

# Facing the Future

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## **Where are we going with this presentation?**

Despite all the amazing technological developments we have seen appear during past few decades of our lives, the fundamental issue we face today is not about technology - rather, it's about people and the mindset they apply to the technology - it's about moving them from a world of relative stability to a time where change is the constant - it's about leveraging that mindset in order to create a personal & professional vision for life in 21st C.

These are trying times. In our lives, as we lurch from one crisis to another, we all suffer from some form of the tyranny of the urgent, immediate and unnecessary! For many of us, this leads to a sense of being terminally overwhelmed by our day to day existence. I ask you to step back from this for just a moment. Do you have a hard time keeping up with all of the swirling events of our lives? How do you deal with such times? What is the key to success in the future. Strange as it may seem, the key to the future is in your past. Huh??

## **The lure of the familiar**

Look, I'm a charter member of a group known as Overusers Anonymous - I have a leather jacket that I bought many years ago while I was still in university (many, many years ago) - I've got to tell you - I LOVE that jacket and still wear it today any time I get the opportunity even though it has definitely seen better days - it has rips, stains and doesn't really fit the way it used to - but no problem, when people give me a bad time about it, I just say that the jacket has character. However, I have to admit that the condition of the jacket deteriorated to the point where my wife has warned me that if I ever leave the property again wearing it, she will personally incinerate it (with me in it).

The problem I'm having is that I've spent a long time making that jacket comfortable. Sure, I know that I can afford to buy a new one, but I don't want to. The reason is that I have been rewarded through the initial efforts that were required to break the jacket in. If I bought a new one, I'd have to start all over again from scratch getting comfortable with it and this would take time.

Consequently, I'm reluctant ( some might say resistant ) to making what my wife believes is a necessary change.

Now what gives us comfort in our lives? Really it's different things I guess. But the fundamental issue is not really just about old coats or old shoes. Think of that old couch that has certainly seen better days as it has descended down the feeding chain from the living room to the den to the basement and out into the garage. In fact, it's not just about things. It's also about different ways of doing things - new ideas - alternative world views - looking at things from a different perspective.

It's not that people are fundamentally opposed to change - it's just that change requires effort, and change causes discomfort to those who are asked to change. And besides, when you get right down to it, we all try to avoid discomfort if at all possible.

In much the same way, technology changes how things are done - and for a large portion of the population, these changes make them feel uncomfortable. Beyond this, it requires a great deal of effort to master. Consequently, in many sectors of the population (not the least of which is education) its use is naturally resisted. As a result, the introduction of the use of technology is often limited by a desire for personal comfort. In order to overcome this resistance, people must learn to differentiate between power of the technology and the mindsets that guide its use

### **So what's the problem.**

So, is there a problem? In education, superficially at least, it really doesn't seem like there's much of a problem - it appears that we're on track. The use of technology by educators is starting to gradually surface in the classroom and a new way of teaching is slowly appearing. But if the implementation of technology into the educational experience is limited by our desire for comfort, it also leaves room for our competitors - it's just that in education we don't understand that we have competitors or that public education might be at risk. Many educators believe that change is something that happens somewhere and to someone else - to steelworkers, factory hands, loggers or miner - but not to us in education. However, the grim reality today is that no country is an island. There seems to be less and less time to adjust to what appears to be more changes & more power

### **So what's the answer?**

Strange as it seems, the answer is NOT technology. The key to success in the rapidly changing world of today is PEOPLE; and the key aspect of people is PARADIGM

### **So what is paradigm?**

Paradigm is a mindset. Paradigm is what you value. Paradigm is the way you see things

As an example, think back to the first time you saw this picture?



I remember becoming completely frustrated when someone said there were two pictures - that of an older woman and that of a younger woman, in the same picture. Try as I did, I just couldn't see it. Then suddenly, my focus changed and there they were. Once I knew how to change my focus, it was easy to move back and forth between the two images - in fact, it was hard to believe that there was ever a time in my life when I couldn't see them both. Many people have the same experience working with the new 3-Dimensional pictures that have recently appeared.

### **Paradigm and real life**

Imagine the mind-set of the farmer in 1908 who relies on horses for transportation. He is in his wagon behind reliable old Bessie, a strong mare with the ability to pull the farmer and his supplies all the way home. On the way, both are startled by the sudden appearance of a noisy motor car, chugging along on its own power. As the motor car leaves him choking in its dust, the farmer swears at the folly of such technology. If we ask him whether this automobile will have a significant impact on his life, he would not hesitate.

Absolutely not, he would tell us. Not only is there not enough gasoline around for these cursed horse-less carriages, no one knows how to fix them when they break down. More important, he says, there is not enough room on the road for both motor cars and horses. Since building separate roads for motor cars is impractical, it is likely these blasted things will be gone in a year or two.

From here, we can see his mistake. The automobile and its spin-off technologies changed everything. This new technology, at first seen as such a bizarre invention, had an impact in every part of industrialized society. But from where that farmer sat that day in his wagon, none of this was possible. His mind-set, his paradigm, would not allow him to see change even when it roared by him on the road.

It is possible to look at something and miss its true significance because your mind-set or paradigm has not equipped you to deal with this new situation.

The digital watch is another example of how paradigm can have a major impact on perception. The introduction of electronic watches in the 1970s produced one of the most startling shifts in business in the 20th Century. Before the digital watch was invented, a watch was an analog device based on gears and springs with the time displayed by continuously moving hands. Most of the world's watches were produced in Switzerland.

This is the paradigm: watches and clocks had looked and worked the same way for literally hundreds of years. The mind-set for watches was that they looked a certain way, and they had certain capabilities. This paradigm all but killed the Swiss watch industry.

When the first digital watch was invented, the response from the Swiss and other traditional watch makers was fascinating. They did very little, and so they lost most of the world market for watches they had held for so long. Japanese competitors saw the potential for the digital watch, marketed it to the world, and took the world market for watches away from the Swiss.

Before we judge the Swiss, we should stop for a moment and reflect back on our experience with the graphic on the previous page. If we initially focused on one of the women, we probably had difficulty seeing the other. We might also

have dismissed anyone who said they did. Our mind-set was preventing us from perceiving the entire significance of what we saw.

With this in mind, it is much easier to appreciate the response of the traditional watch makers to this new electronic watch technology. These new devices were a radical departure from what watches had looked like for a long time. Some simply dismissed them as toys that would have little or no real impact on the industry. Besides, how could they possibly approach the quality and accuracy of fine Swiss watches? This new technology didn't even have hands! It was hard to even consider them as real watches.

By relying on their old paradigms, the Swiss were blind to the true power of the new electronic watch. This was a critical mistake for the traditional watch making industry. Within a few short years, the global watch market shifted to the orient, as sales of electronic digital watches overtook and then left behind the now old-fashioned analog watches. Swiss watch makers hardly knew what had hit them. Unable to compete, their response had been crippled by the paradigm they held for their industry.

### **Paradigm paralysis**

Today, society as a whole in North America finds itself in a very similar situation to the Swiss watch makers described above. Astounding developments in communications, computers, entertainment, household appliances, product design and manufacturing presents us with an enormous challenge to our mind-set for how life should unfold, a challenge with incredibly high stakes. Our economic survival depends on our ability to change our paradigms to meet the changes racing toward us.

It's like a chain of dependence. Our continuing viability depends on whether companies can adapt and keep pace with their global competitors. This adaptability depends on our educational institutions and our ability to continually equip people with the relevant skills they need for the rapidly emerging life of the 21st Century. This chain of dependence relies on the ability of all its players to change paradigms as needed.

Incredible advances in technology are staring us in the face. We don't want to find ourselves missing or ignoring significant developments and going the way of

Swiss watch makers. We must embrace technology and use it to its fullest potential. The only way to do this is to let go of obsolete technologies and mind-sets as we move forward. If we cannot do this, we face the prospect of a drastic downward economic slide into a lower standard of living because we cannot compete. Paradigm paralysis is hindering our response as we ponder the impact of new technology. This problem is so significant it must be given full attention as we attempt to tackle this enormous challenge.

The problem is our inherent picture of the way we think life ought to unfold. More specifically, the major problem is the paradigm of people who lived their most impressionable years before the explosion of electronic technology into everyday life. The reason for this lies in the way that technological development has occurred over human history.

The number of new, more powerful developments coming at us today is astonishing. This was not always the case. In fact, for much of history, technological development was very slow. If you look at the development of computational technology over time, for example, you will see that most of our ancestors had quite a long time to get used to technology that was not particularly powerful.

People who grew to adulthood before the microcomputer came into its own understood their grandparents had seen more unbelievable change during their lifetimes than all the generations before them. They had started with horses as a major mode of transportation and lived to see man walk on the moon. Still, that rate of change is nothing compared to what is coming. The amount of change humanity witnessed during the 60-year span from 1940 to 2000 will accelerate over the next several years. Some say the change that happened during that 60 years will continue, only it will be compressed into 20, 15, 10, even five years.

People living today are experiencing a most extraordinary period of human history. The overwhelming majority of the development in the quantity and the power of computational and communications technology has occurred over the last 60 years. This has created a situation without precedent in human history.

Previously, advances in technology have first been understood and then implemented by adults, who taught their children how to use them. Now young people are better able to change their paradigm and to embrace this new age of

high technology. The young grasp the potential of new technology first and the young are now teaching older people how to use it. Older people are struggling to catch up and keep up. Young people today live a substantially different paradigm than their parents. They may not be able to articulate the difference, but they know the life they are living is unlike that experienced by those who are older. A major paradigm shift has taken place, creating something much more significant than a generation gap. Most important, this situation has happened in less time than it takes to create a new generation.

Now we can begin to understand the incredible potential for paradigm paralysis that exists in North America today. Young people may be living the new paradigm for life, but who is in control of most of the world they experience? Who makes the decisions in business, government, and education? The power is wielded by people who, for the most part, are still operating under an old paradigm for life. Most of the people in positions of control in North America were born before the early 1970s. When those people passed through their most impressionable years, life was radically different than it is today.

People born before 1970 did not experience an electronic world in their youth. Their world view, their understanding of society, their perspective on the structure of things was created in a world radically different from the world of today. The world they experienced was based on an industrial model for life. It did not teach them how to integrate "smart" electronic devices into their lives. It did not teach them how to get new information visually. They did not learn the implications of instantaneous global communication. The life they experienced did not equip them to handle the world we now see unfolding before eyes.

The paradigm paralysis we face today is a direct result of the unparalleled shift technology has created since 1970. We face the prospect that decisions are being made by people who do not understand the full implications of the changes taking place. It is also likely the decision-makers are resisting change in the same way some people resist buying a new coat. The old ideas that shape their world view are comfortable and to change would bring unwelcome struggle. This is a prescription for disaster.

### **An age of constant change**

That brings us to today. We truly do live in an age where change is the constant. As a result, we seem to have less and less time to deal with more and more

change leading to a relentless assault on our comfort zone. How do we deal with this environment? Start by not believing your eyes. As it relates to the growth in technological power, we simply can't base decisions just on what exists today. If it exists today, it's probably already obsolete - it's not that it's unusable - I can still use an old Apple IIE well - it's just that the technologies that we will be using in the next 5 to 10 years have already been invented, you just can't buy them yet. If a device or gadget is sitting in front of us, you can rest assured that there are already 3 to 5 new generations of the device somewhere in the development pipeline.

For example, the production cycle for Sony products is currently 7 days from idea to first prototype. And you think that's fast - Sony regularly replaces their products on a 90 day cycle - 90 days on the market and the product is replaced with a new and improved version. This brings new meaning to the phrase "disposable income." But Sony says that by early in the 21<sup>st</sup> Century they want to bring the product cycle down to 18 days. Their corporate motto explains why - "Today let's put ourselves out of business because if we don't, someone else will"

### **Dealing with rapid change**

So how do you anticipate the necessary changes, particularly in an area such as education, where we are limited by budgets and even more so by the mindsets of many of the politicians and administrators who control the system? I believe that we all need to learn to live life like a quarterback. When a quarterback steps up over the center, he has to be a futurist, anticipating where everyone will be in 3.2 second. As the quarterback takes the snap, drops back and sets up to throw, he cannot throw to where the receiver *is* but rather where the receiver is *going to be*. In much the same manner in education we are now working with a moving target - because our job is not just to prepare students for tomorrow, but the many tomorrows beyond tomorrow. To do this in a time of rapid change, you must learn to use your intuition. By this, I am not referring to some sort of mystical crystal ball gazing, but rather through the use of reasoned extrapolation based on the trends that are occurring today. So let's do it - where is technology heading in the next 10 years?

### **The wired world**

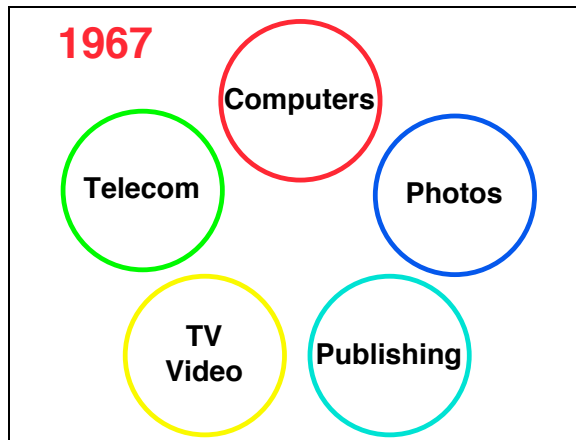
What's the biggest problem right now? It's speed - even with a 56k modem, downloading files from the Web is truly like trying to suck peanut butter up a straw - but don't worry about that - things will improve quickly. Have you tried a

coaxial cable modems? Quite a bit faster - 10 megabits per second or a CD ROM in about 60 seconds. Remember that a CD ROM holds the amount of information that would take a secretary typing at 100 words a minute for 60 minutes per hour, 8 hours a day, 52 weeks a year for 12 years to fill - does that sound like a lot of information? Well get over it. Today, with fiber optics they can push down a single strand of glass fiber equivalent of 10 CD-ROM's per second - this is more than 1000 times faster than the cable modem.

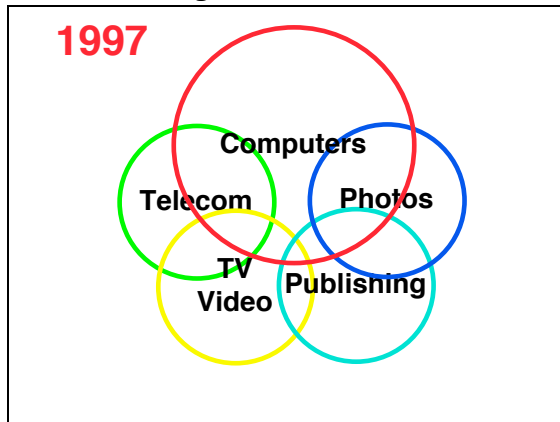
Do you think that that's fast? Well get ready for some real speed. George Gilder, a futurist from San Francisco talks about the Law of the Photon, which asserts that bandwidth speed triples every 12 months - he also suggests that this tripling will continue unabatedly for at least the next 20 years - which would suggest that we will see speeds 1 billion times those we see now in 20 years - do you think that we will notice the difference? This is absolute conceptual dynamite - a 10.5 on Richter scale of social significance - combine this with initiatives such as the Teledesic project being developed by Bill Gates (heard of him?), Craig McCaw (developer of the cellular networks in American) and Loughheed Martin (a small manufacturing) - the propose to put into orbit by 2005 a global grid of 288 Low Earth Orbit satellites in order to provide an anytime, anywhere Internet in space.

You see, the future includes both cables and wireless - it's not a matter of either/or. This will lead to an anyone, anytime, anywhere world through a single interactive info network that is seamless, high speed & global and which will link telephone, TV, cable, satellites & computers - connecting everyone & everything - will it have an impact on our lives. You bet!

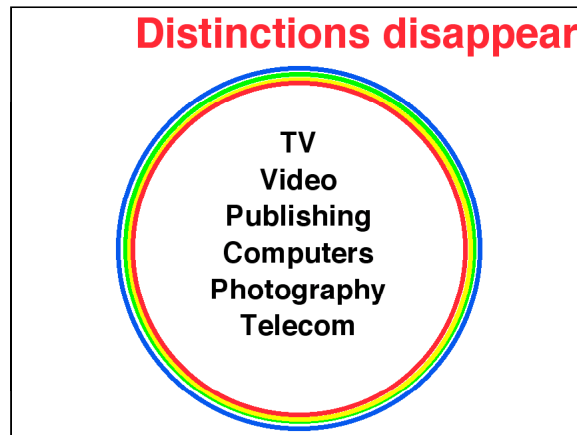
**This is conceptual dynamite by itself, but when combined with** But it doesn't stop there. When these powerful trends get together with the third trend, technological fusion, things start to get really weird. Technological fusion occurs when technological cybrids are created when previously separate fields are fused together. In 1967, there were five very distinct technological applications - telecommunications, computers, photography, publishing, and TV/Video.



Early in the 1990's, we were beginning to see a distinct overlap between what were previously separate technologies:



As we extrapolate this trend, it's easy to anticipate where things are heading in the early part of this new millennium>:



In very short order, we are moving from multimedia to monomedia - it's all zeroes and ones to the technology - how they get put together is entirely up to

the user. This is a direct result of technological doubling and technological fusion. Today, we're seeing more and more electronic devices being compressed into a smaller and smaller piece of electronic real estate. All forms of media are now converging around the portable digital desktop while at the same time we are seeing a movement toward natural interaction & technological transparency.

Consider the Newton by Apple. The Newton was the first hand-held device. Smaller than a paperback, the Newton was a powerful palmtop computer complete with handwriting translation software, a writable plasma screen and the ability to wirelessly send/receive email and surf the Internet. Once again, when it was first introduced, most people didn't understand how it could be effectively used. The Newton is no longer being made, having been over run by smaller, more powerful technologies such as the Pilot, that have extended the power of the palmtop well beyond the original vision of the Newton.

The hard lesson is, that if it exists, there are probably several more generations of the technology already on the production line. So these palmtops, as is the case with all new technologies, must be viewed as museums - today's high technology quickly become tomorrow's discarded antiquities. They are simply a portent of things to come. As we write this article, new indicators are already on horizon. Hitachi has been profiling an early prototype of Bill Gates' long talked about wallet PC - Nokia has released a digital celleputer - Mentis is selling a wearable multimedia computer with voiceprint and a GPS system. And it doesn't stop there.

Technological fusion leads quickly to powerful new electronic cybrids. Moore's Law ensures that these devices are quickly being superseded by even more powerful devices. One doesn't need to be a rocket scientist to predict that based on the emergence of these cybrids, by the year 2005 such devices will be as common and transparent as pencils. However, unlike pencils, these devices will be able to communicate effortlessly with all of the other devices that are also out there.

Unfortunately (or perhaps fortunately, depending on your definition of "disposable income") these devices have not been developed primarily for us, but rather, for our children. Such devices are the next natural next step for Nintendo generation as they move from schools to the workplace. Since children have no previous experience, the current technological paradigm easily becomes their personal technological paradigm. For them, these devices are merely part

of the everyday fabric of their lives. It's our problem if we're having difficulty understanding and/or embracing this.

### Looking to the Future

So where do things go from here? A wise man once said that those who live by the crystal ball usually end up eating crushed glass. It's hard to accurately anticipate the future when you live in a world of fundamental uncertainty.

Nevertheless, we must try. We all need to start thinking in future tense - to live life like a quarterback. A quarterback must be a futurist - learning to throw the ball not to where the receiver is, but to where the receiver is going to be. It's much the same with technology. We need to be looking ahead, considering where things might go 3, 4 even 5 generations down the road.

The future possibilities are absolutely amazing. Miniaturized electronics built at the micron level; palmtop technologies effortlessly connected to the global digital network; the ability to fax three dimensional objects; molecular and bacteria based computers; new cyborg controls; remarkable new implant technologies and body transceivers; intelligent pacemakers; biofeedback technology; thought control computing; virtual experiences; virtual existence - all of these and much, much more are in our immediate future. These will be remarkable new devices that create potential for amazing new possibilities.

But are we becoming the Borg? We will become the computer at the point when the power of the computer is no longer able to be viewed in isolation from humankind. Increasingly, we will live in an anytime, anywhere world where if you're not connected, you're really won't be computing. To really understand where we are and what we need to do, we must stand back and consider the profound implications all of these developments will have for education. And as always, mindset will be the key to bringing the many possibilities to reality.

Okay, let's stop for a moment and take a deep breath - I suspect that many of you are convinced I've gone right over the edge - that this will never happen - that the medication must be wearing off. My friend and colleague David Thornburg once said that the difference between science fiction and reality is that science fiction must be believable. That's because much of the reality coming down the pipeline at us right now is absolutely unbelievable. And while things may not turn out exactly like they have been described here, the bottom line is that these new technologies and their accompanying mindsets are coming at us like an absolute tidal wave. Without doubt, tomorrow's student will use voice activated/thought activated computers that will be directly connected to

the Global Digital Networks through such things as body-implant transceivers, wearable computers and transplanted cornea virtual retinal displays. Stuff that's worth a fortune or not even available today will be on the clearance table at Walmart tomorrow.

What impact will these developments have on the nature of schools?

### **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 real 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 this network from anywhere using personal, pocket, wireless, tiny-tech communication devices. We are already seeing the first signs of this today.

But why will this have such a dramatic effect on where students learn? First, 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, the worldwide network is 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/or 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 our pocket.

But this is just the beginning. AT&T has patents out for cellular telephones that will fit in your ring, your watch, the rims of glasses, a tooth, your cuff links, even 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, only limited by the size of our fingers and our imagination. Put all of these developments together and you can see that the "Dick Tracy" wrist watch communicator is just around the corner. But the real one will add super-computing power, and a worldwide network that can be accessed from anywhere 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 kind of powerful personal computer-communicators that will be available in the next few years, learning will literally 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 180 days a year, 5 1/2 hour day 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 it can be primarily driven by need and/or 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 aren't going to get it from the employer or the employee. This remarkable prediction is borne out by 1998 US Department of Labor statistics that tell us 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. Add to this that the Secretary of Education, Richard Riley, was recently quoted as saying that none of the top 10 jobs that will be available in the year 2010 exist today; and that these are jobs that will require workers to use technology that hasn't been invented yet to solve problems that we haven't even thought out yet.

We are entering an era that increasingly will demand "just-in-time learning." This contrasts dramatically with the "just-in-case" model currently used in most schools - just-in-case it's 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

information coming at us grows almost as quickly as the new technologies. By the time children who are now in Kindergarten graduate from Grade 12, information will have conservatively doubled itself 7 times, and technological power will have doubled itself nearly 9 times. It's 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 or more of what they learned will be obsolete, outdated, or just plain wrong on the day they graduate. Taking this further, for people attending university in 2001, 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 inventory, and begin to order the materials they need only when a customer orders a product from them.

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, marketing products, etc. Many businesses have some workers that are not actually working at any given time. Instead, they are pulled away from their regular duties in order to learn new techniques, methods, etc. that will soon come into play in their particular jobs. This kind of learning will become much easier when personal pocket-sized wireless computer/communicators allow workers to access information from wherever they are when the need arises. This technology will also make it much easier for students to learn in the same way.

### **3. Education will not be confined to a single person**

Traditionally, a single teacher was the sole source of teaching in the classroom. However, when students have access to technology and information any time they need it, 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. Students will be able to contact community and political leaders, business owners, scientists, and a variety of experts from many fields, as well as traditional school personnel such as teachers, librarians, counselors, and others from wherever they are.

In addition, language will increasingly become less of a barrier to any of these communications. Already, there is computer software available that will take typed text and translate it into any of the major languages in the world. There are also personal computers that will respond to verbal commands. Naturally Speaking and ViaVoice are similar software packages that automatically convert the spoken word into typewritten text as you speak. Although 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 interpreted by the 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. Students will benefit from the combined wisdom and experience of many people, while learning new skills and concepts. 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 haven't existed, will take to this like ducks to water.

To understand what is about to happen in terms of 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's 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. However, we must consider 2 key developments that will influence the direction that non-human instruction might take - expert systems/smart agents and hypermatation.

Let's consider expert systems/smart agents first. An expert system or smart agent is a computer program that is given general rules for its operation, as well as the capacity to learn from experience. In this way the program increases its power as it tackles specific problems. One example of this would be a system programmed to diagnose engine problems in cars. Such a system is 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. In this way, 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 program could have an enormous impact on education. In the previous chapter, 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.

For example, 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. This smart agent would learn from experience 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 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 text book anywhere. Personal smart agent technology combined with the global digital network will render the traditional role of the teacher as 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, that there is little time left over for teaching students how to process, synthesize, and evaluate what was found. 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.

This development should be welcomed by a teaching profession, who has for years bemoaned the lack of time and resources needed to teach higher-level thinking skills. As a consequence, 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.

Now let's consider the work being done on the development of hypermedia learning systems that we discussed in chapter 6 combined with personal pocket computer-communicators and smart agents. 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 at the teacher's desk of students waiting to get some help with the reading or math problems they are working on.

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 that is 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 seem difficult to accept because even though we live in a multimedia generation, the dissemination of information in schools is still essentially paper-based. It will not be long however, 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's difficult to get them interested in the 2-dimensional world of paper. That's because they live in a digital 3D interactive video world outside the classroom. Out there, they are already saturated with light and electrons so paper and ink aren't really in sync with their everyday reality. Educators and schools have to focus on this point of incongruity. Children today get up in the morning to 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 where they 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 could suck up and regurgitate information on demand were highly regarded and rewarded. However, this kind of intellectual and informational bulimia does not adequately prepare a person for the Information and Communication Age that we live in. 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 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. Whereas, in the old system, the emphasis was on getting students ready for tests, in the new emerging system, the emphasis will be primarily on applying what is learned, solving problems, and demonstrating the transfer of learning to new situations. Today, much information has a very short shelf life and therefore quickly becomes disposable. This implies that content specialization must give way to more general knowledge. In other words, 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 in the middle. The logical sequence was from beginning to end. This was the only way to do things. Until 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 turn the dial through channels 4, 5 and 6 first. Channel 4 was only connected to channels 3 and 5, channel 5 was only connected to channels 4 and 6, channel 6 only to 5 and 7, and so on. Now that we have digital channel changers, we can jump directly from channel 3 to 7 and back again without ever having to go through the other channels in between. As a result, every 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 lineal, logical, sequential model. With the introduction of new technologies, however, 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. As a result, technology has become the great equalizer, allowing, as David Thornburg says, 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 any 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 led 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 before imagined - empowering them to rise above their disabilities. In the future, it's possible that the definition of disability will reflect a person's ability to interact with technology. As a result, 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 - those who are unable to learn or unwilling to change as the world changes around them. As a result, 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 view people now 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 already 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 mind set used a predetermined, 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. Using this perspective, we thought there must be something wrong with the people who didn't fit the system. 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 defined environment, educators have had to become fire fighters managing the blaze and maintaining the perimeter. In doing so, some people have suggested that educators have become overzealous, and, in some cases, extinguishing students' love of learning completely. Educators must abandon this fire fighting mentality. Instead, 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 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 that technology will have on our current school system, let's now turn our attention to the skills, knowledge, understanding, and behaviors that students will need to develop in order to function effectively in this new environment of the 21st Century.

### **So what's the starting point?**

How do we get there. We must start by defining the gap between what our children leave school with and what's needed for them to survive let alone thrive in the culture of the 21<sup>st</sup> century. We must start by helping others understand that it's a new world out there. That change is absolutely essential if we are to make and keep schools relevant. To do this, we must rethink - Schools - Classrooms - Curriculum - Educational management - Redefine success - Rethink learning & what it means to be educated in the light of the modern changing world.

### **But wait a minute...**

You can forget all I've 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's about more than just 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, In the end, it's not a hardware issue, it's a headware issue. We need a new mindset. As David Thornburg says, we need to prepare students for their future not our past. Our job is not just to serve what is, but to shape what can, might and must be. Our children's future (and ours) depends on it

**You as futurist**

We must move beyond just contemplating the here & now to a strategic planning for future. But before we talk about what we do today, we must visualize future - a future not based on technology but on the social power of technology to fundamentally transform our world.

**A starting point...**

Start by acknowledging that adults live in old paradigm and that our kids, the Millennium generation, live in a new paradigm. We just don't relate to their present let alone their future. So the fundamental problem is that of relevance. We must focus on bringing about conceptual mindshift - we need to change our mindset.

But a simple caveat - don't try to change if society & schools attain everything that you aspire for easy to throw up your hands - but understand that trouble in life doesn't come from aiming to high and missing the mark, it comes from aiming too low and hitting the mark every time

**Making change**

We understand that change is hard - that change is messy - that change is uncomfortable! Given this, it's very easy to throw up our hands and walk away with a complete sense of overwhelm and hopelessness. How can we overcome this feeling? Let's digress for a moment. Consider the blue whale, the largest mammal on earth. It's the length of 3 Greyhound buses placed end to end, it weighs more than a fully loaded 747, and it has a heart almost the size of a Volkswagen Beetle. A blue whale is so big that when it decides to turn around, it takes 5 to 7 minutes to turn 180 degrees. Now there are a lot of people who draw a strong parallel between blue whales and schools. Both of them seem to take forever to turn around. From this perspective it seems hopeless, doesn't it?

But now it's time to shift our mind set. Let's compare a blue whale to a school of sardines that has the same mass as the whale. Unlike the whale, a school of sardines can turn almost instantly. How do they do it? Is it ESP? CB radio? Neither. If you take a closer look at this phenomenon, what you notice is that although all of the fish appear to be swimming together, in reality a small number of fish are beginning to swim in a different direction. As they head off on this new course, they cause conflict, friction, and collisions with the other fish. But when a critical mass of herring is reached (not a huge number like 50

percent or 80 percent of the school, but only 15 to 20 percent who are truly committed to the new direction), the rest of the school changes direction and goes with them - almost instantaneously!

If you stop for a moment and consider some of the major recent changes in the world, you'll see that huge swings in direction can happen very quickly. Isn't that exactly what happened in North America with respect to our attitudes toward smoking, and drinking and driving? Isn't that exactly what happened in East Germany and the Soviet Union when the communist governments lost their grip? Each of these changes were overnight successes that were years in the making and took a small group of truly committed individuals in order to make it happen. It's no different when we consider the necessary changes to our schools.

It's a complete myth that *change* takes time. It's making the *decision* to change that really takes the time. So where and how do we begin? By understanding that the longest journey starts with a single step - that the greatest movement starts with a single individual. And this means more than using rhetoric because rhetoric alone cannot reform schools. No, we need action behind our words if we want real change in our schools. And that will mean we have to stop doing what we are doing now and start doing new things. So it's up to us to take up the challenge and look through the windows on the future to see our part in this great opportunity to create new schools for the new millennium.

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