New Schools for a New Millennium

by Ian Jukes & Ted McCain

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Synopsis

By now, most people have realized that the world is no longer the stable and predictable place that it once was. But why is it moving so fast? There are many that say that the changes in the next 5 to 10 years will absolutely dwarf those of the last 50 years. What impact will this changing world have on education? What will schools look like? What skills will be valued? And how can educators plan effective curriculum in an environment of accelerating change?

By taking a time machine 12 years into the future, this presentation explores the shift in curriculum and thinking that will be necessary to equip learners for success in the 21st century, and identifies what this signifies for education and educators. How can schools prepare students for this world? Perhaps by focusing less on content and technology, and more on critical thinking, problem solving, decision making and the new mindsets needed for the new millennium. Participants should come prepared to have many of their present assumptions about education challenged. Counseling will be provided.

Change is subtle—change is sneaky—change is pervasive. We are now moving from stability as the norm to change as the constant. In times of relentless change, it is time for educators to stop investing in the status quo and to provide a new vision for education—a vision that is not about technology, but about people and mindsets

School Is Like A Train

School is like a train that is being asked to go faster, to be more efficient and to tug along more cars. Despite all the rhetoric about how schools are failing, many of the traditional tools we use to measure the success of schools—graduation rates, SAT scores, participation in AP courses—are telling us that our schools are doing many things well, despite the many expectations and demands placed upon us. And despite the fact each generation looks at the next generation and has their doubts, our children are the best-educated generation of children in history.

At the same time that they are the best-educated generation, they are also the least prepared for what's about to happen. And this is hard for us in education to understand, because that is where we have spent our entire lives. We come from what Bill Spady (*Paradigm Lost*, 1997)—describes as the 'educentric' point of view. We're living in our own world and it is hard to see beyond the end of our noses. My observation from extensive travelling is that education is largely disconnected from the rest of the world. It is a world that has radically changed during the last 15 years, a dramatically different world than the one we experienced growing up.

The World Has Changed

Let's consider for a moment the people who retired from a company 5 to 10 years ago. Let's go back to the office they worked in—what's changed? In a word, everything. Now go back to the school they graduated from 40 or 50 years ago. What's really changed? The answer is…very little. This begs a question. How can it be that our businesses have changed (had to change) again and again over the course of just the past few years, while for many educational institutions, they are pretty much structurally locked in the same old, same old?

Outside of education, it is a completely different world. Technology has fundamentally and irrevocably changed our lives. It is not just about change today, status quo tomorrow, it is about change today, change tomorrow, change forever. New technologies are embedded into every aspect of our lives and only time you really understand how pervasive this has become is when the power goes out or the batteries die. At the same time, new technologies have compressed time and distance to the point where time and distance have never meant less than they do today. We see the bombing of Kosovo or the raid on Elian Gonzalez's Miami home in real time. We see history as it happens and world events as mini-series. Today, we live in a smart embedded environment. So I ask again, has the world changed?

What Has Been Education's Response To These Dramatic Changes?

We have improved the train and made it more efficient by adding a bunch of new cars and engines (technology). The problem is these changes are not perceived as essential, they are just seen as add-ons. This is because education has an amazing stability and an incredible resistance to change. By continuing to add cars to the train we fail to recognize that irrelevance has become the issue. In continuing to take a PhD approach (piling things higher and deeper) we have absolutely missed the point, because in education the issue is not efficiency, it is relevance.

Why? Because in the 1970s as more electronics devices entered into our lives, much of the rest of the world switched to different railway track. It was a track that started to diverge from the one that education was on. And outside of education, they also switched to entirely new vehicles. In the 1980s, with continued increase in technological power, the rest of the world switched to airplanes. We in education missed that one too, and continued down the same old track. And now here we are in the early part of the new millennium, and much of the rest of the world is in a rocket, and we still haven't grasped the significance of this.

So What's Fueling the Rocket?

Trend Number 1: Moore's Law

Gordon Moore was the co-founder & chief research scientist of Intel Corporation, the leading manufacturer of microchips for computers in the world today. In 1964, four years before he founded Intel, he wrote an article in Electronics magazine, in which he proposed Moore's Law. The Moore's Law suggested that the processing power & speed of any electronic calculating device doubled every 18 months, while at the same time that the price for that technology declined by about 50% a year relative to the power. In other words, every 18 months we had technology that was twice as powerful at half the price. This is exponential (as opposed to linear) growth. So far, Moore's prediction has been uncannily accurate, but it's very hard to grasp the significance of Moore's Law because the mind simply can't keep up. Let's take a look at how Moore's Law has impacted on the power of technologies. Take a close look at the table, below, first developed by David Thornburg:

Twice the power for half the price every 18 months

Year	1979	1984	2005	2017
RAM	16k	128k	256mb	104,032 mb
Hard drive	128k	400k	60gb	12,191 gb
Speed	2mhz	10mhz	1600 mhz	650,199 mhz
Cost	$5000	$3900	$900	$9

Here's the Connection

In a recent interview (Wired magazine, March 2005) Moore indicated that he sees no reason why this exponential doubling won't continue for at least another 10 to 20 years.

At that point, he believes it will be superceded by nanotechnology, 3 dimensional chip designs, & DNA & biologically based computing that will increase speeds by a factor of many millions. In fact, recent announcements by IBM & Hewlett Packard in molecular electronics lead many to believe that this doubling will continue for at least another 50 years. Beyond this, because of these developments, it's estimated that this exponential doubling is now happening every twelve months & that with developments in nanotechnology that within a few years, technology will be doubling in power every 6 months.

Twice the power for half the price every 12 months

Year	1979	1984	2005	2017
RAM	16k	128k	256mb	1,048,576 mb
Hard drive	128k	400k	60gb	245,760 gb
Speed	2mhz	10mhz	1600 mhz	13,107,000 mhz
Cost	$5000	$3900	$900	$3

Hyperdrive

Despite the fact that we now see that some of these devices have some power, we are simply not prepared for what's about to unfold. We are now going faster than human beings can endure. The pace of business & society can no longer keep up with the physics of chip technology

By 2007 there will be a billion transistors on a single chip. By 2015 the power of an off-the-shelf computer will exceed the intelligence of that of a human being. By 2030 children will carry in their backpacks devices containing the sum total of all human intelligence. Is there a point where we have to draw the line & focus less on the power & potential of the technology & more on using the technology that we have?

What Does Moore's Law Mean?

For the graduating class of the year 2017 and beyond, what kind of world will they graduate into? Will it be the same as our world, or something completely different? When you extrapolate the growth in technological power over the course of the next 10 years, you can only come to one conclusion. It will have a staggering impact on every aspect of our lives—the way we work, the way we play and certainly on the way we learn. This is hard for us to imagine because of our

educentrism. We in education have little context for the kind of rapid change that is happening, especially outside education. We all know something big is happening and we can't ignore it. The problem is that we want a new result but continue to act in same way. The bottom line is we can't just tinker with the system. We need fundamental changes to our existing systems. Meanwhile, the clock is ticking down and 'last minutism' just will not work

How Can We Deal With This Fast Paced Change?

How can you anticipate the necessary changes? You need to live life like a quarterback—anticipating the future and throwing the ball to where the receiver is going to be, not to where the receiver is right now. To do this, you must use your intuition. We're not talking ESP or the use of a crystal ball. We're talking about using a reasoned extrapolation based on the trends as they are happening today. Why? Because in education, just like football, we are working with a moving target. It is not enough to focus on the here and now, we need to consider years out into the future. We need to look at education through the lens of emerging technologies. Where will learning be in 13 years when the children who entered Kindergarten this year graduate from school?

As that well-known American philosopher Yogi Berra once, said, "If you don't know where you're going, you'll probably end up somewhere else." The key to successful change is successfully anticipating where we are going. Without an effort to anticipate the future, much effort may be wasted in heading in the wrong direction.

How do we do this in light of the rapidly changing modern world? To begin, there is a basic rule to follow. We should never limit our focus by only looking at what's 'hot' today. We cannot base our decisions only on what exists now. As we have discussed, what exists today can only be fully understood when seen as part of a continuum that stretches into the future. For example, if you just look at the latest electronic devices and make decisions based just on what you see, you may be very surprised at what happens in the very near future.

Consider that a new electronic product in Japan today has a shelf life of about 90 days before a new and improved product supersedes it. The world of technology is changing so quickly that many companies have adopted the corporate motto, "Today let's put ourselves out of business, because if we don't, someone else will!" The only

way to adequately plan for the future is to look at the big picture that started in the past and moves through the present and into the future.

So we must look at education the same way that a quarterback looks down the football field. We must perceive where things are headed so we can respond appropriately. This will require us to apply all that we have discussed here, and we must accept that we need a paradigm for how we expect life to unfold. We must accept that in times of radical change, we all suffer from some degree of paradigm paralysis. We must accept that change requires us to let go of ideas and ways of doing things that we hold dear. Keep this in mind as we list the key aspects of what education will look like in the future:

1. Education Will Not Be Confined To A Single Place

For the last 150 years students have gone to school. However, this is not the way it will always be. This may come as a shock to many of our colleagues who have spent most of their career teaching in a classroom. The development of a global digital network of fiber optic cable and wireless communications using satellites and cellular telephones will fundamentally revolutionize the concept of travel. Literally anyone will be able to access computer networks from anywhere using personal, pocket, wireless, tiny-tech communication devices. We are already beginning to see this today.

But why will this have such a dramatic effect on where students learn? First, because all forms of information and communication are being converted to a digital format. TV signals, telephone communications, fax signals and radio transmissions are all going digital. Second, worldwide networks are rapidly blanketing the globe. There are at least 4 projects currently being developed to place satellite systems in a global grid around the world to provide voice and data access anywhere on earth. Third, computers and cellular telephones are being miniaturized. We already have palmtop computers and cellular telephones that fold up and fit comfortably in a pocket.

This is just the beginning. AT & T has patents for cellular telephones that will fit in a finger ring, a watch, the rims of glasses, a tooth, cuff links or an earring. The company even has a patent for a nasal implant cell phone. Video and digital cameras have been reduced to the size of a pea and will continue to shrink in size. Computers will also continue to shrink from the current palmtop size down to unimaginably small dimensions, limited only by the size of our fingers and our

imagination. Put all of these developments together and you can see that the Dick Tracy wristwatch communicator is just around the corner. However the real one will add super-computing power and a worldwide network linked to the 2-way interactive video we have always marveled at in the comics. The impact of the widespread use of this kind of device simply cannot be ignored.

Due to the emergence of these new technologies, learning will not need to be confined to a single place or single source. Students will be able to remain in contact with their teacher and classmates while on vacation, while traveling with a parent on a business trip, or while their parents are working at some remote location. Learning will happen at home, on the job, or in the community. When learners can use the powerful personal communicators available in the next few years, learning will be able to occur wherever the learner is, at any particular moment.

2. Education Will Not Be Confined To A Specific Time

Personal computer communication devices will also break the time barrier for learning. School will no longer be over when the bell rings at the end of a period or end of the school day. The school day and school year will no longer be predicated on the 5 1/2 hour day, 180 days a year, that is a remnant of a time when children were needed in the fields during the summer to help harvest the crops. Using the new technologies, students will be able to access learning materials 24 hours a day, 365 days a year. This will have a major impact on learning because then it will be able to be driven primarily by need and interest.

Occupational futurists tell us that our children can anticipate that in their life times, they will have 10 to 14 distinct careers—not 10 to 14 jobs working for the same company, but 10 to 14 careers. How many of us had parents that worked for the same company or in the same business for 20 or more years? Increasingly the message that we get from business is that if you want loyalty, you better buy a dog, because you are not going to get it from the employer or the employee. This remarkable prediction is borne out by 1998 US Department of Labor statistics. They report that 1 out of 2 workers today has been working for the current company for less than 1 year, and that 2 out of 3 have been working for the same company for less than 5 years. In addition the Secretary of Education, Richard Riley, was recently quoted as saying the top 10 jobs that will be available in the year 2010 do not exist today. And these are jobs that will require workers to use

technology that has not been invented yet, to solve problems that that do not exist yet.

We are entering an era that will increasingly demand 'just-in-time learning.' This contrasts dramatically with the 'just-in-case' model currently used in most schools: just-in-case it is on the test, just-in-case we might need to use it on the job, just-in-case it might be important. This is because the amount of new information being created grows almost as quickly as the new technologies. By the time children now in Kindergarten graduate from Grade 12, information will have doubled seven times, and technological power will have doubled nearly nine times. It is clear that students will still need to learn things, but there will be much less emphasis on the amount of material memorized and much more emphasis on making connections, thinking through issues, and solving problems.

A person attending university today will find that half of what they learn in any given year will be obsolete by the end of that year. For this reason, learning on a need-to-know basis will become a crucial factor in providing relevant education.

This learning on a need-to-know basis or just-in-time learning parallels what has gone on in business since the early 1980s. There has been a shift in the manufacturing of products to something called 'just-in-time delivery.' This means that companies no longer stockpile huge warehouses full of product in the hope someone may place an order, but only buy raw materials and make the product after a customer has placed an order.

In the same way, much of learning will have to shift to just-in-time learning where information and conceptual material are accessed only when they are needed. We are already seeing this today as businesses try to keep up with the dizzying changes that are taking place in the development of new methods for manufacturing goods and marketing products. Many businesses have workers that are not working in production all the time. Instead, they are pulled away from their regular duties in order to learn new techniques or methods that will soon come into play in a new task. This kind of learning will become much easier when personal pocket-sized wireless communicators allow workers to access information from anywhere, anytime. In the same way this technology will also make it much easier for students to access and learn information 'just in time' for when they need it.

3. Education Will Not Be Confined To A Single Person

Traditionally, a single teacher was the sole source of teaching in the classroom. But when students have access to technology and information all the time, who they learn from will radically change. The instantaneous access to people and information will allow students to communicate both locally and globally for instruction. Parents will be able to assist in home-schooling their children whether they are at home or not. Wherever the students are, they will be able to contact community and political leaders, business owners, scientists, and a variety of experts, as well as traditional schoolteachers, librarians, counselors, and others.

Language will become less of a barrier to any of these communications. Computer software is readily available that will take typed text and translate it into any of the major languages in the world. There are also personal computers that respond to verbal commands. Naturally Speaking and ViaVoice are similar software packages that can quickly convert your spoken word into typewritten text. Although they are relatively expensive and still early in their development, Moore's Law means that it will only be a short time before voice recognition computers will be a common part of our lives. Putting these 2 concepts together, a software program using voice recognition and automatic language translation will allow individuals to speak in one language to anyone else in the world in the other person's native language. In other words, an English-speaking person could call a Japanese-speaking person and their communication could proceed in both languages, while their conversation is automatically translated by software.

By removing the constraints of physical location and time of day, the new technologies will allow people other than teachers to enhance the instruction of students. Although this development may seem threatening to many in the educational establishment, the positive effects on learning have to be considered. While learning new skills and concepts students will benefit from the combined wisdom and experience of many people. It will also create a real-world relevance to the learning process. Students will be presented with different and sometimes opposing views as they research their topics. Learning how to draw their own conclusions from a variety of perspectives in such situations will undoubtedly become an essential life skill.

4. Education Will Not Be Confined To Human Teachers

As students gain access to a wide variety of teachers, it is a certainty that some of them will not be human. This idea will make many of the over 30 crowd feel very

uneasy, but the Nintendo generation, who have never had a time in their lives where such technologies have not existed, will take to this like ducks to water.

To understand what is about to happen with the emergence of non-human teaching assistants, we need to apply our knowledge of Moore's Law once again. We simply cannot make our decisions based on what is in existence today, because we know that the continuum of technological development means new and more powerful technologies are imminent. We can only look at what exists today as a basis for projecting where technology will be when the students now in Kindergarten graduate from our high schools.

What are the key technologies that will develop into the truly powerful non-human teaching assistants of the future? It is difficult to provide any definitive answer to this question given the breadth of development happening today. Most certainly technologies capable of making profound changes to the very nature of education will be produced.

Consider smart agents, also known as 'expert systems.' An expert system is a computer program that is given general rules for its operation, as well as the capacity to learn from experience. As it tackles problems and remembers the solutions, the program increases its power. One example would be a system programmed to diagnose engine problems in cars that are connected to car dealerships worldwide via satellite. Each day, every problem a dealership encounters is entered into the program as well as the way that problem was solved. When a mechanic encounters a problem, the expert system can give advice by applying the rules in its program as well as using its growing memory banks. The expert system has become a valuable reference and learning tool that can be used daily by mechanics anywhere around the world.

This type of system could have an enormous impact on education. We discussed the trend towards miniaturization that will result in powerful, personal, pocket-sized devices capable of instant worldwide communication. If these computer-communicators were equipped with smart agents, they would become even more powerful and could be used to find information from any source connected to the worldwide network.
If we were doing research on volcanoes, our personal smart agent could take our verbal request, go out onto the network, and find all incidents of volcanic activity that match our criteria for time, duration, type, and any other attributes we are

looking for. Depending on the information we respond to positively, this smart agent could even learn how we ask questions, and what we are really looking for when we phrase our queries in certain ways. In learning our personal habits and tendencies, the smart agent would learn to make connections and inferences from the coexistence of 2 or more events with similar attributes. Imagine the power this kind of technology would have in the hands of students of all ages.

Once again, we must consider the impact of Moore's Law as it is applies to the amount of information available on the global network combined with the increasing sophistication of information technologies. Students will have immediate access from anywhere in the world to information that is more up-to-date than any encyclopedia or textbook. Personal smart agent technology combined with the global digital network will render the traditional role of the teacher as the main disseminator of information superfluous.

However, these smart agents will do more than just get information. They will also be able to analyze what they find. A student could set an agent to work at monitoring the stock market for any combination of simultaneous ups and downs in various industries; have it watch worldwide arms shipments and terrorist activities; or examine the relationship between the destruction of the rain forest in South America and the depletion of the ozone layer.

The power of this kind of technology to alter education simply cannot be ignored. Much of traditional education in schools today involves getting information. In fact, so much time and effort is focused on just finding the information, there is little time left over for teaching students how to process, synthesize, and evaluate it. In an instructional environment that includes personal smart agents, this problem would be addressed. Teachers would then be able to spend more time on the higher-level thinking skills associated with evaluating the information retrieved by the smart agents.

A teaching profession that often bemoans the lack of time and resources needed to teach higher-level thinking skills should welcome this development. In the rapidly emerging new instructional setting, teaching higher-level thought processes will become the focus by default as the technology removes concerns of the amount of informational resources and the speed of access.

Students will be able to use a personal learning system that knows how they learn. It will continuously adapt to their needs as they read new material and encounter various difficulties. Such technologies will greatly reduce the lineup of students at the teacher's desk waiting to get help with reading or math problems. The power of this kind of personal learning system cannot be underestimated. While not commonly available today, the speed at which these systems will appear will be remarkable. Educators must immediately begin to prepare for a new learning environment where non-human teaching assistants will take over many of the tasks currently done by human teachers.

Again, many may see this as a threat, but it need not be so. These teaching assistants will actually free the teacher from the burden of being the source of a great quantity of low-level learning. Such technologies will enable students to learn the alphabet, the times table, spelling, and other such tasks with minimal assistance from the teacher. The teacher will then be free to work on the higher-level learning that is currently neglected in the traditional classroom. The future will not see teachers replaced. Rather, technology will create the long desired and needed shift in the instructional role the teacher plays.

5. Education Will Not Be Confined to Paper-Based Information

As education becomes a system no longer limited by time and location, and as new technologies become integrated with digital learning technologies, the use of paper will decrease in the classroom. For some this may be difficult to accept because the dissemination of information in schools is still essentially paper-based even though we live do n a multimedia generation. Nevertheless it will not be long until the trends outlined in this book begin to work in concert to produce a new digital reality. As strategic alliances between communications and media companies continue to develop new products and services, digital information and learning technologies will become the norm in schools.

Technologies that bring the world into our homes will soon allow children to wander through the pyramids, to visit the rings of Saturn, to see chemical reactions at the atomic level, as well as to participate in real-time teleconferencing. None of these experiences will involve paper, but all will involve learning.

When students go to school it is difficult to get them interested in the 2-dimensional world of paper. That is because outside the classroom they live in a digital 3D interactive video world where they are saturated with light and

electrons. Educators and schools have to pay attention to this point of incongruity. Children today get up in the morning and watch TV, play interactive games, go to 3D worlds using Nintendo and PlayStation, go around the world using the World Wide Web or pick up photos from Mars. Then they go to school and are confronted with all the power of a photocopied worksheet or blackboard. No wonder schools are out of sync with the world that children experience. Unless we pay attention, this situation will only get much worse.

6. Education Will Not Be Confined to Memorization

Academic success in the Industrial Age was based on a student's ability to memorize facts. People who were good at sucking up information and regurgitating it on demand were highly regarded and highly rewarded. But this kind of intellectual and informational bulimia does not adequately prepare a person for today's Information and Communication Age. The day when all the information that existed could be stuffed into a person's brain is long gone. As the amount of information continues to double, academic success will depend less and less on rote learning, and more and more on a student's ability to process information and use it in a discerning manner.

There will continue to be a shift away from rote learning as the primary means of transmitting knowledge. This means that academic success will increasingly be equated with real learning rather than memorization. In the old system the emphasis was on getting students ready for tests, but in the emerging system the emphasis is primarily on applying what is learned, solving problems, and demonstrating the transfer of learning to new situations. Today, information can have a very short shelf life and quickly become disposable. This implies that content specialization must give way to more general knowledge acquisition. As we shift from rote learning to more significant learning, we will witness a parallel shift from specialists to generalists who have the effective analytical processing skills needed to deal with such transient information. This means that our success in the future will not rely just on what we can remember, it will also rely on what we can perceive about the information we are working with, and how we can apply this to real world situations.

7. Education Will Not Be Confined to Linear Learning

A society that is based on an assembly-line model does not like starting anything in the middle. The logical sequence is from beginning to end, the only apparent way to do things. Before the digital age, televisions reflected this philosophy. If there

were 8 channels and you wanted to get to channel 3 from channel 7, you had to first turn the dial through channels 4, 5 and 6. Channel 4 was only connected to channels 3 and 5, and channel 5 was only connected to channels 4 and 6. Now that we have digital channel changers, we can jump directly from channel 3 to 7 and back. Every single channel is directly connected to every other channel, just like information systems and the World Wide Web allow virtually any idea to be directly connected to any other idea.

Linear learning is compatible with the assembly line model. Learning is done left to right, top to bottom, beginning to end. This is a linear, logical, sequential model. But with the introduction of new technologies, the learner can start an information expedition in the middle of the material and move backwards or forwards through the information as needed. As technology creates an interconnected world, people can construct their own learning webs and personal pathways. They can learn what they need, when they need it, without the interference of unnecessary and irrelevant information. As education and technology visionary Dr. David Thornburg says, "people will be able to move through conceptual space at the speed of thought."

8. Education Will Not Be Confined to the Intellectual Elite

Until recently, the real power in our country was in the hands of the 'literati'—the people of paper. Increasingly, that power has been transferred to the 'clickerati, mouserati and digerati'—people such as Microsoft's Bill Gates, the 'too many billion to count' man. This is because they have developed smart devices that bridge the gap between humans and technology. Technology has become the great equalizer, as David Thornburg says, "allowing ordinary people to do extraordinary things." People who understand how to use the Internet can become ad hoc specialists in any field, because they have access to high level information. That information can theoretically give them a postgraduate degree level of information in a field. The technology also puts unprecedented power into the hands of ordinary people. For example, a home-based business owner using multimedia-publishing technology, combined with the most up-to-date information from the World Wide Web, could develop proposals and presentations that could rival anything produced by major corporations.

Technology has changed the way we view the intellectual elite and has lead to what George Lucas calls a generational shift in the concept of being 'disabled.' Technology has allowed people with physical and mental challenges to work and

produce in ways that we have never imagined before, empowering them to rise above their disabilities. In the future it is possible that the definition of disability will reflect a person's ability to interact with technology. People with visible handicaps who embrace technology will no longer be considered disabled. Instead, we will have to deal with the newly disabled—those who are technologically impaired, the poeple who are unable to learn or unwilling to change as the world changes around them. Our fearless prediction is that in the earliest part of the 21st Century, it is likely that we will view those who are media illiterate, informationally illiterate or technologically illiterate the same way we now view people who cannot read or write the printed word.

9. Education Will Not Be Confined to Childhood

In the past, when information had a much longer shelf life, learning was something that was done once in your youth. Then you were done with learning for life. In the 'good old days,' what you learned in your youth prepared you for your single career. Today, learning has become a lifelong process. Given the rapidly changing nature of our world, people of all ages must constantly learn and relearn what they need to know. What they learned yesterday may no longer be valid in tomorrow's world. Tomorrow, they will have to learn again, because today's information will be out of date. Embracing lifelong learning will be a personal and professional imperative for life in the 21st Century.

10. Education Will Not Be Confined to Controlling Learners

In the industrial era, the traditional educational mindset used a predefined, generic cookie-cutter curriculum, which lead to a 'one-size-fits-all' approach to learning. Unfortunately this approach did not work for many people, and we tended to assume there must be something wrong with them. Today we understand that we must customize the learning to the individual, because different people learn in different ways and at different rates.

Given the traditional approach of controlling learners within a controlled environment, educators have become like fire fighters trying to manage a blaze by maintaining the perimeter. Some people have suggested that this approach can sometimes extinguish a students' love of learning completely. Educators must abandon this fire fighting mentality. In this new era our job should be to become arsonists, creating a roaring blaze of passion for learning in all of our students that will sustain itself not just until the next class or next term, but for a lifetime. Learning can no longer be confined to controlling learners. It needs to become a

lifelong empowerment process, and technology can help create the customized learning experiences that have personal relevance for students.

Now that we have an idea of the impact technology will have on our current school system, let us turn our attention to the skills, behaviors, and knowledge that students need to function effectively in this new 21st Century environment.

We Need New Schools for a New Age

Technology will force us to redefine education. It is not here yet, but it is coming. We are looking at changes of enormous magnitude that will occur quickly. We must make massive preparations right now, we can't just wait until it happens

What skills will the graduating classes of the early 21st Century need to thrive in this environment of accelerating technologically driven change? We already understand that because computer processing power and speeds are doubling at incredible rates, 'anywhere, anytime' access to information will soon be at our fingertips. This suggests that the new curriculum for the new era will have to make a fundamental shift away from a focus on content-driven learning, to a far more process-oriented form. As a result, content knowledge will increasingly take a back seat to process skills in student learning. In the future, the skill of learning itself will become the crucial process skill needed for survival.

What skills will remain that we teach now? It should be of no surprise that the 3Rs—reading, writing and arithmetic—will continue to be central to all student learning. This is because they are the essential process skills in a world that is driven more than ever by text and numerical data. Stop for a moment and consider what we really teach when we teach students to read. Do we teach a student to read a single document, or do we teach them the process of reading so they can later read material we never dreamed of when we began? The process skill of reading we develop in children will be put to use in the future reading things we can hardly imagine today. The writing process skills we teach them today will be used to write things well beyond our current comprehension. The math process skills we introduce to our students will allow them to compute well beyond our present capabilities. Process skills empower a person to become independent from their teacher. Process skills last a lifetime. The 3 skills of reading, writing, and arithmetic will remain the basic process skills needed by all of our students, but they will not be enough. We must add at least 9 more process skills to the learning experience of all students. These include:

1. Problem Solving and Critical Thinking

This set of process skills must be the foundation of all curriculums. An Industrial Age education was designed to teach people to follow directions and fit into a stable, assembly-line world. Traditional curriculum focuses far less on problem solving and more on simple recall. This approach simply cannot foster the essential problem solving and process skills needed in a world of constant change. As a result, too many of today's students suffer from 'worksheet-itis.' To prepare people for the new Information and Communication Ages, we must teach them to think for themselves.

Our key responsibility to our graduates is to send them into the world adequately prepared to live and work. To do this, we must understand the needs of the labor market. Employers frequently comment on the inability of young people to think through a problem to the solution by themselves. They complain that young workers wait to be told what to do. When young people first move from the predictable, controlled, and unchanging environment of school, to the unpredictable, uncontrolled, rapidly changing environment of the workplace they are like fish out of water. In today's world, young adults are required to think on their feet, solve problems independently and produce results. Is it any wonder they feel lost?

But how do we address this problem? First, students should be presented with a real-life problems suitable for their level of development and understanding. Most importantly, students should be equipped with a systematic, structured process to follow that will enable them to successfully solve problems, regardless of the content area. The process Ted has developed for his students is called the 4Ds. It is based on the structured thought process found in systems analysis and design, and it has proven to be effective in virtually every area of human endeavor. This process involves 4 distinct steps that lead to effective solutions to problems. The 4 steps are:

i) Define

Students must be taught to define a task so the problem is fully understood before work begins. How many times have you seen someone waste time working on the wrong task? It is imperative that students learn to define a task clearly and then confirm their understanding before proceeding any further. This is a valuable life skill. By turning over responsibility for defining a task to students, we force

them to use a variety of higher-level thinking skills as they determine what needs to be done.

In the traditional approach to instruction, teachers do the defining and designing work for their students. Assignments are often presented as something already half-finished, with the questions and the directions the solution already in place. This fosters a culture of student dependency on the teacher for providing appropriate materials and information. The real world simply doesn't work this way, and by teaching in this manner we prevent students from learning to think independently.

ii) Design

Once a problem has been defined, students must then design a solution. Often this will require students to learn new skills or acquire new information. The goal in this step is to have the students determine what they need to learn to accomplish the task. This is a key to fostering independent thinking. Students will not be able to depend on teachers when they enter the workplace, so we need to begin giving the responsibility for learning over to them before they leave us. This means new roles for teachers. If the students are given the job of determining what needs to be learned to accomplish a task, it becomes the job of the teacher to craft problems that draw students into the required curriculum materials. It also means that teachers become guides who point students in the right direction after they have determined what they need to learn.

iii) Do (Develop)

Once a problem has been defined and a plan for its solution has been designed, students must then put the plan into action. This could mean participating in a debate, writing a story, building a desk, writing an essay, baking a cake, doing an experiment, or creating a multimedia presentation. Whatever the task, the students must apply the learning that took place in the design step to do some real work.

iv) Debrief

This is a step that is often overlooked in education. However, determining whether or not you have actually accomplished what you set out to do is an essential part of learning. It provides useful feedback that helps students to do better next time. Continual feedback and performance reviews are just 2 examples of how the Debrief step is built into the procedures of many businesses who are striving for

excellence from their employees. If we want students to be familiar with the environment of continual improvement many will face upon graduation, it is critical that they get feedback on both the product they have developed, as well as the process they followed in creating it.

At every stage of the 4Ds approach real-world relevance is critical in the learning process Students quickly see the worth in applying their problem-solving skills to real world tasks. This fosters ownership of the problem-solving process and leads to a culture of autonomy. Repeated application of the 4Ds empowers students to become independent thinkers. When students are taught this problem-solving approach, they enter the real world knowing what to do when encountering real problems.

While we cannot expect students in Kindergarten to have this set of skills, it is reasonable to expect students in Grade 12 to have them. Developing this set of process skills should be a curriculum goal applied through a combination of repeated practice and a policy of progressive withdrawal. Teachers should first walk younger students through the process step by step. As students get more experienced in applying the 4Ds to problem solving, teachers should progressively withdraw from supporting the students, getting them to do more and more of the work independently. By the time these students reach Grade 12, they should have the necessary skills to allow them to work through real life problems independent of their teachers.

As we mentioned, graduates of the traditional school system find themselves steeped in a culture of dependency. From Kindergarten to Grade 12, they have been in a system that has reinforced the idea that content and memorization taught by rote learning is more important than thinking itself. When we take this system away from our students at graduation, we shouldn't be surprised to see they are not able to stand on their own. As we begin to make the transition from traditional teaching methods to a problem-solving approach for all students, we must learn to gradually let go. It is like watching small children learning to walk. They often fall, but eventually they are able to move around on their own. When it comes to these problem-solving process skills, we must equip students with an understanding of the 4Ds approach, and then let go of them so they can fall and make mistakes. In that way, we can provide guidance and feedback to help students become better problem solvers while they are still with us.

2. Communication skills

Communication skills are vital for survival in the 21st Century. Reading and writing are the 2 essential communication skills that have long been the cornerstone of the traditional education system. In today's emerging Communication Age, being able to speak and listen are just as important, if not more so. As a member of a family, whether in the community or working in a business, what do we do more of—reading and writing, or speaking and listening?

Clearly, it is the latter. In a typical day, the average person will speak 18,000 words, which is the equivalent of a 54-page book. Yet in schools, we focus our instruction on reading and writing skills. The skills we use most in everyday life—speaking and listening skills—are the ones that are taught the least. It should also be clear that teaching students the necessary skills for effective speaking and listening are as essential as those for reading and writing, and that these skills must be taught at all grades and in all subject areas.

3. Technical Reading and Writing

Technical reading and writing involves a fundamentally different cognitive process that requires a very different set of skills than those used for literary reading and writing. Literary reading as compared to technical reading is the difference between reading a novel or poem and reading a computer screen or technical manual. Literary writing as compared to technical writing is the difference between writing an essay about plot development in Hamlet, and writing a set of technical instructions for programming a VCR to record a program while the owner is out of the house. Technical reading and writing was once considered to be solely the domain of technicians and related wireheads, a job they did not very well, by the way. Given the amount of technology in our world, technical reading and writing has become a process skill that everyone should master. With the constant doubling of computer power and the exponential growth of information in our lifetimes, we must be able to deal with new technical issues and ideas as they appear. More and more frequently we must be able to work with new technologies, teaching ourselves and our co-workers the things that we need to know.

Literary reading and writing skills will continue to be important to the learning process. But equal weight must be given to technical reading and writing skills as they apply to the curriculum. It is not a question of allowing students to choose whether they prefer reading novels or software manuals because this is not an either-or situation. Both sets of skills will be absolutely necessary. To ensure that

all people are equipped for success in the modern technical world, technical reading and writing must not be taught in isolation. These are skills that must be taught at the highest level of integration in all subject areas and at all grade levels.

4. Applied Technical Reasoning Skills

Question: What do you think will happen over the course of the next few years—will there be less technology or more technology in our lives? While many people wish the answer were less, there will certainly be lots more. It follows applied technical reasoning skills will undoubtedly be essential skills to teach students to prepare for our increasingly technological world.

What do we mean by technical reasoning skills? People with technical reasoning skills can understand more than just how something works, they can apply their understanding to real world situations. For example, they can apply theoretical science and mathematics to real world problems and come up with solutions to real world problems. It is not about everyone becoming a scientist, it is about everyone being scientifically literate. They should be able to apply statistics, logic and probability to a variety of real life, real time situations, and feel comfortable using statistical numerical systems. It is less about becoming a mathematician that it is about them becoming mathematically literate in the application of mathematics in everyday life. They should also be confident they could learn whatever technical knowledge they do not have, because they have the process skills that allow them to quickly learn what is necessary. More than anything else, they should be able to apply what they know to do real work.

While in much of the rest of the industrialized world the term 'applied' refers to applying theory to real life situations, in North America 'applied' has long been a euphemism for 'easier.' In the minds of many educators, the term 'applied' refers to a set of lower level skills taught to less able students. The problem with this perspective is that it is extremely difficult to apply something you do not understand. In Bloom's Taxonomy of Higher Order Thinking Skills, application is considered to be a higher skill than simply knowing facts. It is hard to actually apply something you do not know or understand.

One way to help students develop applied reasoning skills is to engage them in hands-on learning experiences involving technology. While it would be wonderful for our students to have access to state-of-the-art technology, we can provide them the similar experiences with solutions that are far more 'low tech' in nature.

Technology is far more than computers. A great many technology concepts can be taught using ordinary equipment such as phones or blenders. We must not stop there. If we want our students to be prepared for the real world of today, we must have a progression in our curriculum that moves from focusing on individual tools, to examining systems. The Industrial Age mind set divided things into individual items and then focused on them. What we want our students to grasp is the interconnected, interdependent nature of how things function in real settings. There are a great many resources in the community that can help us do this. For example, ask your local telephone company to donate old telephones and have your students put them together to learn about electricity and electronics; ask a local technician to show students how to disassemble a VCR or clock radio; or take your students on a tour of the local electrical plant, water purification system, or telephone switching station.

As things stand the whole realm of logic, probability and statistics gets very little attention in a traditional curriculum. This clearly has to change, and change quickly because these skills are going to play an increasingly important role in our lives. Like critical thinking, problem solving, communication skills, and technical reading and writing, these skills need to be taught at the applied level rather than just the theoretical level. Why? Anyone who took algebra or trigonometry in high school or university understands that if you do not apply it, you lose the ability to do it. How many of you could pass the algebra or trig test you took way back when? Exactly!
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5. Information Literacy

Consider what comes into our homes these days. In March 1998, Business Week reported that almost 98 percent of homes in America today have a color television, 97 percent have a radio, 96 percent have a telephone, and increasingly, homes have access to cable and the World Wide Web. Add to these all of the print-based information in newspapers, magazines, journals, etc., and we are bombarded with information. However, much of the material that inundates us has no significance attached to it. Rather than living in the age of the explosion of information, we are actually living in the age of the explosion of raw data. For it inform us, we need to be able to see the importance of the data we receive.

In times such as these, the ability to manage and work with information is becoming a survival skill. Those who are not able to manage the flow will inevitably end up suffering from information overwhelm and exhaustion. As Richard Wurman describes in his book *Information Anxiety*, the sheer volume of information is

tending to engulf us, like someone forced to drink water from a gushing fire hydrant. When this happens, information becomes ineffective or even useless. When we are unable to make sense of the data we are drowning in, it is difficult to get beyond the data to knowledge. In the Information Age, we all need the ability to find and apply significant information. The toughest part is being able to differentiate the important bits of data from the unimportant ones. People do not only need to know what the data says, they need to understand its significance so it can become information.

How do we do this? The answer lies in acquiring a complete set of information literacy skills to access, analyze, authenticate, and apply the information so that we can personalize it into useful knowledge. It is critical that we equip students with these skills. The first step is to teach them how to integrate question asking into their information retrieval activities. Students must learn that the quality of the questions they ask will determine the quality of their research. By doing this, students begin to understand the importance of moving beyond getting the right answers, to asking the right questions.

In the modern world students must learn to access information from a variety of sources worldwide. They should be able to do research on the World Wide Web, and using a wide selection of electronic and non-electronic resources. Information literacy goes beyond asking where to get the information, to include the organization and presentation of the acquired knowledge. Students must determine the most appropriate medium to present their material. They should appreciate the wide variety of means through which they can communicate their learning. These might include audio and video clips, a verbal presentation or a debate, or a written essay that might include graphics to illustrate the important points.

It is time that educators recognize that we live in an intensely graphical world, which makes the use of images, sounds, and video clips a basic part of the communication process. Educators have long known that the final step in the writing process is the presentation of material to the intended audience. Teachers in the elementary grades understand this and encourage their students to enhance the communication of their writing with pictures, color, and decoration. Unfortunately, much of this is lost as students progress into high school where the emphasis shifts almost exclusively to the writing itself. But the real world of modern information dissemination is a colorful multimedia experience where graphic design is used to enhance the communication of content. It is so much a

part of how information is communicated today that people simply expect effective graphic design to be an integral part of what they read or view. The print and electronic media industries have recognized this expectation and have responded appropriately. It is time for educators to catch up, both in the learning materials they produce and the way we teach all students to communicate their ideas. An understanding of the principles of graphic design should be taught to students as an integral part of the communication process.

Understanding the power of graphic design in publishing, video, and multimedia communications must be a fundamental component of a student's basic literacy education, both for communicating ideas and for intelligently processing the messages being targeted at them. As students develop an understanding of the visual world and the principles of visual literacy, they can begin to recognize how information can be shaped to manipulate us. Unfortunately far too many people do not understand how our increasingly graphical world is being used to bias the messages we receive.

We must acknowledge that the Information Age requires a new set of cognitive skills for information processing. Most adults are text and paper-trained. We grew up in a world that was linear, logical, sequential, left to right, top to bottom, beginning to end. The new generation is light and sound-trained. This is a world of hypertext, sound, and images where you can process information like you are in the center of a web—you can move forward, backward, or sideways at will. Whereas we learned to think and write with ink and lead, students today need to learn to think and write with electrons. This involves a fundamentally different cognitive process that compels us to redefine the true meaning of information literacy, from the traditional text and still picture curriculum of our past, to the multimedia world of the Information Age.

6. Technology as a tool

There is a widespread misconception that technology is a subject, that technology is a curriculum. This is absolutely wrong. Learning technology is not about teaching Microsoft Word, AppleWorks or Hyperstudio. It is not even about the cards, cables, RAM or ROM, input or output issues that fascinate many. What it is really about is using technology as a tool to help us be more productive. In fact, the term technology is misleading. It seems we only apply the term to those things that were invented after we were born. For example, we don't call a refrigerator technology and spend hours pondering what refrigeration is doing to the nature of food. We

do not consider a piano as technology and wonder what it is doing to the essence of music. The problem is that many of our generation can remember a time when much of the stuff that we are dealing with today did not exist. But for our children—for the Nintendo generation—there has never been a time in their lives where VCRs, CD players, satellites, cell phones, computers, and the Internet did not exist. They have always been there. If we are having trouble dealing with it, it is our problem, and it is time for us to get over it and get on with things. We don't ponder the pencil and wonder about how they got the lead in there. It is transparent. Unless the thing is broken or we can't find it, we do not dwell on the pencil, instead we focus on the task. This applies equally as well to the use of electronic technology in the learning process.

For education, the central issue is about how technology can be organized around student learning, not how student learning can be organized around technology. We need to see technology as helping students think and communicate effectively. If a device can do something more efficiently, more accurately, or more quickly than we can do it manually, then why not use it? Is not that the true purpose of technology? It is only when we learn to get beyond the tool and begin to focus on the task that we will really be able to appreciate and understand the power of the device. People today use the technology of cars, electricity, and a multitude of other technologies to make our lives more pleasant and efficient. We are not conscious of these things. We simply let the technology empower us to do much more than what we could do without it. Most of the time the technology we use is transparent.

If new electronic technology will empower us to do more than before, we must make a major shift in how we approach its use. We must learn to let go of the mechanical things technology can do for us and concentrate on the things that the technology cannot do. Many teachers find this sort of statement unnerving. This is because there is a great deal of concern expressed that students should not become too dependent on technology to do their spelling and basic arithmetic calculations. It is here, where technology begins to enter the cognitive realm, that it is making some of us uncomfortable. While it is true that in the past a student may have been able to manually add, subtract, divide, and multiply better than a student will in the future, it is also true that in the future a student will be able do these operations faster and more accurately using electronic technology. That is because tomorrow's students will not struggle with technology, but will allow it to empower them. Consider how students play video games. They are not concerned

with how the joystick works. They use it intuitively to focus on what the joystick does. In the same way, the focus with technology needs to shift from the tools to how the capabilities of these new tools will empower students to do new things. This will free them to go places that we never had the opportunity to go ourselves. In the years ahead, technology will not be the focus, but simply the vehicle that takes the student of the future farther than the student of the past could ever imagine.

To begin this process, we must stop teaching things like keyboarding and word processing as separate subjects. These should be considered simply a part of the communications process, and taught incidentally in the teaching of the writing process in Language Arts, Science, and Social Studies classes. As the use of technology becomes an ordinary part of our lives and the lives of our children, educators will find that the technology will become increasingly transparent, just like the pencil. All that will be left is for the student to focus on the task while the technology works in the background.

Educators must get over the idea that technology will replace them. Any teacher that can be replaced by a computer absolutely deserves to be, because they just do not get it. Simply stated, we could put a state-of-the-art device on the desk of every student, every teacher, every administrator, even every superintendent in every district in this nation, and if that is all we did, the only thing that would change is the power bill might get a lot bigger. Without the vision and understanding of an inspired educator, little else of value would happen. Education is a human task that cannot be delegated solely to computers. While these new electronic tools have great power, we must not confuse the tool with the task, because technology in and of itself does not and cannot improve the human condition—only *humans* can improve the human condition. The critical question must be where and how we can best use of the technology to help us on the road to knowledge.

7. New Personal Skills

Global competition, the doubling of technological power, and the explosion of information in the modern world has created an absolute economic pressure-cooker for business and industry. No longer do we have the stability that was common even as little as 15 years ago. In an increasingly global economy where everything is directly connected to everything else, when the yen, Eurodollar, mark or dollar changes value, business plans have to be reworked. This has lead to a rapid and

dramatic change in the nature of the workplace. Companies that were based on being big and predictable are rapidly being replaced by organizations that are fast, flexible quick-change artists. This is reflected in today's workplace. Dr. John Walsh from the University of Guelph reports that for every one job created by a company of more than 100 employees, there are 17 jobs being created by companies with less than 8 employees. In such an environment, it is likely that many of today's students will spend their lives working as digital entrepreneurs. But we have seen only a hint of the enormous changes that are to come.

One of the major reasons for the dramatic increase in the number of small companies in the economy is the amazing power that is now available to these businesses. Due to the tremendous gains in efficiency from electronic technology, in the book *Infomedia Revolution*, Frank Koelsch has projected that in the next 5 years we will see changes in productivity in the order of $^1/_2$ by 2 by 3. This means that half as many people will be paid twice as much money to produce 3 times as much value. Continual development of new and more powerful electronic tools has made the business world an exciting, rapidly changing, and unstable environment.

For workers dealing with this ever-changing playing field where the balance of power is shifting quickly in favor of small business, it means that coping with ambiguity and fundamental uncertainty will become the norm. To survive, companies of the future will increasingly contract out large portions of their business. Trends like this tell us that as many as 80 percent of today's kindergarten students will have to be their own employers. To survive, let alone thrive in such an environment, they will need to be equipped with a very different set of skills than the previous generations.

First and foremost, teaching students how to be independent will be a critical outcome that must guide educators as they prepare students for the rest of their lives. This will require a major shift in mindset as we embrace a whole new skill set that people will need for success in this new business environment. People who work as entrepreneurs must learn how to be self-motivators, self-learners, and self-assessors. They will need to learn about such things as goal-setting, time management, stress management, teamwork, self-marketing, presentation making, financial management, negotiation skills and 21st Century communications skills. We will have to make a huge shift in emphasis in how and what we teach our students to make our instruction relevant in the modern, competitive world of powerful small business.

8. New Mind Set Skills

As a result of these many changes, everyone will need to learn to live life like a quarterback and anticipate the future. We will need to develop strategies for passing this important mind set skill on to our students. Developing their intuition about where things are going will be critical, because learning will not only be about learning new skills; it will also be about learning to let go of old skills that no longer work. Getting rid of old, ineffective skills will help remove some of the barriers that prevent us from seeing things from different perspectives. To do this requires students to practice the principles of organized abandonment and to learn how to undo their previous thinking, creating space for new ideas. If they cannot do this, they will have difficulty learning the new things they must learn in the short time they will have to learn them.

In the new millennium, experience will not be as valuable as it used to be. The ability to adjust and leverage what you know will matter as much as the experience you have gained. In fact, there are already managers today that look at resumes with a critical eye because too much experience in one company or with one way of doing business may indicate that an individual has become married to a paradigm. It may mean a person is not as open to change as they need to be. This is a complete inversion of the Industrial Age thinking that still pervades our society. Instead of staying the course and valuing the way we have always done it, now we need to be on the hunt for new ideas that could reinvent our business or organization. In the words of Robert Kreigel, "If it ain't broke, break it!" because in the fast-paced competitive modern world, if we don't, somebody else will.

Now just stop for a moment and think what that means for equipping students with the right skills needed for continual success. Again, a major shift in how we approach this thing called education will be required. Students will need the mindset skills necessary for dealing with rapid change. We will need to instruct our students how to continually be thinking 'outside the box.' As Tom Peters often says, this will mean teaching students how to understand and appreciate the value of crazy, stupid, completely off the wall ideas. If an idea seems crazy or stupid, it is often because it is outside our personal or company paradigm. We must learn to overcome our desire to immediately dismiss these ideas and give them careful consideration. Staying competitive often means coming up with crazy, non-linear ideas.

We must help students develop their thinking and intuition skills, and encourage them to change their mindsets often. Using a different mindset unlocks a whole new way of thinking and seeing things. The contributions made to our world by the likes of Stephen Hawking and Albert Einstein began with a change of mind set. It was their new approach to a problem that was the key to their success.

Understanding this, we need to appreciate the value of useful failure as a teaching tool. The essence of innovation is the pursuit of failure. Consequently, failing can be a good exercise, as long as it is productive. In business today, the message is that if you do not fail, then you are not succeeding. Learning from a mistake means we can move on and try something else that will work better. To understand this, we should take a lesson from the past. On December 31, 1879, Thomas Edison demonstrated his most famous invention—the first practical incandescent electric lamp. But to get to that point, he had experienced hundreds of failures. When it was suggested by his assistant that he must feel like a failure, Edison replied by simply saying that he now knew hundreds of ways how *not* to make a light bulb. In the end, he was successful because he persisted and learned from his failures. We must now teach students today that failing can be a good thing.

9. A Beef Stew Curriculum

In the earliest part of this century, Henry Ford used Eli Whitney's principles of mass production to create the automobile assembly line. As we have already discussed, this resulted in workers being assigned to a task they were expected to complete as quickly and accurately as they could, in a machine-like manner. Working within such a system, each worker was only responsible for a specific task. They were not expected to think or concern themselves with the bigger picture of what happened to the product before they received it, or after it left their hands. Concern about the finished product was left to the 15 percent of the work force who made up the management of the company. These were the select few who were paid to use their mind rather than just their hands. The increased levels of productivity that resulted from the application of these principles were so astonishing that within a very short time, they were applied widely across all of society throughout North America, including the public school system.

As a direct result of this decision, in very short order learning became compartmentalized and life began to be taught as a series of separate subjects. For a long time, this model worked as well in schools as it did on the production line. However, at the beginning of the new millennium, we live in a fundamentally

different world of work that long ago outgrew the principles of mass production. Yet, despite the fact that the world out there has radically changed, most schools continue to teach a meat and potatoes curriculum, where subjects are taught as separate courses using an assembly-line approach to move students along from one specialist to another when the bell rings. How many times have you heard a teacher say, "I don't teach Math," or "I only teach senior Chemistry," or "It is not my job to teach grammar"? These statements reflect the fact that the school system is still based on the Industrial Age premise of departmentalization. The school system is suffering from a hardening of the categories! While this worked very well many years ago, this approach is becoming increasingly irrelevant to the world of tomorrow.

What we understand now is that life cannot be fully understood if we just learn about meat and potatoes separately. Rather, life is a stew of interrelated experiences and can be much more fully understood with a holistic approach that makes the connections between what we have previously considered as separate disciplines. Students can sit in math class and have a math experience, but life is about far more than that. It is about how the math of statistics, logic, probability, algebra, and trigonometry connects with the music, science, art, social studies, English, and psychology. In the classrooms of tomorrow, it is likely that the math department will become a sphere of influence that exerts its impact to varying degrees on the various tasks and problems that students tackle in school. As a result, schools will have to move beyond getting students ready for the next class, next unit, next term, or next year of a subject. We will have to embrace a much more holistic approach.

Educators must understand the power of technology and information to transform everything they teach. They must be willing to accept the problems associated with paradigm paralysis and be willing to do something about it and they must begin by accepting the challenge of working on acquiring this new set of skills for themselves, as well as for their students. Learning these new skills will enable educators to prepare young people for the changing world we must all face.

The bottom line is that we must discard the notion that schools can teach everything that students will need to know in their lives. What we must understand is that learning has now become a life long process of keeping abreast of change, of learning to learn. A world where learning is not just about earning a living, but

about learning and relearning a living. It is about learning today, learning tomorrow, and learning forever for our students as well as ourselves!

So What's The Starting Point?

We must define the gap between where we are and where we need to be. We must start by helping others understand that it is a new world out there and change is absolutely essential to make and keep schools relevant. To do this, we must rethink things. We must rethink schools, classrooms, curriculum and educational management. We must redefine success. We must rethink what learning means and what it means to be educated in the light of the modern changing world.

You can forget all I have said because on Monday morning, when they close the door it could just as easily be 1950 or 1920. If you want significant change, it is more than defining the gap. It must result in a fundamental philosophical realignment. It must translate into changes in attitudes and mindsets, which is the only basis of true curricular change.

This is not a hardware issue—it is a headware issue. We need a new mindset that will help us prepare students for their future, not our past. Our job is not just to serve what is, but to shape what can and must be. Their future (and ours) depends on it.

We must move from simply contemplating the here and now to a strategic planning for the future. But before we can talk about what we do today, we must visualize that future. This is not about technology, it is about the social power of technology to fundamentally transform our world.

A starting point...

Start by acknowledging that adults live in an old paradigm while kids live in a new one. We have trouble relating to their present let alone their future. The core of the problem is about relevance. We must focus on bringing about a conceptual shift. To do this, we need to change our mindset. One caveat however—do not try to change if society and schools attain everything that you aspire for. The trouble in life does not come from aiming too high and missing the mark. It comes from aiming too low and hitting the mark every time.

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