

# **Making Schools Work in the 21<sup>st</sup> Century**

**Why it can't be business as usual in schools**

**By Ted McCain**

- What I mean when I say making schools work in the 21st century I mean that we will organize our schools & adjust our instruction to prepare the next generation for success in the increasingly complex & interconnected modern world
- I also mean that we will create in students a love for learning & inspire them to see this as a worthwhile life-long endeavor
- But we face some significant challenges

## **1. Schools are not engaging students**

- I remember having a problem with the behavior of some students in my first year of teaching so I went to Mike Josiah, a master teacher in our school for advice
- He said, "The key to classroom management is engaging methodology"
- What Mike was saying is really quite simple - if your instruction is interesting, then you won't have behavior problems
- Interest is the key to effective instruction
- I now believe that generating interest is the prime task of any teacher
- Richard Saul Wurman puts it this way...
- Learning can be seen as the acquisition of information, but before it can take place, there must be interest; interest precedes learning
- Wurman has another way of underlining the importance of engaging students in learning
- He says that instruction without interest is like having only one side of a piece of velcro - it just doesn't stick
- To have velcro learning we must have instruction and interest

- But here is the problem:
- In the rush for accountability in schools, in the push for higher test scores, a major casualty has been interest & engagement
- Neil Postman said students enter the school system as a question mark wanting to ask & learn & they leave as a period
- It is a tragedy that school can rob kids of their desire to learn
- Is that what we want? Of course not
- We want engagement, we want interest, we want velcro learning
- But the killing of a young person's desire to learn is being repeated over and over again in schools all across North America
- The lack of engagement in school is a major problem that we must address
- And this problem goes hand in hand with the next issue we must deal with as we try to prepare students for success in the modern world

## **2. Schools are not connecting with the world outside**

- What are our mandates in public education?
- We have two mandates
- First - the acculturation of an individual
- Passing on the accumulated wisdom of our society through literature, poetry, history, geography, science, mathematics
- Also an appreciation of the aesthetic, philosophical, moral, ethical through art & music
- But we have a 2nd mandate
- Equally important to the first
- That is to prepare students to be productive members of society
- Learning to work, acquiring useful skills for the world of today and the future
- To do this effectively school must connect with the world at large

- But this is not one of our strong points
- But this is not a new problem- Here's my story of leaving the school system
- I did a bachelor's degree in computer cartography - then into a Masters program
- At 23 I took a break to earn money for school
- My grad school advisor arranged a job with a cartographic company - hired as a programmer
- I used university computer to do the things I had done in school to make maps
- And I convinced company they needed a computer
- Then they did something that caught me completely off guard
- I was called into the president's office and told they were impressed with what I had made the computer do
- So they wanted me to recommend on the purchase of a minicomputer
  - Gave me a budget of \$500,000 (this was 1978 - cheapest \$200,000)
- Told me to travel around the world to do the research
- Gave me 6 months - then left me on my own... So how did I do?
- Not well
- This was my first real-world problem to solve
- Not a theoretical exercise - a real problem with real money being spent by a real company
- No one there to tell me what to do
- Where do I start?
- Where do I get the info?
- More importantly - How do I assess the information I do get?
- I faked it
- But the problem was I didn't have time to learn on the job
- I was fired after 4 months
- I was absolutely crushed
- Looking back now it's obvious what I should have done but at the time I was at a loss
- Why did this happen?

- Not because I was uneducated
- Not because I was stupid
- Not because I was uninterested
- Not because I chose a field of study that was impractical - I was in Computer Science
- So why?
- Because all I had were school skills
- Those skills necessary for success inside the school system
- Those skills that are the ticket to higher levels of schooling
- But I was unprepared for the world outside school
- I could write an essay, do a lab report, write computer programs, but I was a highly educated useless person with no real world problem solving skills
- Half of my education began at 23 - the real-world part
- It was disillusioning for me and it's disillusioning for kids today
- Kids are recognizing the increasing irrelevance of school & many are leaving the system altogether
- According to the 2005 report, "Getting Honest About Grad Rates" by Daria Hall & in 2005 the report "1/3rd of a Nation" from Education Testing Service
- More than 1/3<sup>rd</sup> of students & almost 1/2 of minorities drop out before finishing high school
- Among the states, the lowest grad rate was in Arizona - only 55% of youth graduated in 2000
- In Texas only 67.7% graduate - 1 in 3 drop out
- Even if there is some debate about the exact graduation rate, these are not numbers to be proud of
- Data from The Center for Education Statistics in the report "The Condition of Education 2002", shows the seriousness of the disconnect between the school world & the rest of life
- Kid's view of the relevancy of their school experience to their future lives has declined steadily since the late 1980s
- Today
  - only 28% of 12th-grade high school students believe that school work is meaningful
  - only 21% believe that their courses are interesting
  - a mere 39% believe that school work will have any bearing

on their success in later life

- These stats are more shocking when one realizes that these are the opinions of those students who have remained in high school
- Students who find the high school experience the least relevant have already exited the system in huge numbers
- If their voices were heard in the above poll, the profile of the relevancy of school would be far worse
- For those who do remain in school, their blunt assessment of the interest level & relevancy of school is an indictment
- Kids' disconnect with the usefulness of school should be a wake up call to all involved in education
- We should have all the motivation to try new approaches to learning
- An it's going to get worse because the world around us is changing
- Bringing new opportunities for learning & new demands on education
- So let's look at the third challenge we face as we try to make schools work in the 21st century

### **3. Schools face a world on the move**

- The world of the near future (read 5 to 10 years) will be more different & more fantastic than we could have dreamed and have a more profound impact on education than anyone here has imagined - even me
- How can I make such a statement?
- Because the world of the 21st century is based on a new kind of change
- That no one in this room has fully experienced before
- 21st century life will be marked with continual and ever-increasing change based on exponential development
- This is not change that happens incrementally, but change where the impact of development is sudden, massive and overwhelming due to doubling, tripling & even quadrupling of power each year

- Let's look at 4 trends that are developing exponentially that will impact us greatly

## **i. Awesome Tech Power**

- The astounding changes we have seen in the modern world have been fueled by increasing technological power
- But there's much more coming than we have seen to date
- To get a sense of where things are headed we must understand that tech development is following Moore's Law
- In 1965 Gordon Moore (the co-founder of Intel) - journal article - tech power double every 18 months while costing half as much over the same period of time
- Is this true? And if so, what does it mean?
- I remember sitting with my friend Ian Jukes thinking about this a few years ago wrestling with the meaning of Moore's Law & I decided to create a spreadsheet that illustrated the math
- To our surprise we discovered that the math of Moore's Law matched perfectly with the reality of the development of computer power
- Moore was interviewed recently & said he sees no diminishing for at least 15 years
- But - recent breakthroughs at IBM & HP in molecular electronics lead many to believe that Moore's Law will continue much longer
- The extrapolation of this trend is unbelievable!
- I want to see where we'll be in 10 years, but before we look at that let's consider some new developments that are on the horizon...
- I want to talk about nanotechnology - this is the world of the incredibly small
- Not making things smaller but building things up one atom at a time
- First done by IBM several years ago when they used 35 precisely placed Xenon atoms to spell out IBM logo
- Nanotechnology will be used to greatly boost tech power

- In Ray Kurzweil's book *The Age of Spiritual Machines* - he talks about the Law of Accelerating Returns
- He says that as Moore's Law starts to diminish it will be superseded by 3 dimensional nanotechnology chip designs, nanotubes, silicon photonics
- This will increase technology speeds by a factor of many millions
- Consequently we can see a continuum of astounding technological development that extends at least 50 years perhaps as much as 100 years into the future
- In his new book, *The Singularity is Near* Kurzweil tells us that due to nanotechnology Moore's Law will be adjusted again by the year 2010 to doubling in power every 6 months
- What you must see is that raw technological power is the foundation of the astounding developments we will see in the future
- This explosion in power will soon make possible many new features of technology that seem only in the realm of science fiction today

## **ii. Universal Connectivity**

- Real online speed is just coming into view
  - 2006 - Alcatel/NEC - crystal dark fiber
  - 10 trillion bps down single glass fiber
- What about tomorrow?
- George Gilder in his book *Telecosm* talks about Law of the Photon
- He says is that since 1983, when the first fiber line was installed between NY & Washington, DC that bandwidth speed & capacity per dollar tripling every 12 months
- He projects this will continue for the next 20 years
- But amazing as this is - it's only a part of the story...
- True universal connectivity can only come from cables and wireless access
- Did you realize - as of today - already more wireless Internet access than from desktop?
- And think of the power of universal access to network

resources - just beginning to see it

- Here's an example - a vending machine in Tokyo - use a cell phone to buy your drinks
- This is the power of networks - & remember this is being driven by exponential development - sooner than you think we will have universal access to the networked world
- But when you combine awesome technological power & universal connectivity with this next trend you begin to see a much bigger picture...

### **iii. The Online World**

- The online world is an amazing development providing access to information & communication literally around the globe
- But the Internet is fast becoming much more than surfing websites, e-mail, & online chatting
- It will soon become a means of natural transparent communication between people for a whole range of activities
- Transparency has been a long-standing goal of computer use
- It is completely natural interaction with machines
- Just think of Captain Kirk or Captain Picard of Star Trek - how do they interact with computer technology?
- "Computer..." - access is transparent - they are completely focused on the task
- A key area of focus for high tech companies is in new ways to interact with technology, especially online
- We are already seeing the first steps away from traditional keyboard input
- Natural hand-writing devices are starting to become really useful
- Voice input for computers & cell phones is just starting to come to the main stream market
- And eye monitoring systems show promise for new forms of interaction
- All these are functional today
- Here is a look at a medical tutoring system developed at the University of Florida that uses natural input

- Students must examine Diana, a virtual patient and ask the right questions
- The system responds to voice commands
- Vic, a virtual tutor, provides medical students with feedback on the student's performance - remember this is AI
- But the system also monitors the student's eye movement to see if they wander down to Diana's considerable breasts & assists in sensitivity training for aspiring doctors
- But natural input will go quite a bit further
- I want to show you two technologies that will soon combine to radically change the way we interact with the online world
- The first is one that has flown below the radar of most educators
- It is the development of customizable computer generated figures for use in games with 3 dimensional worlds
- You choose a figure, and the computer let's you customize it
- And then play a sports game as that figure in a simulated 3D world
- How many of you play World of Warcraft or Grand Theft Auto?
- Amazingly complex 3D worlds with customizable figures
- Here you see adventure role play game
- These are figures from EverQuest
- Literally many thousands of users are playing this online game and others as we speak
- Many adults including educators are not aware of the development in computer gaming, but astounding advances in computing power originate in this area of computer use
- Now the second technology I want you to consider is...
- Digital animation and human motion capture
- This is how they create realistic motion for animated figures
- This technology has come a long way with some fantastic results
- The most famous is Gollum, an animated figure in Lord of The Rings
- Gollum's motion was captured from the real person Andy Ferkus then transferred to a digital figure
- The result was astounding realism in Gollum's motion

- Today it takes time to transfer the motion data to the digital figure, but let's throw exponential growth of computational power & photonics into the mix & soon this transfer will happen instantly
- You will put on one of these animation suits that mark key spots on your body with sensors and the computer will digitize your motion in real time & send it out on the Internet
- This will create a digital online version of you called an Avatar that is completely customizable just like the figures we see in games today
- These two technologies will combine to let you literally walk out onto the Internet
- You put on a headset & a motion suit and you will see and interact with other avatars much like today's 3D games
- Except you will control your digital figure by moving your body
- What will you do walk out onto the Internet?
- Besides talking with other figures you will also manipulate virtual objects
- Already impressive strides made in creating 3D worlds
- This is an 3D image system created at Simon Fraser University that lets multiple users manipulate images online
- All those watching around the world can see you make changes and then take turns making their own
- It is operational today
- This is an article about a system from the Scripps Research Institute that allows people to hold virtual molecules in their hands and manipulate the objects in 3D space
- It allows students & researchers to see and understand what is otherwise invisible
- Soon you will see, touch and manipulate 3D objects in a virtual online world
- All the while interacting with digital figures
- These will be truly natural interactive experiences
- That will let you speak and listen with people from around the globe in a virtual 3D world
- This will have a profound impact on education
- These digital online experiences will allow students to

discover rather than be told

- To wander the halls of the Louvre & interact with knowledgeable guides
- To travel down to the microscopic and watch atoms join to form molecules
- To break free of earth and explore the solar system & beyond
- To manipulate 3D simulations of everything from math formulas to traffic control systems
- To learn while interacting naturally with teachers and fellow students online
- This is absolutely amazing, but there is more...
- There is one more exponential trend I want to highlight so you can see the educational potential of the online world
- This is the exponential trend of...

#### **iv. Hyper Information**

- Exponential growth in tech power has had an incredible impact on the sheer volume of information available in the modern world
- How many of you have a “to be read” pile?
- How many of you are reading it?
- It’s getting harder to keep up isn’t it?
- You are experiencing the effects of a powerful 21st century trend
- We’re drowning in data
- The amount of data in the world has gone crazy
- According to research from U of California in Berkeley the world produced 5 billion gigabytes of digital information in 2003
- That’s like a stack of books that reaches one third of the way from earth to the sun
- But that’s nothing - remember we said we are dealing with exponential trends?
- Here’s what happened last year...
- According to the Expanding Digital Universe IDC Whitepaper the world generated 161 billion gigabytes of digital

information in 2006

- That's 161 exabytes - that's like 12 stacks of books that reach from earth to the sun
- Or think of it as 3 million times more info than in all the books ever written
- And all that in just 1 year!
- And it doesn't stop - by 2010 estimates are that the world will generate 988 exabytes of digital information
- And it just keeps growing exponentially into the future
- Here's another way to see what is happening to information in the world
- George Gilder estimates that the amount of unique new technical info is now doubling every year
- But again it doesn't stop - Gilder has predicted that it will soon be doubling every 2 weeks
- In the first quarter of the 21st century it will be doubling every 72 hours
- We are in a world of disposable info - has shelf-life that is getting shorter each day
- But it's much more than just the amount of information - it's the kind of info & how it's interconnected
- There is a profound shift in information taking place even as we speak
- It involves the creation of a digital library of great literary works
- Google started this shift when it announced in December 2004 it would digitize all of the books in 5 major research libraries (Stanford U, Harvard U, Oxford U, U of Michigan & New York Public Library)
- Google is now partnering with several major publishing companies to digitize vast numbers of out of print books and excerpts from books currently in print
- Also in 2004, Raj Reddy, professor at Carnegie Mellon U began scanning books from his U's library - Called the Million Book Project - goal a million books by 2008
- Superstar, a company based in Beijing, has scanned every book from 200 libraries in China - half of all the books published in the Chinese language since 1949

- There is a rapidly growing digital library of digital books being created
- Just think of what will be available when people do searches
- But it is much more than just access...
- There is great power when books are seamlessly linked together
- Just imagine being able to jump to each book in a bibliography to see the context of quotes
- Or being able to assemble all of the passages from all digital books on a specific term or concept
- Or accessing all of the works with an opinion on a particular issue
- And we are only talking about print here - what happens when recordings & film are linked to the books in the same way?
- Now a question - Hyper Information is a staggering trend for us personally but it also has profound implications for us professionally
- Take a look at the vast majority of evaluation that takes place in school - tests & assignments
- What is primary skill that students develop? - memorization
- Now the critical question: is rote memory a useful skill in the age of instantaneous online access and Hyper Information?
- If not, it is critical we look at what skills do kids need for success in the 21st Century
- And the 4th issue we must consider if we want schools to work is...

#### **4. Schools face a different kind of student**

- Digital technology affects those who use it - and I don't mean you - you dabble with technology - kids live with it
- What you need to know is that digital technology and online experiences have already profoundly affected the minds of young people today
- Research is now confirming that the interactive visual & auditory presentation of info kids experience in the digital world is actually rewiring their brains

- In books like...
- **How People Learn** by John Bradsford &
- **How the Brain Learns** by David DeSousa &
- **Teaching With The Brain in Mind** by Eric Jensen
- These publications indicate that kids are actually using different parts of their brains than we do
- Most educators are oblivious to this change and continue to teach as if its 1975
- But research is confirming that kids today are different than kids from previous generations
- We know this from Neuroinformatics
- This involves the analysis of brain processes by means of neural scanning & imaging
- Using the incredible number-crunching power of computers & our growing understanding of the chemistry & biology of the brain
- Combined with powerful scanners called FMRI's
- That allow us to examine living brains non-invasively while they're in the process of thinking
- Using this technology, researchers can pinpoint to within a few mm the parts of the brain that "light up" when people move a finger, feel sad, add 2 plus 2, or do specific tasks
- Researchers like Johnson, Restak, Rushkoff, Jensen & others are telling us is that if you were to take an electronic scan of our parents' brains & compare it to a scan of our brains we would quickly discover that we use slightly different neural pathways to process the same information than our parents do
- But what is really remarkable is that if we were to take an electronic scan of our brains & compare them to scans of our children's brains we would find that they use fundamentally different neural pathways to take in, process and store the same information we do when doing the same tasks
- We see this particularly in the area of the visual cortex
- According to Eric Jensen at least 87% of students in any given classroom are NOT auditory or text-based learners
- But they're either visual or visual kinesthetic learners

- They're visual kinesthetic not to drive us crazy but because they've grown up that way - they're wired for multi-media
- But most of the people in this room grew up in the 1960's through the 1980's
- And just as kids today have been shaped by their digital world, we were shaped by our text-based, simpler, lower-tech world
- As a result today we face a 2nd digital divide - not just one based on haves & have-nots, but a far more serious digital divide due to the fundamental difference in the way we grew up vs. the way our students are growing up... we come from another land & time
- As Marc Prensky says - in today's world kids are the digital natives who have grown up in this digital environment & adults are the foreigners who speak digital as a 2nd language

Digital learners prefer:

- receiving info quickly from multiple multimedia sources
- parallel processing & multi-tasking
- to process pictures, sounds & video before text
- random access to hyperlinked multimedia information
- interact/network simultaneously with many others
- to learn "just-in-time"
- instant gratification & instant rewards
- online up-to-date visual & auditory information sources
- learning that is relevant, instantly useful & fun

Many teachers prefer:

- slow & controlled release of info from single or limited sources
- singular processing & single/limited-tasking
- to provide text before pictures, sounds & video
- to provide information linearly, logically & sequentially
- students to work independently rather than network & interact with others
- to teach "just-in-case"
- deferred gratification & deferred rewards
- text-based handouts & books
- to teach memorization of material in the curriculum guide in preparation for standardized tests

- This is a recipe for disaster
- And it has profound implications for anyone involved in education
- It begins with the realization that there is empirical data that tells us that teachers, administrators, board members & you are not understanding the learning styles of your clientele of digital kids
- This tells us that the instructional methods that used to work will not be successful with the students of today & tomorrow
- And if schools are currently not engaging students
- And a changing world & changing clientele are only going to make this worse...
- Can we continue to teach kids in the same way?
- Of course not - we must look for innovative new ways to reach the digital generation to make schools relevant for 21st century students
- So how do we make schools work for the 21st century?
- I want to leave you with two important changes that I believe are critical if we hope to make schools work in the 21st century
- The first has to do with us...

## **1. We must catch up**

- It is a whole new world out there!
- We must also acknowledge our ignorance of this new age
- It's time for us to let go of our pride in being highly trained experts
- Because that training was based on 20th century thinking
- In the 21st century we are all facing a new world with new ways of doing things
- It is critical that we all become learners in this new environment
- I think this quote from Eric Hoffer captures this best...

- In times of radical change the learners inherit the earth, while the learned find themselves perfectly equipped for a world that no longer exists
- How could we do things differently as teachers to effectively reach the kids of today?
- I have written a book about 21st century teaching & learning in which I outline 6 major changes we must make to instruction to make it effective in the modern world (I actually have 8 changes now)
- But if I had to choose just one it would be

## **2. We must resist the temptation to tell**

- My son's experience in Science
- He went from his elementary school experience of a wonderful range of discovery learning experiences
- To junior high school where he had to sit still and listen as he was told what science had already discovered
- Where does this desire come from?
- For most teachers it's all they have ever known
- It is the most common instructional approach that is modeled throughout the entire school system
- I believe telling is the native language of teachers
- We persist in using it even though there are indications it is the least effective way for students to learn
- The most important reason for stopping teachers telling things to kids
- Is that telling takes the life out of learning
- Just think about watching a suspense movie
- The experience of watching the actors narrowly escape certain death as the music creates a suspenseful atmosphere would keep you on the edge of your seat
- The experience would be indelibly etched in your mind
- But what would the experience be if just before the movie someone told you what was going to happen & they all made it through without a scratch?

- The problem is that telling takes the excitement of discovery out of learning
- Why is discovery so important?
- It generates the interest that was highlighted in the quote from Richard Saul Wurman that I shared with you earlier
- Interest creates the other side of the velcro to make learning stick
- Our job as teachers is to create the other side of the Velcro - the interest that is so desperately needed to engage students
- I believe the most important job we have as teachers is to create the interest that gets kids hooked on learning
- For Science teachers we must remember that even if we know a science concept well and it's as old as the hills
- If it is the first time a student has encountered it, the potential exists for a wonderful discovery experience
- And isn't that what Science is supposed to be all about anyway?
- So what is stopping us?
- In a word - change
- And I know I am preaching to the choir when I speak to this group of people - if you are here the chances are you know that we have to change
- But the vast majority of our colleagues their motto is
- Change is good - you go first
- So let's do just that - let's change the way we teach and blaze a trail for other teachers to follow
- Let's make learning engaging & relevant in our classrooms
- Let's make sure our schools work effectively with teaching that addresses the important issues I have presented this morning
- So that our students can be ready for their future in this wild new world of the 21st century