worthwhile learning from these sites, and how to protect themselves from other, less desirable content. Instead we build high walls and barriers to protect children for the six hours a day that they are at school, while leaving them to explore this content unsupported and alone, behind closed bedroom doors.

Social networking has exploded as an online phenomenon in recent years. Even politicians have recognised the need to embrace this and use it to enhance their connections to their constituents, but schools once again usually choose to lock it out. As schools increasingly isolate themselves from the digital world by creating more and more filters and blocks to the things that young people interact with in their everyday lives, they become more and more disconnected and irrelevant to young people. Many students are doing more learning outside of school than inside of school. If you know how to access it, you can find most of what you want to know about almost anything online. The skill is in knowing how to use search tools effectively. People working in the IT industry have used online communities for learning for decades. Because information and knowledge is changing so rapidly, printed texts in the IT area are almost worthless, and people turn to each other and online resources to learn. In recent years these learning communities have extended to other areas beyond IT and now there are online university courses and other courses and resources for almost everything imaginable. This has meant that students who are interested in learning about anything at all can now do it whenever and wherever they want, without having to rely on it to be offered as a course or by a teacher at school. A good example of this is Cat, a 16 year old girl, who says:

'I can have a conversation with a person with a PhD in whatever I want. If you try and do that in real life they don't take a 16 year old girl seriously, but when it's just text based or voice based they don't really care how old you are, what you look like, what colour your skin is. It's just about you, your ideas and how you can get them across to them in a way they can discuss with you.

I discuss philosophy on a regular basis, whereas at school we've just started meeting once a month to have philosophical conversations for half an hour. I need more mental stimulation than that really.'

What an indictment that is on our education system that an obviously intelligent 16 year old has to get her mental stimulation from outside of school!

Video games are another dominant aspect of youth culture largely ignored by schools. When thinking of computer games, many older people are unaware that games have progressed beyond the trivial games of the 1980s, such as Pong, Tetris and Solitaire. Serious games today are complex and challenging, requiring thinking and learning, are often frustrating, and many take up to 100 hours, or perhaps even more, to master. They are immersive virtual worlds which require collaboration with others and involve developing values, insights and new knowledge. Surrounding video games there are external environments involving communities of practice, buying and selling of game items, blogs and developer communities. But how is it that game designers can get people to pay money to do something so difficult? If only students at school were as willing to put in long hours to work at challenging tasks! The secret is that good video games are complex learning systems with good learning principles built into them, enabling the player to experience just the right balance of challenge and reward to keep them wanting to come back for more. If a game has poor learning

principles, then players do not learn how to play it, and they lose interest and it doesn't sell⁴. So over time video games have increasingly embedded better and better learning principles to reach the massive sales figures they have today.

Just as the generation before them did for television, parents are often quick to condemn games. They see inactive, young people engaged in seemingly mindless activity for hours at a time. What is it about games that is attractive to young people? Games are powerful, immersive virtual worlds where the player is learning to manipulate electronic information. The player is the hero and centre of attention. They have total control, unlike television which is passive and seen as boring by many gamers. Unlike the real world, the game world is comparatively simple and predictable. This can provide welcome relief to many young people trying to negotiate and understand the complexities of the real world. Game worlds transcend age, race and culture. Players from all around the world are often collaborating or competing in a unifying and empowering experience. Online guilds can provide the opportunity for anyone to experience leading and managing a group of 200 or more people, young and old, students, workers and professionals, from all over the world, as they experience the virtual world together.

Different styles of games provide different learning experiences. Real time strategy games teach about planning, timing and strategy, how to think about and manage multiple things at once. First person shooters teach split second thinking, teamwork, and how to identify and concentrate on the most important aspects of a situation. Allowing yourself to be distracted by the pretty graphics of a level will result in a quick death! Role playing games are primarily problem solving games requiring lateral thinking, planning and tactics. They help the player to explore different aspects of their personality, and how to persist to solve a problem.

The business world has recognised the value of games as learning systems and their use in corporate training is becoming increasingly widespread. For example the Beth Israel Hospital in New York has recognised that surgeons who play video games make less mistakes and operate faster. They have even established a games room where surgeons can 'warm up' for 30 mins before going to theatre. There are games to teach emergency workers how to make the best decisions in critical incidents, games to teach workers how to use complicated software to do their job, games to teach auditors boring material about derivatives in an engaging and interesting way, games to teach teamwork, interaction with clients, communication and collaboration skills. While there are a small number of games that do similar things for school education, their use is not at all widespread yet.

Schools are still largely operating under an industrial age model, where the teacher is clinging on to trying to be the expert and controller of access to knowledge and information. Social networks and other forms of communication and access to much of the knowledge of the internet is strictly controlled, or blocked completely. Learning is seen as an activity largely restricted to the hours of 9 am to 3 pm for 9 months of the year, with the exception of often pointless homework tasks. Many students see the sort of learning going on in the classroom as irrelevant to their future, but have recognised that they can learn what they want, when they want and how they want on their own terms using technology, and they are busy doing more learning outside of the classroom than inside it. This informal learning goes on largely unrecognised and unsupported by schools.

⁴ Gee, J.P. 2004, What Video Games have to Teach Us About Learning and Literacy. Palgrave McMillan

But what skills will be needed in the future?

Learning How to Learn:

The time span from when knowledge is gained to when it is obsolete is rapidly decreasing. The amount of knowledge in the world is supposedly doubling every 18 months. Whether this is accurate or not, it is clear that most knowledge learned by students today will be obsolete in the near future. So it is not what is learned that becomes important, but learning *how to learn* to prepare students to become the lifelong learners they will need to be for survival. Closely coupled to this is learning how to ask the right questions and to develop a passion and curiosity for learning. Without enthusiasm and questioning, learning of any substance is unlikely to occur.

Innovation and Creativity:

As more and more jobs are done by machines, and as the labour market is swamped with billions of workers from all around the world, the successful people will be those who have something unique or different to offer.

Communication Skills, Teamwork and Collaboration:

People need to be able to work in a team with others from all around the world, overcome cultural differences and to communicate effectively with a diverse range of people. It seems strange that in schools we currently actively block technologies that support and encourage this sort of experience.

Critical Thinking and Problem Solving:

People will need to be able to think and problem solve in many different ways and in many different situations in a rapidly changing world.

Technological Literacy:

People who are unable to understand and control technology to make it do what they want it to do will be unlikely to be successful in the digital world. It will be no use having innovative or creative ideas if you do not understand how they can be implemented, or whether it is realistic to implement them. Not everybody has to be a computer programmer, but everybody should be able to think in ways that provide them with an understanding of the way technology impacts our lives and how it can be made to do whatever it is we want it to do. As time goes on, more and more information is disseminated in multimedia form rather than in printed form. There are a range of devices available that can convert print to spoken language meaning the ability to decode text is not as vital as it was only a few years ago. It is becoming easier and easier for a person who is print illiterate to function in the world, provided that they are technologically literate and able to operate devices to help them overcome their print handicap. Even leisure reading can be accessed with tiny portable audio books increasingly available.

Interestingly these are all things that can be learned by playing video games. Just like television or books though, it is vital to know the difference between good games and bad games and how to leverage the good ones for learning, entertainment or relaxation.

All is not lost in education – there are some glimmers of hope. The One Laptop per Child Program aims to give a device to 2 billion children in developing countries to connect to each other and the

world and 'provide opportunities to explore, experiment and express themselves'⁵. They are designed to help children learn how to learn, and for children to control the machine, not the machine to control the child. The possibilities for 2 billion kids with a hunger for learning joining the technological world are almost unimaginable!

There are a number of other environments that are starting to filter into schools to help support innovation, creativity, learning how to learn, collaboration, problem solving and technological literacy. Some examples of these include:

Scratch: an environment designed to support students to create interactive stories, animations, games, music and art, while learning to control technology, problem solve, and design, create and collaborate with others. The software is free and works on most computer platforms.

PicoCricket: a playful environment designed to blend artistic creativity with technological literacy and problem solving. Students can create musical sculptures, interactive jewellery, dancing creatures or anything else, only limited by imagination.

Game Maker: There are a number of game-making environments aimed at supporting students to design and create their own computer games. Leading these is Game Maker, for the Windows environment. Creating computer games is a powerful and engaging learning experience, with strong connections to mathematics, science and literacy, as well as being valuable in the development technological literacy and problem solving skills.

Squeak Etoys: This is a media authoring tool enabling children to create and share their products with others. Like Game Maker it has powerful connections to mathematics and science, where the idea is not to teach classroom mathematics, but to teach students to think like a mathematician.

All of these environments⁶ help students to think creatively, communicate clearly, analyse systematically, use and control technologies fluently, collaborate effectively, design iteratively and learn continuously. Surely this is what we want of our 21st century students?

Prior to the digital age knowledge resided in text books and was controlled and handed out by the teacher. If a student wanted to know something, they were largely reliant upon their teacher. That has now changed. Students today know that if they want to know something, they go to Wikipedia or Google. They recognise that teachers only have very limited knowledge about a small range of things, and that these are not often the things that the student actually wants to know about. As such a pedagogical approach, where the teacher decides what the learner needs to know and how the knowledge and skills need to be taught, is no longer appropriate. Perhaps the principles and practice of heutagogy, self directed learning, may be more appropriate for the 21st century, where the control of learning can shift more towards the learner and reignite the flames of interest, curiosity, questioning, creativity and innovation in learners.

When questioned as to what courses students should take to best prepare for the digital world, Tom Friedman suggested finding out who were their friends' favourite teachers, and take their courses, no matter what the subject. He went on to say, 'I don't remember what my favourite teachers taught me, but I remember being excited about learning it. It's not the facts they imparted,

⁵ OLPC Program <http://laptop.org> Accessed Oct 7, 2007

⁶ Further examples are available at <http://www.mindtools.tased.edu.au>

but the excitement about learning they inspired.’⁷ In this lies the simple truth that to really learn how to learn, you have to truly enjoy learning.

The digital age has provided us with tools to enable students to become active participants in their own learning, unrestricted by time, place or age. They can learn how to learn, be creative, flexible and adaptable in a range of both novel and familiar situations, collaborate with others, and work with and controlling technology to achieve their goals. Schools should be promoting and encouraging this, but at the very least must not be hindering it.

In 1994 Jay Lemke, Professor in the School of Education at the University of Michigan, suggested a model which has potential for 21st Century learning with three independent, but loosely integrated components.⁸

1. Individual multimedia workstations with access to global resources, learning assistants (both human and machine) and networked communication groups for interaction and collaboration
2. Learning centres, where face to face interactions can occur, with specialist teachers and consultants, and where skills requiring specialised materials or equipment can be learned.
3. Visits and placements in real world settings to participate in a range of economic, artistic, technical and recreational activities with other young people and with adults.

The emergence of social networking tools, together with the explosion in power and connectivity for digital devices in the last 13 years since its writing, makes Professor Lemke’s vision a realistic possibility. Indeed, the Knowsley District in London is closing all of its eleven existing secondary schools, and reopening them as seven state-of-the-art, around-the-clock learning centres, based on similar ideas.

Just as Ebay and Amazon have taken an innovative approach to retailing, the challenge for schools is to reinvent themselves to remain relevant and valued by all members of the community throughout the coming decades. It is not only new skills that we need for the new age, it’s new schools that we need.

⁷ Friedman, T. L. (2006), ‘The World is Flat’, Penguin Books

⁸ Lemke, J. L. (1994), ‘The Coming Paradigm Wars in Education: Curriculum vs Information Access’, <http://www-personal.umich.edu/~jaylemke/papers/cfppaper.htm>, accessed Oct 7, 2007