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# *Schools Must Change*

The world we live in has fundamentally changed. Our students have moved into the Information Age. Meanwhile, our high schools continue to operate on the ideas and assumptions from the Industrial Age. As a result, there is a fundamental disconnect between students and the schools they attend.

- The industrial efficiency envisioned for teaching in the early 20th century is not reflected in learning efficiency for students in the 21st century.
- The learning styles of today's digital kids are significantly different than those for whom our high schools were originally designed. They work, think, and learn differently—and our schools were not designed for them.
- Instruction is primarily based on teachers talking in classrooms, textbooks, memorization, and content-based tests; schools are becoming increasingly out of sync with the world around them.
- Schools focus on linear, sequential, left-brain thinking in a world that requires both left- and right-brain capabilities.
- The segregation of skills and tasks that typified the industrial approach is reflected today in our approach to creating schools for the future—and it does not serve us well.

### *What's the definition of insanity?*

*Doing the same thing you've always done, but expecting or wanting or needing completely different results. If we continue to do what we've always done, we will continue to get what we've always got.*

## WHY SCHOOLS ARE THE WAY THEY ARE

How many of you recognize this scenario from your own high school experience? A teacher returns to her high school after a weekend. She walks to the school office and checks her mailbox. Then she heads for her classroom. After turning on the lights and adjusting the window blinds, she puts her binder on the lectern and opens it to the lesson plan for first period. Kids start arriving and wander to their desks. The bell rings, the teacher takes attendance, and she places the absentee list on the hook on the outside of the door. Then she walks over to the lectern and begins talking about the topic to be covered. Students listen until she gives them an assignment to be done using the textbook for the course. The teacher tells students to pay particular attention to this assignment because there will be a test on the material next period. Sound familiar?

Of course it does, because that scene is repeated over and over again each day in our high schools all across North America. Teachers and students meet in classrooms. Teachers talk and students listen. Students are given work to do using textbooks that focus on committing content to memory. Students are motivated to do the work of memorization because their performance on tests will be recorded.

Teachers are completely comfortable with teaching this way because it was the only approach to instruction that was modeled for them in high school, or university for that matter. Education has happened this way for so long, no one questions it. It's just assumed that this is the way it's supposed to be.

Those who work in the school system are victims of TTWWADI—**T**hat's **T**he **W**ay **W**e've **A**lways **D**one **I**t. Schools, especially high schools, have operated the same way for such a long time, most people who work there don't really know the reasons why they do the things they do.

So how did schools get to look like this and when did it happen? Let's have a quick look at the historical roots of our schools.

Believe it or not, the mindset for the current structure of our 21st-century schools is partly based on decisions that were made in the days of the horse and buggy, the kerosene lamp, ploughs pulled by oxen, and the first production lines. For example, the yearly calendar for our current school system was set in the United States and Canada in the late 1800s, and it is based on the agricultural cycle in which students were released for three months each summer so that they could help harvest the crops.

The basic organization of schools and the school day dates back to the early 1900s, when the world was excited about the success of Henry Ford's assembly line. This method of production was based on the ideas of Scientific Management developed by Frederick Winslow Taylor. With such dramatic improvements in productivity at Ford, there was great excitement in applying Taylor's ideas widely across society. Schools were not exempt. According to Linda Darling-Hammond in *The*

*Right to Learn* (1997), in 1908, William Wirt came up with the idea of the "platoon school."

> Hoping to save on wasted plant space and solve overcrowding in schools, Wirt devised a system in which students circulate through the school from one classroom to another, with different teachers teaching them different subjects for short periods of time. (Darling-Hammond, 1997, p. 41)

Under this system, schools became modeled after the assembly line, and teachers began to specialize and teach only one subject, over and over again, all day.

According to Darling-Hammond, in 1890, the only nonteacher in most school districts was the superintendent. By the 1920s, however, schools based on Taylor's ideas had developed a new class of managers called principals, who were to do all the thinking. The role of the teacher was restricted to conducting routine instructional tasks following procedures developed by the principals. The Taylor system was criticized for the number of unproductive people his plan introduced into a system. That has certainly proven to be the case in education, where today non-teaching personnel constitute more than half of the workforce in the U.S. education system.

Also in the early years of the 20th century, decisions about teaching, curriculum, assessment, and learning passed from the hands of teachers to administrators, commercial textbook publishers, and test makers, who were not concerned with the needs of individual students. Instructional standards were introduced into education at this time as well. These standards were to be used with extensive tests so the teacher could know at all times whether instruction was progressing as it should.

Taylor's ideas caused a great reorganization in society. People fell into distinct groups based on the roles they played in the economy. In the same way, it quickly became the role of the school to sort students in order to prepare them for the roles they would assume on leaving high school. Educators created different tracks for students performing at different levels. Harvard University president Charles Eliot identified three distinct roles in industrial life in 1909, each of which required a different form of education. A small number of the most intellectually gifted students would become managers and leaders. A larger number of students would become skilled workers and merchants, and the vast majority of students would become manual laborers. In the 1920s, IQ testing was introduced into education and quickly became the main tool for sorting students into the various tracks in school.

As early as 1926, behaviorist theories were put into practice in schools. B.F. Skinner further modified this thinking in 1954. The basic idea behind the behaviorist approach to learning was that by giving students only

small, discrete portions of information in a predetermined sequence, performance would improve. The key to this approach was short responses that would be learned by rote with immediate positive reinforcement for correct answers. This approach focused on the memorization skills that were critical for the Industrial Age production line life of the time. Schools rapidly adopted it, and, although subsequent research in cognitive psychology has identified considerable limitations to behaviorist thinking, this approach to learning persists to the present:

> A recent international evaluation of mathematics and science curriculum found that US curricula and textbooks cover far more topics with less depth and more repetition, and with less attention to higher-order thinking skills, than those in most other countries. (Darling-Hammond, 1997, p. 52)

Designs for high schools changed to support this new assembly-line approach to instruction that resulted from Taylor's ideas of Scientific Management. Schools very much resembled a production line, with workers specializing in subtasks of the instruction process. Teachers abandoned the holistic approach in which they had taught many subjects to a wide range of ages. They began teaching a single subject to students who were all the same age. Schools were organized into departments to further the specialization of teachers. Teachers were given classrooms in which they would teach for short periods of time, typically an hour. A bell would ring, and the students would move from one specialist to another. The basic layout of the high school we have today, with its hallways, classrooms, and departments, was created before the Great Depression.

There are many who believe that the high schools of today are radically different than the schools of the early 20th century. They point to computers, networking, air conditioning, skylights, video surveillance, telephones in classrooms, digital phone and PA systems, digital whiteboards in classrooms, and a multitude of other improvements as proof that schools have changed. Although there have been changes, most of them are superficial. The underlying assumptions and organization of the school into classrooms, hallways, and departments that was instituted so long ago remain unchanged. Further, the basic instructional approach of teachers talking to students as they sit passively in their seats continues to be the main teaching strategy of the vast majority of educators.

It is amazing to review this history and realize that so many aspects of our current education system are deeply rooted in Industrial Age life of the early 1900s. As we have seen, most of the ideas that form the basis of our current schools were well established by the 1920s. That means schools have looked the same for more than 80 years! And because the basic instructional strategies have not changed significantly over that time, the assumptions behind school facility design have not changed that much either.

## WHAT'S WRONG WITH THAT?

Quite simply, what's wrong is that the world has changed and schools have not. The world outside school has shifted to the Information Age, but most schools are still operating on the ideas of the Industrial Age. Capitalizing on the astounding power of new electronic tools, the world outside of education has moved beyond the idea of mass production that was the hallmark of Taylor's assembly-line approach to life. We are now in the beginnings of a whole new era of technologically driven mass customization and the age of the individual.

This new age represents a shift in life experience of enormous magnitude. It is affecting virtually every aspect of our lives, and it has already significantly altered many of the traditional foundations for our schools. For example, the technology of the modern world has radically changed the nature of information. Remember that information, especially textual information, makes the school world go around and has been the major focus of instruction for more than a hundred years. Schools, more specifically teachers, have traditionally been the source of the important information students require to do their schoolwork and to prepare for their future life in the workforce. But now the Internet, through Google and a multitude of other online searching tools, has made vast amounts of information readily available to students in their bedrooms, on the bus, at their friends' houses—anywhere they can connect to the Internet via a cable or wireless device. They can retrieve specific details in seconds. But not only has the access to information changed, there has also been a major shift in the kind of information that is available. The digital world has quickly left behind the black-and-white text-only information most of us grew up with and facilitated access to full-color graphics and video accompanied by stereo sound.

In addition, access to information has rapidly progressed from the linear, paper-based information of the 20th century to the fully hyperlinked, random access, digital world of online information sources. Further, through online cameras, simulations, and games, more and more, technology is allowing people to have firsthand experiences of events, to communicate with other people, and to observe and manipulate natural processes. Learning about the world has become dynamic, relevant, and fun.

Plus, the sheer amount of information in the world has gone berserk. It is growing exponentially. We are being infowhelmed. *The Expanding Digital Universe* (IDC, 2007) says that according to research from the University of California, Berkeley, the world produced five billion gigabytes of digital information in 2003. That's like a stack of books that reaches a third of the way from the Earth to the sun. But that's nothing! According to *The Expanding Digital Universe,* the world generated 161 billion gigabytes of digital information in 2006. That's 161 exabytes of data— that's like 12 stacks of books that reach from the Earth to the sun. Or think

of it as three million times more info than in all the books ever written. And all that happened in just one year! But it doesn't stop there. Estimates are that by 2010 the world will generate 988 exabytes of digital information (IDC, 2007).

But the real story concerning information in the modern world is not just about the *amount* of data being produced. It's about the ability to search for the information you require. Google, Yahoo, and other search engines allow users of the Internet to zero in on specific material from an enormous database of information posted on Web sites around the globe. The ability to find the information you need from these online sources without having to leave your home, office, or classroom has significantly changed the notion of research in just a few short years. But even more momentous changes in information access are on the horizon.

Of great significance is the creation of an online digital library of great literary works. In his article for the *New York Times*, Kevin Kelly (2006) says Google started this project off when it announced in December 2004 that it would digitize all of the books in five major research libraries (Stanford University, Harvard University, Oxford University, the University of Michigan, and the 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. Others have joined in the effort to create this online digital library. Also in 2004, Raj Reddy, a professor at Carnegie Mellon University, began scanning books from his university's library. His Million Book Project has a goal of digitizing a million books by 2008. Superstar, a company based in Beijing, has scanned every book from 200 libraries in China, representing half of all the books published in the Chinese language since 1949. Just think of what will be available when students begin doing research online. But the real power will be in the ability to link digital information. Kevin Kelly puts it this way:

> Turning inked letters into electronic dots that can be read on a screen is simply the first essential step in creating this new library. The real magic will come in the second act, as each word in each book is cross-linked, clustered, cited, extracted, indexed, analyzed, annotated, remixed, reassembled and woven deeper into the culture than ever before. In the new world of books, every bit informs another; every page reads all the other pages. (Kelly, 2006)

There will be awesome new possibilities for research when digital 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 and film are linked to the books in the same way? Students in school

desperately need to be taught strategies for effectively handling this kind of information growth and the new tools that are emerging to access it.

But as important as this online information library is, there is an even more important aspect of the Information Age for educators to consider: the impact the online digital world is having on the thinking patterns of young people. Kids today are growing up in a radically different environment than kids did as little as 10 or 15 years ago. They have been exposed to online digital tools for their entire lives. The use of such devices as computers, digital cameras, hand-held digital assistants, cell phones, scanners, printers, wireless devices for the home and those you store in your pocket or wear on your body, and a myriad of other networked digital tools and social networking software is as natural to them as breathing. They are completely comfortable with powerful software tools that allow them to send e-mail, chat with text or video, surf the online world, search online resources for specific information, download music, movies, drivers, demos, etc., play games both independently and networked with other game players around the world, write essays and reports, edit digital photos, and a whole host of other tasks. Kids today are immersed in an online digital experience.

It is critical for parents and educators to grasp that this digital immersion is changing the way kids think. These digital tools provide kids with an unprecedented level of interaction and immediate feedback. As a result, kids today crave interactivity in their lives. They love to play electronic games because they provide so much more than just sitting watching TV. These digital tools also are a gateway to the world through connections to the online world. Whether it's through a computer or a cell phone, kids today have a strong desire to be networked with others across the room, down the hall, across the city, or around the world. And digital tools provide kids with a sensory-rich world full of color, sound, graphics, and video. Consequently, unlike their parents, kids today want multimedia before they want text-only information. And they want multiple points of entry into informational sources and nonlinear pathways through informational space.

But there is even more for parents and educators to consider. This new digital experience that has sprung into being in the last few years has actually altered the neural pathways in kids' brains. Brain research has progressed significantly in the last 10 years because of the ability of powerful new FMRI scanners to scan a person's brain noninvasively while they are in the process of thinking. This research has revealed that young people who have grown up digital have developed a cultural brain. Because they have grown up with digital bombardment as an everyday part of their lives, they process the same information differently than their parents or teachers.

Today's generations operate at twitch speed because of constant exposure to video games, hypertext, and all of the other experiences that reflect an increasingly digital world. As a result, digital learners have had far

more experience at processing information quickly than the older generations have, and they're better at managing high-speed information. To borrow a phrase from the movie *Top Gun*, digital kids have "a need for speed."

This is especially the case in terms of visual information: kids are more visually oriented. They receive and process visual information more effectively than their elders. It is critical that parents, teachers, and administrators understand that these kids think differently than they do.

But in the face of these fantastic changes in the world and the impact they are having on the minds of young people, schools have steadfastly resisted any major alterations to the way instruction takes place. Students are still expected to sit in classrooms and listen to teachers talk. Information access is still provided largely through black-and-white handouts and textbooks. Content-based tests, still the main evaluative tool teachers use, emphasize memorization while largely ignoring other important learning. Remarkably, despite the fact that the world has changed so dramatically, schools persist in operating on ideas from another age. As a consequence of this intransigence, schools are becoming increasingly out of sync with the world around them. And this is having a very real, negative impact on how students view the relevancy of school to the rest of their lives.

There are a number of alarming indications of just how bad this situation has already become. The problem is 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. Today, more than one-third of students and almost half of minorities drop out before they complete high school. Many more of those who do graduate are learning disabled or delayed. What's more, they're increasingly turned off. According to a recent study (National Center for Education Statistics, 2002, p. 72), only 39% of 12th grade high school students believe that schoolwork will have any bearing on their success in later life, only 28% believe that schoolwork is meaningful, and a mere 21% believe that their courses are interesting. 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. Students who have found the high school experience the least relevant have already exited the system in huge numbers.

And for those students who do stay in the system, current instructional techniques are not proving to be effective. In a 2005 survey for the National Association of Manufacturers, 55% of business respondents said schools are deficient in preparing students with basic employability skills (attendance, timeliness, work ethic), 51% cited math and science deficiencies, and 38% cited reading and comprehension deficiencies (National Association of Manufacturers, 2005).

The response to these concerns from many teachers, parents, administrators, and politicians has been to go back and teach basic skills. The idea

seems to be that if we just get students of today to master the skills that served the older generation well, then the kids will be well prepared for the modern world.

Unfortunately, this nostalgic view of education usually does not work as well as expected because more often than not, the basic skills to be taught are determined by what worked when the teachers or parents went to school in the 20th century. Going back to the basic skills needed for success in the late Industrial Age doesn't make sense in the Information Age of the 21st century. There are new basic skills that are needed to survive in the online, digital world. It would be like teaching students how to ride a horse and then expecting them to know how to drive a car. Given the definition we provided at the beginning of this chapter, this would qualify as insanity.

Why? Because the digital tools of this new age have radically changed the way things are done. It's not that there is anything wrong with the basic skills that were needed for success in the 20th century. In fact, they are still very important. It's that those skills alone are not enough to prepare students for the reality of the new workplace. Bill Gates captured this when he said the following:

> America's high schools are obsolete. . . . By obsolete, I mean that our high schools, even when they're working exactly as designed, cannot teach our kids what they need to know today. Training the workforce of tomorrow with the high schools of today is like trying to teach kids about today's computers on a 50-year-old mainframe. It's the wrong tool for the times. Our high schools were designed fifty years ago to meet the needs of another age. Until we design them to meet the needs of the 21st century, we will keep limiting, even ruining, the lives of millions of Americans every year. (Gates, 2005)

If you take the time to read what people like Tom Peters, Ray Kurzweil, Thomas Friedman, Daniel Pink, Marc Prensky, Alvin Toffler, Jeremy Rifkin, Frank Levy, Donald Tapscott, James Canton, John Naisbitt, Richard Murname, and a whole host of others are saying, you will quickly realize that students today must be equipped with skills that enable them to handle the radically different and constantly changing, technologically driven, bewildering and exciting working world of the 21st century.

Many educators, parents, and politicians have a great deal of difficulty understanding that the world is that different than the world they experienced when they grew up. Does education have to change that much? After all, if school was OK for me and my generation, why won't the same schooling be OK for kids today? It's easy to understand why so many older people have missed the significance of what has happened. This major shift to the online Information Age happened suddenly. In the early 1990s, a number of exponential trends came together with remarkable

rapidity to provide us with the amazing online world and relatively inexpensive digital tools to access it. In the few short years since then, the ways people communicate, do business, get information, and entertain themselves have all been radically transformed by this online digital revolution.

This has some startling implications for the older generation. If you graduated from high school before the early 1990s, then you will have a difficult time relating to the life experience of kids today. And it is critical that you understand that your high school experience, while it may have been a good experience for you, cannot be used as a good example for what schools should look like today. The sudden shift to the online digital world has rendered that experience irrelevant to modern students.

So how should we respond to this new world? How can education address the disconnect students are experiencing with school today? How can we change to ensure that schooling will remain relevant as we go further into the 21st century? There are five major shifts that must take place immediately if we are going to come up with effective solutions to the problems schools face.

### We Must Shift Instruction to Focus on the Higher Level Thinking Skills Needed for the 21st Century

As we mentioned previously, memorization was a key focus of Industrial Age schools. This was important because memorizing policies and procedures was vital for the vast majority of Industrial Age workers. Only those employees at the management level were required to think independently. But in the technologically rich work environment of today, many of the manual labor tasks done by the Industrial workforce have been automated. Tom Peters (2001) states:

> The age of the blue collar automaton hanging out in that Ford or U.S. Steel factory, then spending a couple of hours at the pub, then going home and sleeping it off . . . and then robotically returning to work . . . is dead. Long dead. (Peters, 2001, p. 10)

But it's much more than the traditional blue-collar jobs that are at risk in the new economy. Many white-collar jobs in accounting, engineering, medicine, and other fields are being outsourced to well-educated, low-salary workers in other parts of the world like India and China. Thomas Friedman, a journalist for the *New York Times*, tells in his book *The World Is Flat* of his surprise at discovering that his profession was not exempt from this aspect of the new world of work.

> Thank goodness I'm a journalist and not an accountant or a radiologist. There will be no outsourcing for me . . . at least that's what I thought. Then I heard about the Reuters operation in India . . . outsourcing elements of the news supply chain. (Friedman, 2005, p. 10)

This is a substantially different world than the one most of us experienced growing up. What we face is a world of work that is a radically different than the one of the 20th century and one that is not familiar to teachers, administrators, parents, and politicians. In this new world, workers will work individually and in teams on an entrepreneurial basis, empowered by new technological tools. The online world will be the gateway to this new workplace, and it will be unlike anything we have ever seen before. Just listen to what Thomas Malone and Robert Laubacher wrote in *Harvard Business Review* about how workers will operate in the future:

> The fundamental unit of the new economy is not the corporation, but the individual. Tasks aren't assigned and controlled through a stable chain of management, but rather are carried out autonomously by independent contractors—e-lancers—who join together into fluid and temporary networks to produce and sell goods and service. When the job is done . . . the network dissolves, and its members become independent agents again, circulating through the economy, seeking the next assignment. (quoted in Peters, 2001, p. 11)

Richard Worzel, writing in *Teach* magazine, said the following about the workplace of tomorrow:

> The world of work is automating rapidly, and routine work of all kinds is disappearing. Tomorrow's workers will survive on the basis of their unique talents, plus their ability to innovate, create, market, and sell their ideas in the global marketplace. They will probably be self-employed, even if they work under contract for a large corporation. (Worzel, 2006, p. 7)

This is a whole new ball game. People will survive on their wits. They will rely on themselves, working as independent entrepreneurs. They will increasingly deal with online information. They will use powerful portable digital tools to get and process information as they need it wherever they are. They will use it to communicate and network with clients and coworkers. Whether this occupies all of their time or is only a part of what they do, an ever-increasing number of people will require a much higher level of thinking skills to do the information processing and problem solving to function successfully at work.

In *A Whole New Mind,* Daniel Pink (2005) examines recent brain research to discover the secrets of how people think. Pink's goal is to determine the kind of thinking that will be needed for the 21st century. He starts by outlining what has been learned about the two hemispheres of the brain. He summarizes this research by saying the left brain handles details, logic, sequence, literalness, and analysis—breaking things down into their components to see how they work.

On the other hand, the right brain handles emotional expression, context, and synthesis—the weaving together of components to see the big picture to gain meaning and significance. Schools have traditionally focused on reinforcing left-brain thinking, and with good reason: It was the basis of the incredible success of the Industrial Age.

Taylor's idea of breaking complex tasks down into manageable subtasks and having workers specialize in doing specific subtasks is at the heart of Scientific Management. Breaking tasks down into their components is largely a left-brain activity.

So, too, is the linear, logical, beginning to end, sequential reasoning required to do work in this environment. Workers don't need to see the big picture. They just need to master their part in the process. Don't think, just do as you are told and memorize the procedures you are responsible for was the mantra of Industrial Age workers. From assembly-line workers to office workers to high school teachers, this was the approach that was needed for success. In that world, only a very few managers needed the big-picture thinking skills. And so schools focused on left-brain thinking in their instruction to the overwhelming majority of students to prepare them for the realities of life after school.

But along came the Information Age, in which many of the tasks of the Industrial Age have been automated or outsourced.

Increasingly, we are left with jobs in which people have to see the significance in information to determine the big-picture meaning of what is being said. Then workers have to take that newfound knowledge and apply it to solve problems and accomplish a task. This kind of thinking requires people to use the capabilities of the right side of their brains working in concert with their left brain's functions to be successful. This environment requires all workers to have the higher level, big-picture thinking skills that only managers needed in the Industrial Age.

And there's the rub. Schools must shift gears to catch up to this new world. Schools cannot continue the current traditional focus on low-level detail recall as the main thinking skill for students in a world that is crying out for workers with high-level thinking skills. Thinkers must use both sides of their brain to be truly effective at applying the full capacity of human reasoning to 21st-century tasks. That means we must change the focus of what we teach to encompass much more than we do now. A recent report on 21st-century skills stated this clearly:

> Even if every student in this country satisfied traditional metrics, they still would remain woefully under-prepared for success beyond high school. (Partnership for 21st Century Skills, 2006, p. 2)

In addition to teaching the wrong skills, the traditional emphasis on low-level memorization has a stultifying effect on the students who must endure teaching whose goal is content recall. In this approach to instruction, success

is measured in higher scores on tests that rate a student's memory. To prepare students for such exercises, teachers often resort to drills to improve content recall. The problem is that these mind-numbing exercises take the enjoyment out of learning. This is captured in a quote from W. James Popham:

> [M]any teachers, in desperation, require seemingly endless practice with items similar to those on an approaching accountability test. This dreary drilling often stamps out any genuine joy students might (and should) experience while they learn. (Popham, 2005, p. 41)

This is not what we want to do to our children. Instead, we want to cultivate in them a love for learning that will be so strong that it will sustain them for a lifetime. We want them to see that the relevance of what we teach them in school is so compelling that they can't wait to get at it. To do this, we must make a significant shift in the kinds of skills we emphasize in our instruction. We must shift our focus to the higher level thinking skills that are needed for success in 21st-century life.

### We Must Embrace the New Digital Reality

Over the last 10 years, the school system has spent a substantial amount of money on technology. Some think that the job of equipping our schools must be just about done. They are wrong on two accounts.

First, technological change is increasing. This means that equipping schools with new technology will always be with us. Because the role of the public school system is to be the great equalizer in society, ensuring that those who are economically disadvantaged are given the same opportunities as those from wealthier households, it is critical that we embrace the idea that doing our best to give schools the newest technology possible will be an ongoing goal in the 21st century.

Second, we must continue to focus on technology to keep our schools relevant to the society in which they function and to address the already existing problem of the disconnect between students and school. Even before the online revolution, schools were having difficulty reaching their students and convincing them of the usefulness of schools. Now that the world outside school has made a quantum leap into an entirely new way of doing everything from work to entertainment, there is an expectation that education will keep up. Schools that continue to teach to an Industrial Age way of life will be dismissed outright by their clientele of 21st-century digital kids.

Educators have not grasped how pervasive technology has become for kids today. One of the most significant realities of digital tools is that increasing power is continually becoming available at decreasing cost. As a result, in addition to using desktop and laptop computers, kids today are

also surfing the Internet, sending e-mail, sending text messages, and talking to one another on inexpensive cell phones and other handheld devices. This digitally charged environment has become so much a part of the daily experience of the majority of kids today that it is affecting the way they think. You can't speak their language unless you understand their world, and today that means embracing the new digital reality they live every day.

Why is it so important for educators to embrace this new digital world? Why is it so important to speak the new digital language of modern kids? Because connecting with the world students experience is at the very heart of what we know about learning.

Brain research has demonstrated that for new learning to stick in a student's long-term memory, the student must make a connection between the new information and something she already knows. Therefore, for teachers to teach effectively for long-term memory recall, they must use examples, illustrations, and stories that come from the kids' world—ideas the kids can relate to.

So what does it mean to embrace the new digital reality? Nothing less than jumping into the digital world with both feet. This means that everyone who is involved in teaching kids and designing the schools they attend needs to catch up to these new digital kids. For teachers and administrators who communicate directly with kids, this means firsthand experience with communicating with e-mail, chatting with instant messaging, surfing and searching the Internet, reading and publishing blogs, texting with cell phones, going online with cell phones, taking and sending pictures with cell phones, playing electronic and online games, listening, watching, and creating podcasts, and a whole range of other activities kids take for granted.

This is also the case for school district staff who make decisions about the allocation of learning resources, teaching training, and the assessment of learning. In fact, if we want to ensure that schools become relevant to the kids of today and tomorrow, then everyone in education from the classroom teacher to the superintendent must address the critical need for educators to catch up with the kids they teach. It can't be optional.

If the adults involved in education are willing to do this, it will have three enormous benefits. First, as we mentioned above, instruction in the classroom will become more relevant to students because it will be linked to their world. It's very simple—if we can't relate to the digital world of our students, then we can't make schools relevant.

Second, by exploring the digital world, teachers will be able to discover powerful new electronic tools that will enhance the learning experience for their kids. These include games, simulations, new ways for students to publish their work, entirely new ways to access and process information, and new ways for students to communicate and collaborate. Some of these tools exist today, and more will certainly appear in the near future. Third, teachers will be able to bring the wisdom of their life experiences to guide

students in using the new digital tools that are cascading onto the market. Right now, the kids are way ahead of adults in the use of digital tools, so they are defining the parameters of the how, when, where, what, and why these tools are used.

### We Must Address the Shift in Thinking Patterns of Digital Kids

It is the normal experience of the majority of kids growing up today to be immersed in this digital world. From a very early age, kids are surfing the Internet, downloading files, playing games, doing online chatting, blogging, and engaging in a multitude of other digital activities. The impact of this experience on the minds of young people has been nothing short of phenomenal.

The reason for this impact has to do with a relatively new discovery about how the brain works. It is called neuroplasticity, and it is the brain's amazing ability to reorganize how it processes information based on new input. If the brain encounters a new kind of input for sustained periods of time on a daily basis for an extended period of time, it will reorganize neural pathways to handle the new input more effectively. This is what happens when a child learns to read. With sustained exposure to textual input on a daily basis, the child's brain reorganizes how the brain processes this new input so the brain can make sense of it.

In the same way, kids growing up in a digital world are being exposed to new kinds of input from digital experiences for sustained periods of time on a daily basis. Consequently, their brains are reorganizing to handle the digital environment more effectively. This is creating a huge problem in our schools. Kids are quite literally thinking differently than those who teach them.

Here are just some of the differences that already exist between the way digital kids process information and learn because of their digital experiences and the way nondigital adults teach. Digital learners prefer receiving information quickly from multiple multimedia sources, but many nondigital teachers prefer slow and controlled release of information at conventional speed and from limited sources. Digital learners prefer parallel processing and multitasking, but many nondigital teachers prefer singular processing and single or limited tasking. Digital learners prefer active, engaged learning, but many nondigital teachers have more experience with passive learning such as lectures. Digital learners prefer processing pictures, sounds, and video before text, but many nondigital teachers prefer to provide text before pictures, sounds, and video. Digital learners prefer random access to hyperlinked multimedia information, but many nondigital teachers prefer to provide new info linearly, logically, and sequentially. Digital learners prefer to network simultaneously with many others, but many nondigital teachers prefer students to work independently before they network and interact.

Furthermore, kids today are developing a high level of skill with new technologies that nondigital adults do not value or even recognize. These adults dismiss the abilities kids acquire from playing games, using cell phones, surfing the Internet, etc., and complain about the skills they don't have. They fail to realize that the skills kids do have are vitally important for younger people to survive in the digital world they live in and are increasingly a part of business and life.

You can quickly see the magnitude of the problem we face in trying to teach digital kids effectively. And because children have much more time to use, learn, and master new digital tools than adults do, educators face the prospect of a clientele whose brains are continually being reorganized as new digital experiences emerge from the relentless technological development in the modern world. It will be imperative for educators to monitor the way kids use new technology if they hope to keep their instruction effective.

However, although we will always be playing catch up with students, it is already clear that there are some significant changes we can make to our approach to instruction that will greatly improve our effectiveness at reaching digital students. First, our instruction must shift from a predominantly lecture format to one that focuses more on discovery learning. Digital kids are used to learning by doing, by manipulating, and by interacting with digital experiences. Thus, even though just talking at them never was the best way to teach, it will prove increasingly ineffective at communicating concepts and content to our students. Instead, students need more hands-on learning activities that allow them to use the rapid-fire, trial-and-error approach that enables them to master digital tools.

Second, teachers must make a significant shift away from text-based learning materials. They must embrace photographs, especially with color, video, and sound as the primary vehicles for conveying information to students. These are not only the preferred means of communication for students today, they are much more powerful ways to get messages across than traditional textual material. Research by 3M shows that the brain is able to process visual information 60,000 times more quickly than textual information. Robert L. Lindstrom, in *The Business Week Guide to Multimedia Presentations* (1994), explains that the brain is much more suited to processing visual information than any other. He states that nerve cells devoted to visual processing account for about 30% of the brain's cortex, compared to 8% for touch and 3% for hearing (Lindstrom, 1994, p. 2). Those creating the new digital experiences kids are exposed to are keenly aware of the visual processing preference of the brain and craft the new tools to provide maximum visual content. Consequently, kids are becoming increasingly visually oriented and adept at processing this kind of communication. Therefore, it is critical for educators to shift the way they communicate in schools both to capitalize on the power of visual information and to keep instruction relevant to their clientele of digital students.

Third, we must provide students with more access to hyperlinked information that can be navigated randomly. This is the underlying structure of

the World Wide Web, and kids learn to travel in this kind of informational space from an early age. Although it is foreign to most adults, it has great power to support learning. It allows a person to follow cognitive links as they develop. It is a kind of learning that young people are completely comfortable with. To many adults, kids employ seemingly nonsensical strategies to discover the information they need. But they can find information in seconds that would take hours, perhaps longer, using the strategies of their parents and teachers.

Fourth, we must allow students to network and collaborate with each other and with experts from around the world on an ad hoc basis. Kids are interacting with people in the online world from an early age. Although most adults cannot understand their need to constantly be connected using e-mail, cell phones, instant messaging, and texting, communicating with people in a virtual world is natural to kids today. Plus, many adults have no idea of the kind of collaboration that takes place when kids play online games. But this kind of networking is second nature to digital kids, and they use this collaboration to joint problem solve and accomplish tasks. In fact, collaborating in this way will be an essential skill for success in the ultraconnected world of the 21st century.

Taken together, these shifts in instruction lead us to question one of the fundamental assumptions of Industrial Age schools—that the classroom is the best way to organize a school and provide instruction. Certainly many of the most effective learning activities in the future will be provided by technology. There are strong indications that the online world will soon be providing much more than the two-dimensional experiences we currently get from computer screens. It will be critical that educators continually monitor new developments in technology and evaluate their potential to enhance student learning. It will be equally important that educators consider how schools could be reorganized to maximize the learning experience of students.

These shifts in instruction also point to the need for massive teacher retraining. Unfortunately, universities generally have not anticipated the kinds of changes we have discussed in this chapter. As a result, teacher training programs continue to prepare young teachers to teach in Industrial Age schools. But it is clear that teachers need new skills to be able to function in 21st-century schools. These skills include hands-on interactive learning, visual literacy and graphic design, the use of both stand-alone and networked digital tools for deep learning activities, information processing, and assessment strategies for measuring higher level thinking.

### We Must Broaden Evaluation to Encompass Activities That Provide a Complete Picture of Student Learning

The problem with the way we evaluate student achievement is captured in an analogy that Dave Master (1999) uses in his presentations. Dave's wife, a nurse, has told him that you can get a good picture of a

person's health by measuring his height and weight. But, Dave asks, would you go to a doctor who only took your height and weight and then said here's a complete picture of your health? Of course you wouldn't!

Everyone knows that a doctor can get a complete picture of a person's health only after poking and prodding and doing a multitude of tests. Yet when it comes to getting a picture of a student's achievement, the school system operates much like the doctor who just measures height and weight. We simply don't do enough measuring to get a complete picture of student learning. Nowhere is this more the case than in the United States, where current federal legislation for education has greatly narrowed the definition of success in school.

Just as the thinking is flawed by only looking at height and weight as the measure of a person's health, the thinking behind the No Child Left Behind Act in the United States is severely flawed in its focus on written standardized tests as the major, if not the only, instrument for measuring student achievement. Although it is laudable that we hold schools accountable, this act has two significant problems.

First, the focus on text-based tests with mainly multiple-choice answers is far too narrow to give a complete picture of a student's learning and skill development. A complete picture of student learning would be a portfolio of student work that would measure such things as skill in debating, skill in performing scientific experiments, the ability to see the meaning in information retrieved from various sources, the ability to use a variety of digital tools to accomplish real-world tasks effectively, the ability to evaluate the messages in photographs and videos, skill in solving real-world problems, skill in publishing information on the World Wide Web in an effective graphical format, and a whole host of other skills that do not show up on the standardized tests that are used today. It's presumptuous for us to say that current test scores are a complete indicator of student learning. In fact, they are only a small part of learning a student should do in school.

Second, the skills that are measured by the standardized tests required by the No Child Left Behind Act are not the skills that students will need for success in 21st-century life. These standardized tests overwhelmingly measure information recall and low-level understanding of concepts. As we have already discussed, low-level memorization skills are not as important in the Information Age as they were in the late industrialized life of the 20th century. Students now need higher level thinking skills if they are going to be successful in life after school. However, these are generally not measured in schools, especially since the No Child Left Behind Act narrowed the definition of success in school to test scores on text-based, multiple-choice standardized tests.

Therefore, we must broaden the focus of our instruction to include the new skills young people will need for 21st-century life. However, the reality of school life is that students and teachers will focus on whatever is

being measured. "Is this going to be on the test?" is a common question from students who want to know where to put their effort. Similarly, teachers will ignore teaching concepts, content, and skills that, although important, are not going to be measured on standardized tests because they know that their effectiveness as teachers will be gauged on how well their students score on the tests. Thus, if we want to change the kind of teaching in our schools, we must change the way we measure student achievement.

In addition to changing the focus of student evaluation, we must also look at massive teacher retraining. Teachers will need new skills to empower them to teach effectively in the digital world of the Information Age. They need not only the skills to harness the power of the new modes of communication that are cascading into daily life, but also the ability to equip students with the new thinking skills they will need for success in the postgraduation world This will require a huge shift in focus in teacher training programs. It is critical that we begin immediately to equip teachers with skills in information processing, visual literacy, problem solving and higher level thinking, ad hoc collaboration, effective graphic design skills, and a deep understanding of how technological tools can enhance the learning process.

### We Must Increase the Connection Between Instruction in Schools and the World Outside

One of the biggest problems we face in education is convincing students that what we are teaching them is relevant to their lives and important for them to learn. This is especially the case with much of the theoretical, decontextualized content contained in many of the curriculum guides for high school courses. Therefore, we must make a concerted effort to help students see the connection between learning and the world at large. There are two significant changes educators must embrace to address this issue. First, teachers must make the effort to relate their instruction to the real world outside the walls of the school. The key point here is that the kids must understand not just the content, but also the context of how that content is applied in the outside world.

Second, schools must make it a priority to provide students with real-world experiences while they are still in school. This can involve inviting speakers to come into the school, but it is much more effective if you can get students out of the school environment and let them experience the nonschool world. Traditional field trips are still a valid way to get kids to see the larger world. Students benefit greatly from working with mentors who have real-world jobs. Job shadowing provides students with a more in-depth experience of what people do in various occupations. To ensure that students see the relevancy of what they are learning, schools need to be much less insular than they are today.

Technology can already be of great assistance in making connections with the world outside school. Students can communicate with mentors via e-mail, instant messaging, and video chatting. They can also use digital simulations to get real-world experiences. Incredibly realistic simulations are already being used in many places in the working world. Pilots train in simulators that are so realistic that trainees quite literally begin to sweat and panic when things go wrong. This kind of virtual experience will proliferate rapidly in the near future.

To make the shift necessary to address the five issues we have just discussed, we must be willing to look at alternatives to the traditional organization of Industrial Age schools. We need to reconsider our longstanding assumptions about teaching and learning, about where, how, and when they may occur, and the resources that are put in place to support learning. We need to reexamine the use of time—the school day, the school timetable, and the school year. It is also clear that we must embrace new methods of instructional delivery to prepare our students for life. The bottom line is that schools must change.

## WHY IS THIS IMPORTANT IN A BOOK ABOUT CREATING 21ST-CENTURY LEARNING ENVIRONMENTS?

You might be thinking that this is all well and good, but what does any of this have to do with me? And it's just that kind of thinking that highlights a huge problem with the way schools are designed. There are so many people specializing in subtasks in the process that the overall big picture gets lost. We have observed that students and learning often get overlooked when new schools are being created. Here are some responses we have heard from people involved in designing schools.

"I work in the facilities department for the school district. I don't need to know about all this instructional stuff. I just work on the technical specifications for new schools. It's the job of the architect to come up with a workable design. My job is to nail down the technical specifications for schools to ensure we don't waste money. There's a lot more to designing a school than just focusing on teaching. And you know, the Department of Education won't fund experiments. Besides, we tried doing something new in one of our schools a while ago and as soon as new staff came to the facility they wanted to change it back to a traditional school. Teachers won't change so why should we talk about doing anything different with the design of a school?"

"I'm an architect. It's my job is to take the specifications given to me by a school district and plug the numbers into my spreadsheets to determine the parameters of my design. It's not my job to know about any of this stuff about digital kids. That's the job of the

school district. Besides, most of the school district facilities staff we deal with don't even talk to the instructional people about these things, so why should we?"

"I'm a district business manager. I watch the finances. It's my job to fund the construction and operations of the school within the revenue available to our district. Sure I care about how the school works and looks, but my big concern is keeping design and construction on budget. We have very little flexibility when it comes to expenditures."

"I'm a district facilities manager. My job is to deliver the school on time, on budget. I don't know about instruction. In fact, curriculum and instruction people drive me crazy. It would be a whole lot easier if they just let me create the box and they can decide what to do inside after I'm done."

"I'm a director of curriculum and instruction. I'm not interested in how the construction of facilities takes place. I find it incredibly difficult dealing with the facilities people in our district because they don't value what I do. I don't even try to talk to them anymore about new methods of instruction. They just give me the classrooms and I train the people to teach in them after the school is built."

"I'm a high school principal. I don't have time to worry about instruction. Teachers will have to figure that out for themselves. I'm worried about making sure the new facility has adequate staff parking, a student drop-off and pick-up area, proper building security, a working bell system, and a great PA system. I have to make sure we have the school facility ready on time for school start-up, especially the football field and the gym."

"I'm a high school teacher. They don't consult me when they design a new school. All I get to do is decide where the white boards go after my classroom is built. And I don't know what all the fuss is about the way teachers teach. I teach the way I was taught—I tell students what they need to know to pass the tests from the Department of Education. Besides, if they want me to teach differently, then the school district has to train me. What I really need is more storage in my classroom and a photocopy room and a staff washroom near by."

Remember that these are actual responses we've heard from people when talking about designing schools. Round and round it goes. It's much easier to point a finger and play the blame game than it is to change. The problem is that kids are stuck in the middle and have to attend the schools that are the result of the collective effort of all these people who are involved in the design process. And that is the reason it is vital that everyone who is involved in designing schools consider the information we have presented in this chapter. Not only does this information have huge

implications for how we must shift instruction to be effective in the 21st century, it also has enormous implications for how schools are organized and constructed. If we want to design truly effective schools, then we all must come to grips with these pressing issues.

Let's recap what those issues are. First, we are currently spending millions of dollars on building new high schools that will last for 40 years or more that are designed on ideas that date back to the early 1900s. Other than some network cables, high-tech communications, and air conditioning, the high schools of today amazingly resemble the schools of our grandparents. Second, schools based on these old ideas are not working well with modern students. The combination of an average dropout rate of one-third, a lack of interest in those who stay, and dissatisfaction in the working world with the skills of graduates is an untenable situation that cannot continue. Third, it's going to get worse very quickly. We are facing a new clientele that continually adapts with the ever-changing world of digital wizardry. Schools are already out of step, and the gap is widening.

In the face of these concerns, we certainly cannot continue to design and build schools the way we always have and expect everything to be OK! Remember the definition of insanity we gave you at the beginning of the chapter? Insanity is doing the same thing you've always done, but expecting or wanting or needing completely different results. According to that definition, believing that existing high school designs based on old ideas will serve 21st-century students well certainly qualifies as insane. The question is, are we going to let old, traditional teaching and learning approaches be the underlying foundation for how we design and operate the new schools we build, or are we going to embrace new ideas about teaching and learning that will be suited to the new digital world of the 21st century and create new facilities that reflect this new thinking? More often than not, we simply move an old mindset for what a school is into a new facility. But when you consider the material we have presented in this chapter, it is obvious that the old mindset will not do the job we want it to do. It is clear that we need to do something different if we want to meet the needs of modern kids.

## BACK TO BASICS

But where do we start to address these issues? There is a story told about legendary football coach Vince Lombardi. Each year at the beginning of training camp, he would take all of his players, rookies and veterans alike, out onto the football field and hold up a football. The objective of this game, he would say, is to get this ball across the other team's goal line while keeping the other team from getting it across ours. Lombardi knew that it was important to start with the basics and build from there. So let's go back and re-examine our assumptions about the basics of designing schools and build our ideas for new schools from there. What are we all

about in the public school system? We are about equipping kids with the skills and knowledge they will need for success as they live their lives in the 21st century. Thus, the core activity in schools is instruction. Everything else, although still important, must either support instruction or operate in such a way that it does not interfere with instruction.

It is imperative that we look at innovative new ways to design schools to ensure that the younger generation is given the best opportunity for success in life. But it is critical to remember that the physical design must be driven by what takes place inside. The physical design must support the main activity that occurs in a school—instruction. To come up with the new designs schools need to be successful in the 21st century, it is essential that everyone involved in school planning and design adopt the motto, "instruction must drive construction." So before we can even begin to look at what a new structure might look like, we must clearly grasp the changes that will be taking place in the kinds of activities that will be occurring inside.

If you consider the implications of what we have just presented about the new world of the Information Age and the nature of digital kids, it is clear that educators must come up with new instructional approaches if they hope to reach their students and keep schools relevant. Consequently, innovative new school designs will be needed to support these new approaches to learning. These new designs can be effective only if everyone involved in planning new schools takes the time to consider how best to instruct modern students for life in the 21st century. Teachers must do this, of course. But it also means that school district facilities staff and architects and even parents, students, and the community must be engaged in the discussions about new instructional models and strategies for organizing schools.

Don't dismiss this book because it seeks to integrate all sorts of topics we usually think are unrelated. Otherwise, you just might end up creating the same kind of school we've had for almost a hundred years instead of the new environments students so desperately need.

**Reflect on Your Community and Its High School(s)**

- How do the basic instructional methods in our community's high schools differ from those in the high school you attended?
- How is instruction in our high schools geared to the minds of today's Information Age students?
- How are we using Information Age resources for learning in our high schools?
- How do plans for the future of our high schools reflect the new digital world and new mindsets of students?