

# Understanding Digital Children (DKs)

## Teaching & Learning in the New Digital Landscape

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### Synopsis

**Children** today are different! But not just because they mature years earlier than **children** did even a couple of generations ago. Not just because of the clothes they wear or don't wear. Not just because they dye their hair and style it differently than we did when we were that age. Not just because they seem to have more body parts than we did – which they seem to want to pierce, tattoo, and/or expose. No, today's Instant Messenger Generation has grown up in a new **digital** landscape. For most of them, there's never been a time in their lives when computers, cell phones, video games, the Internet and all the other **digital** wonders that increasingly define their (and our) world haven't surrounded them. Constant exposure to **digital** media has changed the way these **Digital** Natives process, interact with, and use information. As a result, DNs communicate in fundamentally different ways than any previous generation. Meanwhile, many of us, the **Digital** Immigrants, struggle as we try to come to terms with the rapid change, powerful new technologies, and change in thinking that are native to their world – a fundamentally different world than the one we grew up in. This paper examines the new **digital** landscape and the profound implications that it holds for the future of education. What does the latest neuroscience and psychological research tell us about how the Instant Messenger Generation's brains are being rewired? What are the implications of this new **digital** landscape for teaching, learning, and assessment of that learning? What will it mean to be educated in the light of this modern, changed, and continually changing world? How can we reconcile these new developments with current instructional practices in an age of standards, accountability, and high stakes testing for all? What strategies can we use to appeal to the learning preferences and communication needs of **digital** learners? Prepare to have your assumptions about **children** and how they learn severely challenged.

### Understanding Digital Children (DKs)

#### Teaching and Learning in the New Digital Landscape

How many of you have **children** of your own? Don't be ashamed, you can put your hand up. Now how many of you have teenagers? Be assured that each and every one of you has our DEEPEST sympathies. Do you ever catch yourself watching **children** in performance mode and just shaking your head? Do you ever find yourself saying, "What's going on here? What's up with **children** today? I wasn't like that when I was that age. I wouldn't have DARED say or do that. Why are they so different? What could possibly be going on in that head? What could they possibly be thinking? What's wrong with this younger generation?"

#### Hold on!

At the same time others might say, "Hold on, you're wrong. You're being much too harsh! You need to relax a little. **Children** are **children**. They make look different. They may sound different. They may act different. But underneath it all, **children** are just **children**. They have the same issues, the same insecurities, the same hurt feelings, the same immature ways of looking and thinking about things that we did. They're basically the same way we were when we were that age." And if you believe this second statement, we want you to know that we totally respect your opinion even if you are completely wrong!

#### **Children** today are different.

**Children** today really ARE different! Really different! But not just because **children** today mature years earlier than **children** did even a few generations ago. Not just different in terms of the clothes they wear or don't wear; not just because they dye their hair and style it differently than we did; not just because their music is incredibly profane, has no rhythm, and is utterly incomprehensible (oops sorry for that editorial comment); not just because of the way they talk or what they say, or how they act; not just because **children** today seem to have far more body parts than we ever did growing up – body parts that they seem to want to pierce, tattoo, and expose.

## **Different Wiring**

No, what I'm talking about here is, because of **digital** bombardment, because of the pervasive nature of **digital** experiences, **children** today are also different neurologically. They have become screenagers. This is the first generation that has actually grown up with a mouse in their hands along with an assumption that they are supposed to manipulate and interact with the images on the screen – that screens aren't just for passive consumption. As a result of this, they're different in the way their brains are wired. How do we know this? A great deal of brain research, in what is called the neurosciences, has been undertaken in the past few years. This research is validating much of what we suspected from the psychological research, particularly the psychological sciences. The bottom line is that **children** today are **FUNDAMENTALLY** different from previous generations in the way they think, in the way they access, absorb, interpret, process, and use information. Above all, they are different in the way they view, interact, and communicate with the modern world. This holds profound implications for us both personally as parents and professionally as educators. Let's examine **WHY** this has happened and what it means for us.

## **Growing Up in a Different World**

Most of the people reading this article grew up in a different time. I can only speak for myself, but for me, it was a time of relative stability. For example, I had **TWO** parents! And here's a radical concept – they were my original parents. My father worked at the same job for the same company for more than 30 years. My mother stayed home to take care of the family and manage the house, so she was home when we got back from school. These were very different times because just thirty years ago in North America, only one in five families had both parents working outside the home. For me – for most of my generation – life was relatively stable and predictable. I can remember being able to set my watch by the time my father turned the corner and came home from work each evening – it was exactly 5:45 p.m. every night. We all sat down together for dinner – imagine this – for an actual home-cooked meal – with the entire family (including my original mother and father) – at the same time every night – 6:15 p.m. And Sundays were special. It started with church in the morning, followed by brunch, then playing outside in the afternoon, Sunday dinner, followed by Disney, Ed Sullivan, and then a bath, whether we wanted it or not.

## **An Amazing Rhythm**

For many of the people of this time and our generation, there was an amazing rhythm and predictability to life. Change was something that happened, but it seemed to happen slowly. And it wasn't just that life was predictable – our lives were also much simpler. When we came home after school on weekends and during holidays, we played with our friends outside on the street, in the backyard, or at the park, often until it got dark. We could do this because our world was relatively safe. Most parents didn't have to worry that something horrible was going to happen to us. Danger didn't seem to be lurking around every corner. This was due, in part, to the fact that there was a sense of community. Everyone looked out for everyone else and everyone seemed to know everyone else's business. And it was outside, on the street, in the back yard, and in the park where we learned many of our social skills. We worked in groups to solve problems. By turns we led, we followed, we fought, we reconciled, we negotiated, we planned, we built teams, and we learned to get along. And if we fought, it was with our fists – not weapons. And this all happened face-to-face, if not in-your-face.

## **A Low-Tech World**

Our world was decidedly low tech. Do you remember Etch-A-Sketch, Mr. Potato Head, or Slinkies? For me, the ultimate in modern technology was my 3-speed Schwinn Phantom bike and a transistor radio I hid under my pillow at night when I went to bed. Like most other families, we only had one TV. (Why would anyone ever need two?) It was located in the living room, and it was there where we sat together, as a family, watching our shows on the five available channels discussing what we saw. And if we wanted to see the latest movie, we had to go to a theater or a drive-in.

## **Imagination**

Back then imagination was essential. We created our own monsters and villains. Our stick became a sword. The rock was our horse. We rode our bikes with chunks of cardboard clothes pinned to the frame so we could sound like a motorcycle. And we drove our parents' parked cars by turning the steering wheel while creating our own sound effects. And because our lives were decidedly low-tech, probably one of the very worst things that could ever happen to us back then was to be

sent to our room because there was ABSOLUTELY nothing to do in there other than to reflect on our crimes. Do you remember those days?

## **Basic Communications**

Back then communications were basic. Many of us lived on a telephone party line we had to share with several other families. Long distance phone calls were expensive and often of poor quality. Letters took days from the time they were sent to when they were received, and the response took even longer. Telegrams were only used for important events. As a result, whether it was information, goods or communications, we had to learn to wait. We had to learn to be patient.

## **Limited Information**

Information was limited. We only had a few radio stations and even fewer TV channels. World events were something we read or heard about, often long after they had taken place. Information was finite because we lived in a largely single source world. This was a world that was primarily made up of text and paper. Most of our information came from newspapers, magazines, books, encyclopedias, and the library. High tech was an 8 mm film, a slide projector, or a hi-fi stereo. Multimedia meant it had a diagram or a photo. And almost nothing happened right away. We had to wait for everything, from information, to decoder rings, Mickey Mouse Club memberships, and mail order purchases.

## **Doing Research**

Back then doing research was a physical act. We went to the library and used the Dewey Decimal system to search the card catalog. Then we walked through the stacks, hoping we'd find what we were looking for. If we were lucky enough to locate the right book, we flipped through it trying to find pertinent information. Our primary sources for that information were Funk and Wagnall's, the Webster Dictionary, the Encyclopedia Britannica, the Book of Knowledge, or a textbook. This was information that could be committed to paper because our world and the information in it did not change very quickly.

## **The Schools of Our Youth**

The schools of our youth reflected the times in which we lived. They were predictable and safe. They were orderly and punctual. Having a weapon at school meant being caught with a slingshot, cork popgun, or peashooter. Schools had authority. Teachers and administrators were respected. Some students weren't as smart as others, so they failed a grade and were held back to repeat the grade over again. Tests were not adjusted for any reason.

## **School Discipline**

**Children** who misbehaved were dealt with swiftly. Some got detentions while others got the strap, the cane, or a ruler. Our actions were our own responsibility. Consequences were expected. And the vast majority of parents supported the actions of the school. The idea that our parents would rescue us if we got in trouble in school or broke a law was unheard of. But being sent to the principal's office was nothing compared to the fate that awaited us when we got home. Parents and grandparents were a much bigger threat! We sat in rows. The teacher talked. We were expected to listen. Most information came directly from the teacher or a textbook. The focus was primarily on content recall that was tested with fill-in-the-blanks or multiple choices. And as we progressed through the system, teachers became content specialists. Communications came through the PA system. Most classrooms didn't have a phone. In many classrooms, the most powerful technology was a piece of chalk and a blackboard. It was a big deal to have a film or filmstrip; and it was absolutely high-tech for a teacher to have an overhead projector and multi-colored pens. We could go on, but you get the idea. But that was the way it was back then, and in describing the way things were when we were **children**, we have examined the tip of the iceberg.

## **So what about today?**

In more ways than many of us can remember or measure, the world of today is a VERY different place than the one we grew up in. It is a world constantly on the move. It is no longer the stable place in which we grew up. In a few short years, the concept of family has moved from Father Knows Best to the Simpsons – from Beaver Cleaver to Beavis and Butthead.

## The Changing Nature of Families

For example, in North America, during the past 30 years, we have gone from 10% to 28% of families being led by a single parent. Beyond that, we now have blended families, interracial families, gay and lesbian families, families separated by divorce, multiplied by divorce, or just about any possible combination you can imagine.

## The Changing World of Living and Working

And the everyday world is different. Our rhythm of life is now dictated as much by work schedules as by family needs. In the 1950s, both parents worked in only one of five families. And this was typically a five-day work week. Sundays were sacred. Today, both parents work in one in two families, and it is a 24 hours a day, 7 days a week, 365 days a year world of work. In a 24/7/365 world, routines are harder to maintain. Family meals, family time, one on one time, quiet time, down time, and Sundays are more difficult to schedule than ever. As a result, life today has developed a fast food mentality both literally and figuratively. Today, things are a lot different. In 68% of American homes, the only parent or both parents work in order to make ends meet. According to David Walsh from Media Family, in a normal week, an average school-aged child spends 1/2 hour with dad, 2 1/2 hours with Mom, 2.2 hours doing homework, 1/2 hour reading for pleasure, and more than 25 hours watching TV. As a result of this changing world, parents today spend 40% less time with their **children** than parents did 30 years ago, and much of that time is spent watching TV and movies. The scarcest resource for many families today is not time, but attention. Consequently, there's a growing void in **children**'s lives that needs to be filled.

## Subtle Changes

This is not an overnight trend. There has been a steady progression as parents have had less time to spend with their **children**. Technology has filled the growing void. It started years ago with the telephone, radio, and TV. It then progressed to videos and video games. Now it is online gaming, email, surfing, online chatting, cell phones, blogging, texting, and a growing host of other **digital** experiences. Today, a growing percentage of **children** come home from school to no one, because both of their parents or only parent are at work. Consequently, many **children** are literally left to their own devices. But for a number of reasons including safety concerns, instead of playing on the street or at the park, many **children** now stay inside watching TV or videos, listening to music, playing videogames, chatting on Instant Messenger, blogging, talking on the phone, and surfing the Web.

## Gadgets as Babysitter

In this 24/7 world, these new **digital** gizmos have become the babysitter, the constant companions, and best friends for many of this generation's **children**. These devices are increasingly where today's **digital** generation finds their role models and learns their social skills. Their rooms are filled with people, relationships, interactions, and adventures that come through their computers, phones, and video games. As a result, this generation is equally as comfortable with virtual, screen-to-screen relationships as they are with face-to-face relationships.

## Contrast our experiences with theirs.

For our generation, the worst thing that could happen was to be sent to our rooms, but many **children** today are completely comfortable nesting in their **digital** cocoons.

## Today's High-Tech World

Today's world is decidedly more high-tech than our world was. 82% of American **children** play video games on a regular basis – an average of 8.2 hours a week. As a result, over 70% of dollars spent by **children** and teenagers on toys are for electronic games. Today's **children** have access to and take for granted having access to computers, remote controls, the Internet, email, pagers, cell phones, MP3 players, CDs, DVDs, video games, Palm Pilots, and **digital** cameras. These are tools and toys with capabilities that would have been unimaginable when we were **children**. For the Millennium generation, there's never been a time when these **digital** wonders have not existed. Consequently, they have not just adopted **digital** media – increasingly they have internalized them.

## A Different World

Let's be clear that this is a FUNDAMENTALLY different environment than the one we grew up in. It's a 600 channel TV universe. It's a 10,000 station radio universe accessible online. It's a 12,000,000,000 plus page Internet.

**Children** today take for granted that they can view world events as they occur – as TV mini-series that unfold before their very eyes. They see history in the making. They watch the collapse of the World Trade Center building, the downfall of Sadaam Hussein, the Sumatran tsunami, the eruption of an Indonesian volcano, or a hurricane in New Orleans. They watch these events in real time even when they are happening halfway around the world. Consequently, for them the notion of time and distance, which meant so much to us, means very little.

## Twitch Speed

This generation operates at what Marc Prensky describes as twitch speed. **Children** accept as normal that they should have instantaneous access to information, goods and services at the click of a mouse. They expect to be able to communicate with anyone or anything at anytime, anywhere day or night. Such everyday expectations have led to the death of patience and the emergence of a society increasingly expecting, wanting, and demanding instant gratification. This is one of the reasons why it is harder and harder to get **children** to read. Reading is a delayed gratification medium while TV, video games, and the Web provide immediate gratification. For example, I recently heard my son Kyler bitterly complain that it had taken him 20 minutes to register for his spring courses at college, which he was doing ONLINE from his bedroom! Anyone remember the good old days – the huge lineups and hours long wait to register for university courses? Remember finally getting to the front of the line only to find that the courses you wanted were closed?!

## The Emergence of the Web

Such assumptions and expectations about instantaneous access are the result of a massive shift of information and services to the Web. Today, from a desktop, from a laptop, from a handheld device, or a cell phone, **children** have instantaneous access to literally every library, every art gallery, and every museum in the world. And more relevant for these **children**, they also have access to friends, games, music, movies, shopping, cheat sheets, and more than 30,000 online clubs specifically designed to attract the Instant Messenger generation.

## An MTV Mindset

Because they have grown up with not just text-based information, but also images, sounds, and video presented as a single entity, this generation has developed an MTV mindset. For them, this is not multimedia. For them, as David Thornburg suggests, it is monomedia – it is all just **digital** 0s and 1s delivered by a single device. How they are assembled and viewed is entirely up to the viewer/user. And if you think that Sesame Street had an effect on how kids thought, you can imagine the effect of exposure to MTV, the Internet, and video games.

## A Visual World

This **digital** generation is completely comfortable with the visual bombardment of simultaneous images, text and sounds because such experiences provide relevant and compelling experiences that can convey more information in a few seconds than can be communicated by reading an entire book. Moreover, these new media are not just designed for passive viewing because increasingly, passive viewing doesn't cut it. This generation no longer wants to be the audience; they want to be the actors. They expect, want, and need interactive information, interactive resources, interactive communications, and relevant, real-life experiences – which helps to explain the rise in popularity of reality-based shows like *Survivor* and *Fear Factor*.

## A Global Trend

It is absolutely critical to stress that this trend does not just apply to those who have access to the latest **digital** media or the Internet. It even applies to the technological have-nots, the disadvantaged **children** on the other side of the so-called **digital** divide, who still have access to video games, cell phones, pagers, MP3 players and a multitude of other **digital** gadgets. In fact, this trend is not unique to North American **children**. It is pervasive around the world for most **children** regardless of socio-economics, culture, race, or religion. For example, the picture below was taken recently in the 300-year old Arab market in Singapore. For someone who has never experienced the Arab market, it is hard to describe the

overwhelming sensory experience – the sights, sounds, and smells of the street are absolutely overwhelming. According to the locals, other than electricity and automobiles, the scene is very little different than it would have been three centuries ago. This picture is of an 11 year old girl, who is sitting on a bolt of cloth patiently waiting while her mother barter for fabric. In her hand is a palm-sized wireless device she is using to surf the Web.

PHOTO NOT AVAILABLE

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

What's becoming abundantly clear is that this new **digital** generation is very different from our generation. Not just a little different, but FUNDAMENTALLY different. They crave access to tools that let them network with their peers or anyone or anything else they choose. And for them, it is second nature to multitask. They expect, want, and need tools that provide hyperlinks and instantaneous random access that allow them to simultaneously connect everyone with everything for instant gratification. They can be doing their homework, talking on the phone, listening to music, downloading movies, surfing the Web, and maintaining multiple simultaneous conversations on a chat line. And they are still bored. Comparing these experiences to our experiences growing up, these activities have increasingly become their replacement for what we did on the street, in the park, and in our back yards.

### **Where do they get their values?**

Increasingly, today's **children**'s values are not and will not be inculcated by the family, the church, or other institutions. They are and will continue to be developed by the electronic and visual media to which they are exposed. This is where they will learn many of their social skills as they have become increasingly immersed in the new **digital** landscape.

### **Digital Natives**

This is the first generation that has ever mastered a multitude of tools essential to society before the older generations. They have grown up **digital** – it is their native tongue. It's a language in which they are digitally fluent. They are DFL, The speak **Digital** as a First Language. They are, as Marc Prensky describes them, **digital** natives who have grown up in the new **digital** landscape. For this generation, there has never been a time when computers, the Web, cell phones, and all of the other **digital** wonders have not existed.

### **What about us?**

But most of the people reading this article and most educators grew up in the 60s, 70s and 80s. In much the same way that **children** today have been shaped by their world, we were shaped by our predominantly text-based, simpler, predictable, relatively stable, low-tech world.

### **The New Digital Divide**

Most people from our generation and our parents' generations are not **digital** natives. We don't speak **digital** as a first language. We are immigrants because we come from the old country. We come from the non-**digital** world. We come from a time and place before **digital** technology. And as a result, we have old country traditions and assumptions about the world. As Prensky writes, we are **digital** immigrants who speak, hear, and think **digital** with an accent. Like all immigrants, some of us are better than others at adapting to the ways of the new country, but like all immigrants, we retain some degree of our accent from the old country. As a result, we face a **digital** divide. Not just one based on the gap between the haves and have-nots, but one caused by the fundamental difference in the way we grew up.

### **Living and Working in a Digital World**

You could not live or work in another country unless you resided there and learned the language, customs, and culture. In much the same way, to operate today in the new **digital** landscape, we need more than superficial **understanding** of this **digital** landscape. We need a deep **understanding** of the language, customs, culture and learning styles of our **children**. If we do not have that understanding, students walk into class and listen to their teachers speaking to them, and they instantly hear their teachers' **digital** accent. For many of them, there is an immediate disconnect. Consciously or

unconsciously, they sense that many of their teachers are not a part of, not in synch with, and probably do not understand the world of the **digital** natives.

## **Digital Outsiders**

As **digital** outsiders, many of our generation, particularly in the over 30s group, are distracted and disoriented by multiple, simultaneous information sources and random access. We try to use old mindsets to do new things. We need to read a manual, take a course, watch a video, or talk face-to-face like we did in the park so many years ago. And while we may use the **digital** tools, their use does not always come naturally. So while today's children are DFL, we are DSL. We speak **digital** as a second language. That is why we are **digital** immigrants. Like all immigrants, some of us are better than others at adapting to the ways of the new country. But like all immigrants, we also retain some degree of our accent from the old country. The thicker the accent, the harder it is to understand and adapt to the new **digital** landscape. We struggle as we apply old thinking to new ways of doing things, new technologies, new software, and new mindsets. And the thicker our accent, the harder it is to be understood by the **digital** natives. You know you are DSL when you talk about dialing a number; when you need a manual or course to learn new software; when you use the Internet for information second rather than first; when you phone people to tell them about a Web site; when you print out your email to read it; or print out a report to edit it.

## **Digital natives learn differently.**

**Digital** natives on the other hand, pick up new devices and start experimenting with them right away. They assume the inherent design of the devices will teach them how to use a new gadget intuitively. This is because the **digital** native has adopted a mindset of rapid-fire trial and error learning. They are not afraid of making mistakes because they learn more quickly that way. They use devices experientially and have no problems getting help online.

## **Digital immigrants do not understand this.**

But many **digital** immigrants just cannot conceive how anyone could learn like this. So by the time a **digital** immigrant has read the table of contents of a manual, the **digital** native has already figured out 15 things that will work and 15 things that will not. While the **digital** immigrant is afraid they will break the device, the **digital** native knows they can just hit the reset button and do it all over again. In fact, for many **digital** natives, they see the world as one great big reset button. **Digital** immigrants focus on and try to apply the skills learned in another time. And as Steven Johnson points out in Everything Bad is Good For You, we often do not appreciate the skill development of **digital** natives – skills that **children** have honed to perfection with years of trial and error practice. For example, how many of you have ever played a video game with a teenager and lost? What some **digital** immigrants cannot appreciate is that the reason **children** do not have the same skills and literacies as we do is that there has been a profound shift in the kinds of skills used and needed to operate in the **digital** world. The reason their skill development is different is because their focus is different. They are developing skills in OTHER areas than we did - skills like game playing, online searching, and online messaging - and they do all of this simultaneously.

## **We just don't get it.**

We fail to understand, let alone esteem or value the skill development **digital** natives do have. Instead we complain about the skill development they do not have. Because **digital** is not our native language and because we are immigrants to their world, we unconsciously look down our noses at **children** who act differently. **Digital children** have a completely new and different set of skills than the ones we have and value. We tend to unconsciously assume that their skills not as good and they are not as literate as we are because they do not seem to value or prioritize our literacies. So, instead of embracing the new, instead of recognizing that the world has changed, many **digital** immigrants complain, remain attached to the old, and talk about how much better it was in the old country.

## **What We've Learned in the Past Few Years**

Because of this constant **digital** bombardment and the pervasive nature of **digital** experiences, **children** today are growing up **digital**. Because they have grown up **digital**, new research is inferring that the brains of the **digital** generation have and continue to change physically and chemically – they are actually wired differently than our generation. Even though we do not yet fully understand the incredibly complex processes involved in thinking and learning, it is important that we

take a closer look at what we have learned. First, consider that even today, we know more about outer space than we do about inner space. For example, even though the human brain is only 2% body weight, it uses 20% of the energy we consume. For what this energy is used, we are still not sure. Further, research tells us that we come into the world with about 50% of the brain wiring in place to handle critical functions. The other 50% happens after birth.

## Growing Up a Digital Immigrant

We know from both from the research and from personal experience that learning a first language or even a second language comes easiest to us during our first five years of life. For most of us, learning a second language becomes increasingly difficult as we get older. It is not that we cannot learn other languages, but when we do, we tend to have more of an accent and often have problems learning one or more aspects of the new language. Learning a language later in life is just not as easy as learning one early on. Let's use this observation as an analogy for what is going on with our children in the new digital landscape.

## Comparing Digital Immigrants and Digital Natives

Most digital immigrants prefer the telephone over IMing and texting, the newspaper over CNN.com, the weatherman over WeatherBug, face-to-face visits over email exchanges, journals over Google, maps over MapQuest, bookstores over Amazon.com, a daily planner over a palm pilot or blackberry, CDs over MP3s, a dictionary over Dictionary.com and still feel more comfortable walking to and around the library over searching online journal databases or Google.

## Children really are different.

Recently, these were cover stories in Time Magazine: Their conclusion was that children today are different. In fact, based on what we now know from the neurosciences and psychological sciences, what we are now beginning to understand is that children today are FUNDAMENTALLY different than we are in the way they think, in the way they access, absorb, interpret, process and use information, and in the way they view, interact, and communicate in the modern world because of their experiences with digital technologies. If this is the case, it holds profound implications for all of us personally and professionally.

## Conventional Wisdom

For the longest time, most neuroscientists believed that different areas of the brain were hard-wired shortly after birth to handle different aspects of brain function. Conventional thinking was that by the age of three, the brain was stable. From that point on, it really did not change. That by the age of three we had a fixed number of brain cells, which then started to die off one by one with no appreciable new cell growth. As a result, the longstanding assumption has been that we all had fixed memory, fixed processing power, fixed intelligence: that you were essentially stuck with what you were born with. And this was believed to be the case for all brains regardless of race, culture, or experiences. The conclusion was that we all thought in basically the same way because we all used the same neural pathways or brain circuitry to process and utilize information.

## What We Have Learned

But certain cognitive changes, such as recovery from brain injury or stroke, demonstrate that the brain had the capability to change itself given the right conditions. Over the past 20 years, new scanning techniques combined with neuroscience and neurobiological research have demonstrated in one brain area after another that the brain is actually highly adaptive and remains malleable throughout life. It is constantly reorganizing itself structurally based on input or experience and the intensity and duration of that experience. We know this happens because the research tells us that neural circuits are constantly being strengthened or weakened based on the intensity and duration of the inputs. Brain cells and their circuits operate on a use-it-or-lose-it, survival-of-the-fittest principle.

## What This Means

What this means is that you can change memory capacity; that you can change processing power; and that you can re-grow neurons and change neural circuitry throughout your life. As a result, this means that intelligence is not fixed. This holds enormous implications ranging from being able to enhance cognitive performance to being able to arrest or reverse



neural disorders. Teenagers' brains aren't getting bigger as they grow. The brain cells, called neurons, are simply rearranging, making new connections, and pruning unnecessary ones to speed and reroute the flow of thought. And by the way, it is neuron pruning--not hormones--that turns many teens weird.

## Neuroplasticity

This process of ongoing reorganization and restructuring of the brain in response to intensive inputs and constant stimulation is called neuroplasticity. So contrary to longstanding assumptions, the brain literally restructures neural pathways on an ongoing basis throughout our lives. It makes new cells, it creates new connections, it sets up new circuitry, and constantly creates new thinking patterns. There have been a number of new books written on neuroplasticity and **digital children**. In particular I would recommend Everything Bad is Good For You by Steven Johnson. Johnson argues that the plots of today's video games, movies, and TV challenge young viewers to think like grown-ups, follow intricate narratives, and analyze complex social networks. As a result, **Digital** Natives have become VERY sophisticated thinkers. The problem is that the many skills that **digital** bombardment has enhanced such as parallel processing, graphics awareness, and random access, which are sophisticated and valuable thinking skills that have profound implications for their learning, are almost totally ignored by educators and are not measured by the current school system. These are the minds of **children** growing up in nonlinear, light-and-sound-based culture. As a result, **Digital** Natives, who are accustomed to the twitch-speed, multitasking, random-access, graphics-first, active, connected, fun, fantasy, quick-payoff world of their video games, MTV, and Internet are bored by most of today's education. In the past few years there has been increasing concern expressed about **Digital** Natives fascination with multitasking – attending to several things at once. **Digital** Natives are completely comfortable with the sense of "highway hypnosis" – the ability to drive or multitask with little memory of the process of getting there. Human beings have always had a capacity to multitask. Mothers have done it since the hunter-gatherer era – picking berries while suckling an infant, stirring the pot with one eye on the toddler. Nor is electronic multitasking entirely new. We have been driving while listening to car radios since they became popular in the 1930s. But there is no doubt that the phenomenon has reached a kind of warp speed in the era of Web-enabled computers. It has become routine to conduct six IM conversations, watch American Idol on TV, and Google the names of last season's finalists all at once. That level of multiprocessing and interpersonal connectivity is now so commonplace that it is easy to forget how quickly it came about. Fifteen years ago, most home computers were not even linked to the Internet. Any number of dire predictions has been made about the long-term effect of multitasking on **Digital** Natives neural processes. This is not surprising. Ever since the time of Socrates, parents have had trouble dealing with their **children** – it is not that they are deficient; it is that they are different. Every generation of adults sees new technology, the new thinking behind it, and the social changes it stirs as a threat to the rightful order of things. Plato warned (correctly) that reading would be the downfall of oral tradition and memory. Ever since then, every generation of teenagers has embraced the freedoms and possibilities wrought by new technologies in ways that shock the elders and break away from the way that things have traditionally been done. Because most adults (including the critics) can't play the modern complex games themselves (and discount the opinions of the kids who do play them) they rely on secondhand sources of information, most of which are sadly misinformed about both the putative harm and the true benefits of game-playing. How kids now communicate, how kids read, how kids choose to interact with information and others does not conform to our traditional definition of literacy. Another related book is Daniel Pink's A Whole New Mind. Pink says that we live in a linear, logical, left-to-right, top-to-bottom, and beginning-to-end left-brained society. This is and long has been the mindset behind education. Pink states that the role of the right side of the brain, which handles pattern analysis, big picture thinking, and intuition have long been undervalued, underappreciated, and misunderstood in our left-brained society. Pink says that almost anything that involves left-brained thinking can be automated, turned into software or outsourced. For our **children** to be successful, they have to use both hemispheres together – they have to use the Whole New Mind.

## Qualifying This

The caution here is that brains do not just change spontaneously. To do this requires intensive, sustained, stimulation and focus over long periods of time. For example, learning to read and write requires our brains to be reprogrammed over extended periods of time. What we are talking about here is several hours a day, seven days a week. In the same way, watching TV for extended periods of time reprograms our brains. But again, this requires several hours a day, seven days a week. Do several hours a day, seven days a week remind you of anything else happening in our **children**'s lives today? This is increasingly what has been happening to **digital children**'s brains several hours a day, seven days a week since the arrival of Pong in 1974, followed quickly by SuperPong, Donkey Kong, PacMan, SimCity, and Space Invaders. In a recent study undertaken by Jupiter Research, it was estimated that half of all four to six year old **children** and 75% of teenagers play video games on hand-held devices, computers, or consoles several hours a day, several times a week. As a

result, regular exposure to the Internet, video games, computers, cell phones and a multitude of other devices that facilitate hypertext, interactivity, networking, random access and multitasking – this **digital** bombardment is literally wiring and rewiring kids' brains on an ongoing basis, and particularly enhancing visual memory and visual processing skills. A new Kaiser Family Foundation study shows that kids are not spending a larger chunk of time using electronic media. That holds steady at 6.5 hours a day. It shows that kids are packing more media exposure into that time: 8.5 hours' worth, thanks to media multitasking. The bottom line is that these experiences are rewiring **digital children**'s brains so that they process information differently than we do. We know this because of the Human Brain Project.

## The Human Brain Project

Over the past several years, a new field of study called neuroinformatics has emerged. Neuroinformatics involves the **digital** analysis of brain processes by means of neural scanning and imaging using the incredible number-crunching power of computers and our growing **understanding** of the chemistry and biology of the brain. Using powerful brain scanners and imaging techniques, we can now examine the functions of normal and impaired living brains non-invasively while they are involved in various cognitive tasks. With these technologies, researchers can digitally view and analyze a living brain's processing patterns at the molecular level in real time and 3D to determine what parts of the brain and what neural circuitry are being used during specific mental processes. This technology allows researchers to be able to pinpoint to within a few millimeters the parts of the brain that "light up" when people view vivid colors, or react to pictures of calorie-rich desserts, stare at pictures of fearful faces, move a finger, feel sad, or do specific tasks. This technology is helping scientists understand how different areas interact to handle even the simplest of tasks. As a result of these developments, we have learned more about how the brain operates in the last few years than we did in the previous 100 years. The cover article of the latest issue of Scientific American Mind is titled *The Teen Brain*. In it there are some photographs of people of different generations doing specific mental tasks. What the article and the research say is that if you were to take a **digital** electronic scan of our parents' brains doing a specific mental process and compare it to a **digital** electronic scan of ours doing the same mental process, we would quickly see that we use slightly different neural pathways to process, retain, and use the same information than our parents. But in the same way, if we were to take a **digital** electronic scan of our brains doing a specific mental process and compare them to those of **digital children**' brains doing the same process, we would find that they use significantly different neural pathways to take in, process, and store the same information we do. We see this particularly in the area at the back of the brain known as the visual cortex. Consider that the average video game takes about 40 hours to play, the complexity of the puzzles and objectives growing steadily over time as the game progresses. A study by the University of Rochester found that visual processing dramatically increases with as little of 10 hours of gameplay. According to a recent study out of Toronto, if you were to present 100 photographs to people of different generations, **digital** natives, those who have grown up in this new digital landscape, would be able to recall about 90% of the images. People of our generations, the digital immigrants, would be able to recall only about 60% of those same images. And people from our parents' generations, who grew up in a primarily audio and text-based world would only be able to recall about 10% of those same images. Further, research from 3M says that the eye processes and interprets images 60,000 times faster than it does words. This is because the brain is much more suited to processing visual information than anything else. Nerve cells devoted to visual processing account for about 30% of the brain's cortex, compared to only 8% for touch and 3% for hearing. If students are more inclined towards visual processing, do you think that this might hold any implications for the way they learn most effectively? Further, this study says that because digital natives think graphically, the eyes of digital natives move differently when reading materials. Their eyes skim the bottom and edges before they focus on the center. And while we find it a distracting to read text of different colors, specific colors attract and repel digital natives when they're reading - blood red draws attention first, then neon green and burnt orange are skimmed - and black is ignored completely. Do you think this finding might have any implications for strategies we might want to develop to teach reading? Both of these findings become even more significant because according to renowned writer Eric Jensen, at least 87% of students in any given classroom are NOT auditory or text-based learners, but either visual or visual kinesthetic learners. They are visual kinesthetic not because they are trying to drive us crazy, but because they have grown up that way in the new digital landscape. They are digital natives who are wired for multimedia. Yet as Donna Walker Tileston points out, despite this knowledge, at least 85% of the questions on all state exams continue to be based on text. According to Prensky, by the time they are 21, digital kids will have played more than 10,000 hours of video games, sent and received 250,000 emails and text/instant messages, spent 10,000 hours talking on phones, watched more than 20,000 hours of TV and 500,000 commercials. Almost none of these are experiences our parents or we had while we were growing up. Do you think these experiences might have any impact on the way they think, learn, and view the world? Because at the same time, these digital kids will have spent less than 9,000 hours attending school, less than 5,000 hours reading books, and much of that time is spent unengaged. Many of the recent findings from the neurosciences validate what we already knew about

teaching and learning from psychological sciences – things such as social learning theories, the need for context and relevance, the need to make connections to older learning, high challenge, low threat environments, and so on. However, some of the research has also exposed some widely held assumptions, myths, and simplistic beliefs about learning that can impede learning or that are just plain wrong – things such as gender stereotyping, left and right brain learning, enriched environments in early childhood, fixed intelligence, IQ as the measure of all intelligence, that all learners learn in the same way, or that memory fades as we age. We all process information in slightly different ways, but with the experiences and stimulation our children have been exposed to, the research is telling us that digital natives are using different parts of the brain to process information differently than digital immigrants. And by the way, we are beginning to see an accelerated gap between the younger generations – between teenagers, tweenagers, and younger children. Understanding this research helps to explain why children are different – why they act the way they do – why they view the world the way they do. And it also helps to explain some of the fundamental differences between their generation and ours. Despite the fact that there are more than 40 years of solid research on how learners learn best, of how the brain functions, of what instructional models are most effective, this research has not been widely accepted or integrated into most classrooms to help today's learners. Nor is it reflected in many of the assumptions that are the foundations of public education today.

### **Beware of Snake-Oil Salesmen Selling “Mind-Based Education”**

There is considerable hype being generated around recent neuroscientific findings. Interpretations of these findings have led to the emergence of so-called “brain-based education” models which have become fashionable in many schools and districts throughout North America. The reason for the hype is in part due to the fact that neuroscience is viewed in some quarters as being far more exciting than the considerable body of well-established, long-term psychological research. Brain-based education is held up in some quarters as a research-based panacea to many of the ills that beset education. Excuse me while I rant for a moment, but talking about brain-based education makes just about as much sense as talking about leg-based walking or mouth-based eating! What else should education be, if not brain-based? How about shoulder-based learning? How else do we become educated, if not by using our brains? It is important to carefully examine the research base of the many brain-based educational packages and training being offered to educators. A number of these packages are built on hype, myths, and misconceptions that reinforce deeply held erroneous educational beliefs and assumptions about learning. Gullible, solution-seeking educators and policy-makers desperate for immediate, measurable results buy into such products because research can be twisted around to explain, justify, and conversely discredit just about anything. This despite the fact that the hype is often based on isolated or limited research findings that have been glamorized, misinterpreted or misrepresented by overzealous publishers and the media. There is no need for you become a psychological or neurological expert complete with all the jargon and details of the brain and mind at your fingertips. However, it is important that you have a basic understanding of how learning actually does occur to in order to ensure that instructional practices are based on well-researched solid theories of learning. If you keep the following advice in mind, you will not go wrong: “By itself, brain research cannot be used to support particular instructional practices. It can, however, be used to support particular psychological theories of learning, which in turn can be used to design more effective forms of instruction.” James Byrnes, 2000, p. 185

### **How We Can Use Current Research**

What current brain research used in conjunction with psychological research does allow us to do is to make inferences and gain understanding as to why and how our children's experiences with the digital landscape are impacting their brains and minds so we can make good educational decisions. The bottom line is, if we cannot connect with as our children and build relationships with them by understanding their learning and communication practices, and applying this understanding to classroom practices, no amount of energy, money, or mandates will increase student achievement or address the challenges of state standards and No Child Left Behind.

### **What implications does all this hold for schools?**

It has long been known that talking and teaching AT students is NOT effective. You may have heard the saying: I HEAR and I FORGET. I SEE and I REMEMBER. I DO and I UNDERSTAND. We now understand that for information to be remembered, it must be moved from our short-term or working memory to our permanent memory. For information to be retained, four things must consistently take place.

#### **1. Making connections**

First, the new information must connect to something the learner already knows. Unless a connection is made, new content only stays in working memory for a few seconds. This underpins the difference between rote learning and meaningful learning. If it is not meaningful to the learner, the brain will quickly discard it. According to Eric Jensen, we discard 98% of everything that comes into the brain. For example, have you ever been introduced to someone and INSTANTLY forgotten their name? Or have you ever given students a test on something and they do really well, and then given them the same test days or weeks later, and it's as if they had never heard of the material before? This is the difference between rote learning and meaningful learning. Meaningful learning sticks.

## **2. Previous knowledge and experience**

Secondly, previous knowledge and previous experience determine not only WHAT learners will learn, but also HOW, WHEN, WHERE, AND WHY they'll learn. Consider for a moment the child of a colleague – let's call him Nils. Nils is a typical teenager, 16 going on 45. He is bright, affable, articulate, an exceptional reader, and a fantastic musician – but he is also a chronic C/D student, and he is particularly terrible with math. If you ask him why he can be so accomplished in some areas and so lousy at school, he will tell you that schoolwork just does not interest him. One night Nils came to me about 10 p.m. and asked me if I would like to play mini-golf. My response was that I would love to, but it was late so the local mini-golf place was probably closed. He looked at me shaking his head and then said, "Oh, you're such a last century thinker." He proceeded to take me out to an on-line mini-golf web site where all of the shots are based on understanding of geometric theory. He was sitting there explaining the difference between right angles, complementary angles, adjacent angles, and supplementary angles and proceeded to apply theoretical geometry to a real life mini-golf task. For Nils, for the 87% of learners in our classrooms who are visual or visual kinesthetic learners, it is not enough to memorize math formulas. They need to see how the formulas work and how they are applied in life. This is EXACTLY what Howard Gardner has been talking about for years with respect to multiple intelligences and learning styles. He says that learning is personal. It is all about the relevance of the learning to the learner – not the relevance of the learning to the teacher. If it is not relevant to the learner, even if it is relevant to the teacher, it will quickly be discarded.

## **3. Differentiated Learning Opportunities**

Thirdly, learners have to be given repeated, differentiated learning opportunities, distributed over extended periods of time. If kids do not get it when concepts are first introduced to them, we cannot start talking slower and louder. How do you get better at anything? How did you get better at driving a car, playing a sport, or knitting? By practicing it! Children need lots of practice and exposure to materials in different ways, from different contexts, and from different perspectives.

## **4. Feedback and reinforcement**

Finally, students must be provided with consistent feedback and have their efforts regularly and meaningfully reinforced. To be clear, this reinforcement goes well beyond a pat on the back, clapping your hands together, giving a thumbs-up or telling someone they did a good job. In fact, if the student knows that they are not doing their best work, and the teacher says, "Way to go! Good job!", it can have a negative effect on student learning. The kind of feedback that has the greatest effect on student learning is specific and detailed. It allows the student to examine his or her own work and evaluate it based on the teacher's comments. If these four things are consistently done, a measurable improvement in learning will take place.

## **The Impact of Media and Technology in Learning**

This is reinforced by a nifty little study undertaken a few years back in Michigan entitled *The Impact of Media and Technology in Learning* that was prepared for the Bertelsmann Foundation. Briefly, two groups of students taught the Civil War curriculum. One by traditional lecture means, the other using computers and other multimedia tools. At the end of the study, both groups were given an identical teacher-constructed test of knowledge. No significant test differences were found in the scores between the two groups. However, a year later, when an independent interviewer unconnected with the previous year's work interviewed the students in the design and control groups, significant differences were found. Students in the control group could recall almost nothing about the historical content, whereas students in the design group displayed elaborate concepts and ideas that they had extended to other areas of history. Most importantly, although students in the control group defined history as "the record of the facts of the past," students in the design class defined history as "a process of interpreting the past from different perspectives." In short, the "design approach led to knowledge that was richer, better connected, and more applicable to subsequent learning and events."

## **Let's pause for a moment.**

In summary, for effective learning to take place, for test scores to go up, for learning beyond the test to occur, four things must be consistently addressed. First, the new material must have meaning for the learner. That is the context of the experience. Secondly, the teacher needs to understand what knowledge and previous experiences students are bringing into the classroom. That is the relevance of the experience. Third, students must be provided with repeated opportunities to practice and use what they have learned. That is differentiated practice. Finally, students must be provided with regular and meaningful feedback. Without consistently using these four techniques, students will not retain or use new information.

## **Velcro learning**

Learning is based on making connections that relate the new to the familiar – nothing makes sense unless it connects to something within us. Learning is like Velcro. An unfiltered fact taught in isolation is not a complete fastener. Only one side of learning is made up of facts; the other side consists of stories, ideas, and images. Effective learners make attachments or relationships between their existing knowledge base and new information. Novice learners often just try to remember facts in lists. We all know this is a common strategy for students preparing for quizzes and tests. Information without context, interest, or relevance is like having only one side of Velcro – it just does not stick. Most of the information is gone in a matter of seconds. True learning can only occur when the brain can create meaning or relevance by establishing a Velcro connection through making relevant connections between past experiences and new information. When the two are combined, long term learning sticks powerfully to the student just like Velcro.

## **The Learning Pyramid**

This is dramatically supported by research from the National Training Labs in Maine. The Learning Pyramid, also known as the learning cone and the learning triangle tells us that on average we recall:

- less than 7% of what we read
- 7 to 20% of what we hear
- 20 to 30% of content simultaneously using two or more media, like looking at pictures or watching a movie
- about 30% of lessons involving demonstration
- about 50% of content that includes interactive discussions and watching demonstration
- 65-80% of content that involves practice by doing
- and more than 85% that involves the teaching of others as well as the immediate application of learning within the context of a real world task

All of this operates on a continuum from passive receiving and traditional learning with a primary focus on LOTS (lower order thinking skills) to active participation and a focus on HOTS (higher order thinking skills).

## **Standardized Tests for Non-standardized Brains**

In the face of this research, we need to acknowledge that we are using standardized, traditional tests to measure increasingly non-standardized brains. We are trying to fit round pegs into square holes. The vast majority of Ritalin and Adderall given to school children is to treat a disease called ADHD (Attention Deficit Hyperactivity Disorder). Children who suffer from ADHD are said to be inattentive, impulsive, and hyperactive. They often get bored easily in class, squirm in their seats, are always on the go, or don't get along with other students or the teacher. In other words, many children diagnosed with ADHD may simply be normal kids, full of energy, and bored out of their minds sitting in mind-numbing classrooms. They are hyper not because their brains do not work correctly, but because they spend most of the day waiting for slower students to catch up with them. These students are bored to tears, and people who are bored fidget, wiggle, scratch, stretch, and start looking for ways to get into trouble. It is not that they are ADD or ADHD, it is that they are just not interested. Their attention spans are not short for everything. Their attention spans are not short for games or music, or anything else that actually interests them. They have short attention spans for old ways of learning. As educators we just do not understand how different digital natives are. They are not just a little different. Today's learners are not the learners for which our schools were originally designed, and today's learners are not the students teachers were trained to teach. If we continue to take approaches to teaching and learning that we know are not working, then we have to ask ourselves – *Just who has the learning problem?* Because we do not understand the world of digital bombardment, a lot of kids think

they have to slow down when they are dealing with us. If we as educators want understanding, if we want retention, if we want success on state and national exams, if we want to address and exceed the mandates, if we want children to demonstrate proficiency beyond content recall, we cannot just lecture at them.

## **LOTS vs. HOTS**

The emphasis in the classroom cannot be on simple data information recall, low level thinking skills, and lots of information – what we call LOTS (lower order thinking skills and LOTS of information). If we want our children to be successful on tests, if we want them to be successful in life, our emphasis as professional educators has to be on more than just LOTS. More emphasis should be placed upon HOTS, higher order thinking skills and processes, on Bloom's Taxonomy of Higher Order Thinking, on critical thinking, problem solving, project-based learning, Gardner's analysis of multiple intelligences, and the application of best practices based on an emerging understanding about how learning takes place. As Daniel Pink writes in [A Whole New Mind: Moving From the Information Age to the Conceptual Age](#), there is an emerging world where critical thinking, problem solving, and a deep level of information fluency is increasingly more important than content recall by itself. Research tells us that people who grow up in different cultures do not just think about different things, they actually think differently. As educators we have to understand how truly different our students are. In the past, most of the changes we experienced were about style. As we grew up, we saw incremental changes in clothing, language use, body adornments, music, and lifestyle. But for anyone 25 and younger, the changes and differences go far deeper than just style. They are largely driven by the arrival and rapid dissemination of digital technology in the last decades of the 20<sup>th</sup> century. This shift is so fundamental that there is no going back to the way things were. As educators, some of us pay lip service to the notion that this generation is different. We nod our heads but then we shut the door and go back to business as usual. We really do not understand their digital world, and we never will until we take the time to honor and respect where they come from. To do this, we have to be willing to acknowledge their world and start to educate ourselves and our families about that world. Start asking kids the right questions – play videogames with them, explore their online world, open a MySpace account, create a wiki, write a blog, learn how to use IM or become a thumbster. If you have no idea what I am talking about, you have lots of work to do. To truly understand them, we need to immerse ourselves in the new digital landscape. Watch them, ask them, listen to them, challenge them, and more than anything else, respect and honor them. In doing so, we will be able to leverage their digital lifestyles and help them become better, more engaged, more independent learners. Ask yourself this question: How many of your students would be in your classroom if they did not have to be? Are they there because they want to be? Or are they there because they have no choice? And what can we do differently to help more students want to be in our classes? This is not about abandoning your long time practice as teachers, and this is certainly not about creating some far-out vision for learning in the future. But at the same time, this is not about continuing to fixate on the world of yesterday. Rather, it is about understanding that the world has changed, that students have changed, and therefore schools must change. On one hand, we need to honor the successful tradition of schools. At the same time, we need to acknowledge that the world has changed our children – and it will continue to do so. As a result, we also have to acknowledge the different abilities and learning preferences of digital natives. The starting point for us as teachers is to understand how digital kids think and process information and use this understanding to figure out what we can do to differently to take advantage of their digital preferences by modifying what we teach and how we teach it.

## **Some Critical Questions**

- What implications does this research on the brain, the mind, and learning hold for schools?
- What implications does this research hold for how teachers do their job?
- What will students need to know and do to be able to function in the coming ages?
- What will it mean to be educated in the 21st Century?
- Does this research have any implications for teachers' roles in addressing the learning and communications preferences of digital children?
- Do our schools, classrooms, and teaching practices reflect the dramatic changes that have taken place in our world during the past few years?
- Do schools reflect the reality of the world as it is?
- Do our assumptions about teaching and learning align with the issues raised by this research?
- Do our schools reflect our past, our values, our thinking, our perspectives, our experiences, our comfort zones, or us?
- Is there dissonance between what was and what is?
- Is there a dissonance between what is and what should be?

## **It is Déjà Vu All Over Again**

Just like 50+ years ago, many students still sit in rows; the full-frontal lecture, oral tradition continues. The current curriculum primarily stresses content without providing a context. In doing so, we equip our students with little more than the ability to regurgitate meaningless facts; many teachers still chalk and talk; students are still expected to learn primarily by listening; most information still comes from the teacher or textbook. While we do have some new technologies, using them is generally optional and not integral. Typically it is used to reinforce old practices and assumptions about learning. The methodologies underlying the technologies and the methodologies underlying instruction have changed very little. Most importantly, the focus still remains on content without context and low-level content recall. Today's standards and high stakes testing are simply reinforcing this, making it harder for schools to adapt in response to the dramatic changes that are occurring outside of education. It is becoming increasingly evident that there is a fundamental disconnect between the way children think, learn, and communicate and the ways that schools interact with them.

## **The Condition of Education**

This is reflected in startling new data gathered by the Center for Education Statistics, a website often cited as containing the type of research-based resources required to align with the mandates of No Child Left Behind. In *The Condition of Education*, the data shows the seriousness of the disconnect between the real world of high school students and the real world of schools. According to a report released in February 2004, 6% of white children, 29% of African American and 24% of Hispanic children were at-risk. A new cumulative method of calculating dropout rates has found that only about half of all black, Hispanic and American Indian students who entered ninth grade in 2000 were expected to graduate in 2004. The study, which breaks down data by state, gender, and ethnic group, projects the national graduation rate would be just 68% in 2004. Beyond this, children's views of the relevancy of their school experience to their future lives have declined steadily and dramatically since the late 1980s. According to *The Condition of Education*, only 28% of 12<sup>th</sup> grade high school students believe that schoolwork is meaningful; only 21% believe that their courses are interesting. Only 39% believe that schoolwork will have any bearing on their success in life. These statistics are even more shocking when one realizes that these are only the opinions of those students who have remained in high school for four years. The students who find the high school experience the least relevant have already exited the system in huge numbers. The Carnegie Institute reports that in the largest 32 urban districts in our country, only 50% of students who enroll actually graduate. Each day, they estimate that 2,000 high school students drop out. If their voices were included in the above poll, the profile would be far worse.

## **Why has this happened?**

Well, who is in control of education? We are! So what is wrong with that? We are digital immigrants. We come from a time before most of the dramatic developments in our world occurred. The schools of today reflect our comfort zone, our experiences, our views of technology, our views of instruction, and our views of learning. We have not allowed the institutions of education to reflect the world of today, and we are now in the unenviable position of having schools that increasingly reflect a world that does not exist. And for younger teachers, even though you may have been born into a digital world, your educational institutions modeled a non-digital approach to learning. And thus schools today largely reflect our educeentric decades-old view of how learning should take place. The methodologies underlying many of our assumptions about instruction have changed very little from our youth. The primary focus still remains on content without context, low-level content recall and LOTS. If we are truly honest with ourselves, we will acknowledge that today's standards and high stakes tests are simply reinforcing this focus. We will also acknowledge that some teachers are silently delighted because this validates the way they have always taught and tested. It reinforces the notion that they do not need to change; it is the students who need to change.

## **So who are we as educators?**

Are we the learners, or are we the learned? More importantly, do we want our children to inherit the earth, or do we want them to be highly educated useless people; children who are good at school but unprepared for life? The reality is that No Child Left Behind is driving us. We cannot ignore these mandates. We cannot just pretend they do not exist. So how do we address the issues of standards, high-stakes testing and accountability while at the same time addressing the growing dissonance between digital children learning and digital immigrant instructional styles? How can we ensure that truly no child or teacher is left behind? This is not about creating some far out vision for learning in the future. Conversely, it is not about continuing to fixate on the past. It is about understanding that as professionals, we must address the issues of

standards and accountability on one hand, and the abilities and preferences of digital learners on the other. If we can do this, we can create engaged learning environments that are based on solid and well-established research. First we must understand how different we really are from digital natives.

### **Summarizing the Real Digital Divide**

- Native learners prefer receiving information quickly from multiple multimedia sources while many teachers prefer slow and controlled release of information from limited sources.
- Native learners prefer parallel processing and multi-tasking while many teachers prefer singular processing and single/limited-tasking.
- Native learners prefer processing pictures, sounds, and video before text while many teachers prefer to provide text before pictures, sounds, and video.
- Native learners prefer random access to hyperlinked, interactive, multimedia information while many teachers prefer to provide information linearly, logically, and sequentially
- Native learners prefer to interact/network simultaneously with other students while many teachers prefer students to work independently.
- Native learners move seamlessly between real and virtual spaces instantaneously – chat rooms, blogs, wikis, podcasts, email, discussion threads that come and go – while many teachers prefer to operate in real spaces.
- Native learners want instant access to friends, services, and responses to questions, instant gratification, and instant rewards, while many teachers prefer deferred gratification and deferred rewards.
- Native learners prefer learning that is relevant, instantly useful and fun, while many teachers prefer to teach to the curriculum guide and standardized tests.

### **This is not a matter of who is right or wrong.**

This is not a matter of them or us. It is not a matter of which way is better. The bottom line is that children ARE different. They communicate differently than we do. They are motivated by different things than we are. They process information differently than we do. And most importantly, they learn differently than we do. To teach effectively today, we need more than superficial understanding of the digital landscape. We need to understand, honor and speak in the language, customs, culture, and style of children. This is not about being hip, it is about a fundamental reconsideration in our approach and understanding of how information is processed, how communication takes place, how information is remembered, and what skills are needed to solve problems and operate in this environment. This requires far more than just a continued reconsideration of our content. We also need to carefully reconsider our methodologies.

- This requires making learning fun and more relevant to them and their world.
- This means going faster so they can receive information quickly.
- This means less step-by-step instruction and more random access, hyperlinked, just-in-time learning experiences.
- This means less text and more pictures, sounds, and video wherever possible.
- This means providing more opportunities for multitasking, networking and interactivity.
- This means applying what we now know from the brain and mind research about learning.

### **This also means understanding that there are now two kinds of content.**

The first is our traditional content: reading, writing, arithmetic, geography, civics, history, languages, the sciences, and logical thinking. While some of these content areas will become more important as our world changes, others will become less important. There is also a second kind of content, what we call 21<sup>st</sup> century skills. These include critical thinking, problem solving, the structured teaching of process skills combined with personal life skills, interpersonal life skills, team skills, communications skills, information fluency skills, technology fluency skills, visual fluency skills, biotechnology, and bioethics skills. We cannot do it all. We have to get rid of some of what is not as important as it was when we went to school to make room for teaching our digital native learners the skills they need for their future lives.

### **Fixing education – why do we continue to struggle?**

Education is an emotional subject because we are talking about our children and their future. For that reason, it is essential that the public be regularly reassured that all is well. They need to be left with the feeling that schools are doing a good job and that their children are cared for. Because of the emotional nature of this issue, educators, politicians, and decision-



makers spend a great deal of their time encouraging people to believe that their policies and their programs are having a positive effect on schools. This is why reports on just about everything from test scores to attendance to innovative initiatives to sports programs are designed to put schools and the school system in a positive light. Think about the kinds of information that come from the Department of Education. They do not generally focus on the problems. This approach to addressing the issues is nothing but a façade that masks the real issues. The digital divide has created a fundamental disconnect between students and the schools they attend, particularly as it relates to how and what students are taught as they progress through the school system.

## **The Generational Divide**

But it is more than just a matter of disconnect. There is an additional problem – a problem that is invisible to most people. It is the issue related to the real digital divide. It is about more than the widening gap between the haves and have-nots and the know and know-nots. It is about the generational divide based on the age gap between the digital and the non-digital generations. This is a divide that most people of our generation cannot, do not, or will not recognize unless they live in that world every day. The digital, interactive, visual world is an experience unlike any previous generation has ever experienced. As I outlined earlier, there is strong evidence that digital bombardment is fundamentally altering the way that the digital generation thinks and views the world. This is something that most adults including many educators just do not understand or accept. That said, it will not be possible to engage young people in an educational system where the quality of experiences the schools provide are not as inviting or engaging as the quality of the experiences they get outside of school, through the Internet, computer games, teen magazines, and interactive TV. All of these experiences are designed specifically for them. This is particularly the case when you compare these experiences to the experiences provided by the existing educational model – a model that was essentially designed for the life and times of 100 years ago. In addition, there is an accountability problem. Many well-meaning politicians, parents, and adults understand the critical role that public education plays in a democracy, and they appreciate the critical role that education plays in creating an educated new citizenry and workforce. So with the very best of intentions, they have tried to make the school system better by constantly tinkering with schools and offering the ongoing reform of the day, week, or month. The problem with the reform-of-the-week mentality is that education is a complex issue. These same well-meaning people have sought simple solutions to the complex educational issues, and they have done this by deifying content recall and raising test scores. There are several huge problems with this primary focus on raising test scores. The major emphasis of test score fixation is on LOTS (lower order thinking skills) and short-term recall of information. Using this approach, students pass the tests, but their retention of the information is short term. Learners are not provided with the opportunities to develop the necessary HOTS that are increasingly required for jobs and dealing with the growing complexity of the digital world. As Thomas Friedman in *The World is Flat* and Daniel Pink in *A Whole New Mind* point out, computers, high speed communications, and a wide range of powerful new technologies are taking over more of the lower level repetitive tasks and allowing many types of jobs to be automated or outsourced. At a time when our world requires higher level thought and the application of content to real world circumstances, we continue to focus on lower level thinking in schools. What is wrong with this picture? The key skill that students develop with a content focused curriculum and associated standardized tests is memorizing information. While memorization is not a bad thing, as Friedman and Pink note, it is decreasing in importance in the online digital world. Besides, we have all heard the complaints that students today cannot focus and cannot remember the names of the states or their capitals. But this same student, who cannot remember his capitals, can clearly, concisely, and instantly identify the attributes and abilities of dozens of characters in a multitude of video games. So when a teacher asks kids to find and memorize the names of the capitals of the 50 states, the student is thinking, “I can find that out any time I want to in seconds on Google.” Meanwhile the teacher is thinking, “What’s a google?” It is not that students cannot memorize. It is that they cannot see the relevance of having to memorize things. They just do not think that way. This is what has led to the disconnect. Students have a just-in-time mentality – an *I’ll get the information when I need it* mindset. Students are more interested in a general conceptual awareness of the world, not just a factual awareness of the world. Our continued fixation and focus on a factual awareness of the world is what has led to many of our problems. We live in the Age of InfoWhelm. The amount of information in the world is growing at an exponential rate, which is reinforcing the decreasing importance of memorization, while at the same time increasing the need for a general conceptual awareness of the world. In light of these developments, the current primary focus on traditional instruction and content-based, low-level recall testing just does not make sense and it certainly cannot continue. By focusing on content and emphasizing memorization at the exclusion of all else, we are failing our students with the best of intentions. And there is more. If we want to fully understand why students are disconnecting, we also need to acknowledge that the rush towards accountability is forcing teachers to teach to the test, which means that there is a narrowing of focus in the classroom to tasks that are intended to enhance short term memory and content recall. This continued focus is having a disastrous effect. Students are disconnecting because schools are so boring. This is because

many of the broader activities that address the conceptual nature of world, the complexity of modern life, and the contradictory nature of being are experiences that lead to more educated citizens. But today, much more engaging activities for students are being dropped because they are not assessed or are difficult to assess. A focus on test scores says something has to go. Teachers are not stupid. When your evaluation is based on student test scores then HOTS are inevitably the casualty. This narrowing has made the classroom less interesting at precisely the wrong time. In our rush to accountability, we are losing our students. We are actually making schools less relevant and less interesting for students. This is an absolute recipe for disaster. In the short term, we get the warm fuzzy that test scores are going up and that therefore schools are accountable – they are doing their job. But at the same time what is lost is interest and engagement in learning. This is a classic example where the operation was a success but the patient died. Schools must change drastically if we are to reverse this growing disconnect. If we are going to make schools more relevant, there are five fundamental changes that need to take place. First, we must shift instruction to the higher level thinking skills needed for the 21<sup>st</sup> Century. Using left-brained thinking in conjunction with right-brained thinking will increasingly be more valued than simple content recall. The second point is that we must embrace the new digital reality of the online, computerized world described by Friedman and Kurzweil. But this will not happen just because a school has a high-speed network or students have access to laptops or handhelds. If the resources are used to reinforce old mindsets about teaching and learning, little will change. Outside of schools, the digital world has fundamentally and forever changed the way things are done. This is not just the case for business but for many aspects of our life. This new digital landscape is allowing students access to information and learning experiences outside the classroom and away from schools. This is access to experiences that have traditionally been solely the domain of teachers and the adult world. From home, at the mall, whenever and wherever they are, students have access to information, music, original sources, and multi-media full motion color images from friends and acquaintances, as well as people who might have diametrically opposed perspectives. But with our increasing fixation on testing, this means that we are not able to provide them with the guidance and direction they need to develop the essential skills required to effectively use these resources. Instead, students are defining where they go, how they get there and what they do when they get there. This is compounded by the fact that many adults and educators are not immersed in the new digital reality of students. We do not have the experience, skills, or even the inclination to help them even if we have the time. Schools and teachers persist in using new technologies to reinforce old mindsets. These are issues beyond computers and networks and way beyond testing. To understand their world, we must be willing to immerse ourselves in that world. We must embrace the new digital reality. Third, we must address the shift in thinking patterns that are happening to digital students. They live and operate in a multimedia, online, multitask, random access, color graphics, video, audio, visual literacy world. As Steven Johnson points out in Everything Bad is Good For You, these new literacies are generally not valued, not recognized nor addressed in our schools because they do not represent our traditional definition of literacy. The starting point is to understand how much differently they learn and then to reconsider what we can do to modify what we teach and how we teach it. In the minds of some well-meaning policy makers and many parents, achievement simply means raising test scores in basic skills. But mastery of only the basic skills is absolutely insufficient preparation for the modern world. In fact, this emphasis exclusively on the traditional literacies at the exclusion of all else may exacerbate students' alienation from schooling. We must provide a second kind of content to prepare them for the world ahead and to provide them with the skills that they will need to master a world of constant change. These include critical thinking, problem solving and the structured teaching of information processing skills, reading critically, speaking and writing persuasively, being able to apply mathematical and scientific principles to solve real-world problems, and being able to weigh current events through the lens of the world's great cultures. They also must be able to mine the World Wide Web effectively and efficiently and understand the meaning embedded in charts, graphs, audio, video, and animation. They must experience new approaches to learning that are inquiry-based and collaborative. Getting students to do well on our tests is like stepping on the first rung of a ladder. If we go higher up the ladder, we will easily beat all of the elements of accountability while at the same time recognizing the shift in thinking patterns among digital students. Fourth, we must broaden evaluation to encompass activities that provide a complete picture of students' learning. As management guru Tom Peters says, "What get measured gets done," and conversely, "What doesn't get measured doesn't get done." It is imperative that we begin to measure more than information recall. Schools act like a doctor who only takes height and weight and then says, "Here's a complete picture of your health." We test students using standardized instruments that measure informal recall and low level understanding and then say, "Here's a complete picture of a student's learning." A complete picture of student learning would also include portfolios of performance and demonstrations of the application of theory to solve real world problems. It is presumptuous for us to say that current test scores are a complete indicator of student learning. Finally, we must increase the connection between instruction in schools and the world outside if we hope to increase the relevancy of the learning that takes place. Students must perceive the relevancy of what they are learning. They need to understand not just the content, but also the context of that content, and how that content is used in the world outside of schools. But for this to happen, we need to systematically work to bring the outside world into our schools while at the same time sending

our schools into the community. New technologies and an understanding of the new digital landscape can help us do that. The online world creates virtual highway and virtual hallways to both the local and the global community. If we want to unfold the full intellectual and creative genius of all of our children, if we want to prepare them for the new world that awaits them, if we want to help them prepare for their future, not our past, if we are going to march through the 21<sup>st</sup> Century and maintain our tradition of success we must create a bridge between their world and ours. There needs to be fundamental shift in how teaching and learning takes place in schools. We must look for alternatives to the traditional organization of schools. We need to reconsider our longstanding assumptions about teaching and learning, about what a classroom looks, where it is, the resource that used to support it. We need to reexamine the use of time – the length of the school day and school year, the school timetable, and we need to re-examine traditional methods and consider the potential of online, web-based, virtual learning that can be used to augment, extend, and transform the role of the traditional classroom teacher. Teachers stand in the gap between the present and the future. It is your energy, creativity, commitment, and hard work that builds the bridge so children can cross the gap between now and the future. As they do, so does an entire nation. You are your country's greatest hope and most important professionals.

“The world we have created is a product of our thinking. It cannot be changed without changing our thinking.”

- Albert Einstein