

**TOOLS, CULTURE,
AND EDUCATION:
PAST – PRESENT – FUTURE**

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The story of civilization is, in essence, about the invention and use of tools to create culture and about how societies accomplish the transference of the culture from one generation to the next. Over the thousands of years of human existence, there have been a few periods of particularly deep importance in this unfolding story. These are the seams of history when the means for creating and transferring the culture shifts from one era to another. We are in the midst of one such period.

In his [2001 paper](#) Marc Prensky coined the terms “digital natives” and “digital immigrants.” I would fit Prensky’s definition of a digital immigrant. My generation is the transition generation from the BICTE (Before ICT Era) to the AICTE (After ICT Era). I was born in 1939 which was only 19 years after the world’s first radio station (KDKA) went on the air. KDKA and I were both born in Pittsburgh. The first sound motion picture, *The Jazz Singer*, was released only twelve years before I was born. Two years after I was born, the newly founded Columbia Broadcasting System (CBS) began broadcasting two television newscasts of 15 minutes to a small audience in New York. The world’s first electronic digital computer, the ENIAC was installed at the University of Pennsylvania a month after my seventh birthday. The World Wide Web began operation only 15 years ago when the CERN team led by Tim Berners-Lee and Robert Cailliau put the first Web server onto the Internet.

While it is helpful to recognize the difference between those who were born into the world of omnipresent information technology from those of us who came to all of this later in life, I do not believe that merely being disposed to take the technology for granted, or being adept at manipulating it, provides any particular ability to grasp the significance of what is happening all around us. It is, I believe, more accurate to contend that we are all digital pioneers and we all need to try not to stumble too badly as we move through unfamiliar terrain. The challenge is to see where we are and where we are headed at the beginning of a new chapter in the story of civilization. For those attending this Summit, the ability to move beyond cliché and vague abstraction about the changes occurring in our world is more than an interesting intellectual challenge. As leaders, how you make sense of what is happening has a direct bearing on your role in shaping educational policy and practices – for better or for worse.

In the U.S. we use the term “educational technology” but ICT is a much better term since it includes both audio/video, telephony or cable, and IT which have converged. In this paper, I will put the developments in ICT of the past few years into a historic perspective which I believe is helpful in grasping the significance of what is happening at our moment in time. Then, I will give my thoughts on what this means for education. Intimidated, as I am, by Gerry White, I have made a serious effort to heed his admonition to write a short paper rather than a long book. But it hasn’t been easy to do so!

In the spirit of the Global Summit 2006 I consider this paper a draft. It is a work in progress and it is my expectation that what I will learn at the Summit will enable me to see flaws in my thinking and to gain new ideas and understandings which I can use to improve this paper in a subsequent revision.

HOMO FABER

The symbiosis between humans and the tools they create is the basis for the creation of culture. Let me be clear about what I mean by “culture.” In an old but still good definition of culture E. B. Tylor, one of the founders of cultural anthropology defined it as, “that complex whole which includes knowledge, belief, art, morals, custom, and any other capabilities and habits acquired by man as a member of society.” (Tylor, E.B. 1874, *Primitive Culture*. New York, Harper. p1) I am not using the term “culture” in an honorific sense. The “complex whole” includes both that which uplifts and that which degrades the human condition. Thus, culture includes the plays of Shakespeare but also Mein Kampf. It includes knowledge about treatment of cancer but also recipes for making anthrax.

The story of civilization begins around 200, 000 years ago, give or take several thousand millennia, with *Homo sapiens*. The emergence and development of our species is interwoven with the crafting of tools to chop, scrape, and chisel. Indeed, the nature and sophistication of the tools found with the skeletal remains are critical indications that hominoids had evolved into a new species. The French philosopher Henri Bergson observed that a better name for our species than *homo sapiens* would be *homo faber* – “man the maker” since in his words, “intelligence considered in what seems to be its original feature, is the faculty of manufacturing artificial objects, especially tools to make tools, and of indefinitely varying the manufacture,” ([Bergson section 139](#)).

Humans invent tools and the products of their tools shape the human condition. Just as humans make tools that are used to create the physical environment of the civilization, humans have also invented tools that are used to create the cognitive environment of civilization: the tools for the mind. The invention of three clusters of cognitive tools have had profound impact on the human condition and, in each instance, have led to a radical transformation in the way culture is created and disseminated.

TOOLS FOR THE MIND

Human beings had consciousness long before they had any particularly effective means to structure what was in their minds and to communicate it to others. Since culture is intrinsically a shared enterprise, a means for enabling sharing of cognitions is essential and the nature of the means for sharing shapes the texture of the culture. Over the span of human history there has been the invention of three seminal systems which have enabled the inner life of the human mind – thoughts and ideas - to be coded into a form which enables them to be stored, transmitted, and shared.

Language

The first great tool of the mind made use of phonemes, units of utterance, as a basis for speech. The dating of the origin of speech is contentious and ranges from 20,000 to 40,000 years ago. The invention of systems of language was not coincidental with the development of speech; rather, the formation of language structures of increasing sophistication occurred over a long period of time. Spoken language made human thought a social commodity. Speech made it possible for one person to tell another person what was in his/her mind - to inform someone. Thus, our far distant ancestors created the first information revolution since it was they who invented information. Just as a person could leave the product of their hands such as a bowl or an axe to their progeny, spoken language now enabled them to leave behind the products of their mind - their stories, their truths, their beliefs, their ideas, their knowledge. By memorizing the accumulated knowledge of the society and by passing it to successive generations by word of mouth, the products of human minds achieved durability beyond the life span of the humans who created the knowledge. This was the oral tradition.

Writing

The invention of the second tool of the mind involved the use of graphic symbols to produce writing. The first use of graphic symbols as a system of writing probably occurred sometime between 3500 – 5000 BCE. Writing provided new and powerful capability for structuring and manipulating cognition. Writing was first done on clay or carved onto rock but later inscribed on vellum or parchment. Manuscripts were expensive and not portable and literacy was limited; so, access to the intellectual content of the culture was reserved for the elite.

Several millennia later, in the 1450s, the invention of printing along with the invention of ways to make paper production cheap expanded access. Books meant that the transfer of information was no longer limited to the distance that a voice would be audible or to those places, limited as they were where manuscripts could be read. Persons unconnected in time and space could build on the work of one another in ways that were not possible in the oral tradition. Books also meant that the information that was accessible to a person went far beyond what they could hold in their head; people, at least some people, could augment the capabilities of their mind with their own personal library. This led to the great information explosion in the eighteenth century. There was a tremendous outpouring of printed materials in all fields which ultimately led to the birth of science and to the transformation of political, religious, and commercial life.

It is important to understand that there are trade-offs in these cultural shifts. When Socrates was born in 499 BCE writing existed, but the spirit of the oral tradition was still strong. Socrates spoke; Plato wrote. In the [*Phaedrus*](#) Plato recounts how Socrates inveighed against writing as a means of advancing human knowledge. Knowledge, for Socrates was not something which resided in the inert written word but only in the minds of humans. “I cannot help feeling, Phaedrus, [Socrates

said] that writing is unfortunately like painting; for the creations of the painter have the attitude of life, and yet if you ask them a question they preserve a solemn silence. And the same may be said of written discourses.” This passage from Phaedrus is sometimes used to show that even Socrates could be an enemy of progress but, in fact it reminds us that often change brings with it both something gained and something lost. Certainly anyone who has ever struggled to make sense of a passage in a text book, when reading and rereading fails to clarify recognizes what is lost when the author of the words is not there to be interrogated. How that frustrated person would welcome the oral tradition!

Information and Communications Technology

On May 24, 1844, Samuel Morse sent the message “What hast God wrought!” from Washington D.C. to Baltimore via telegraph. Morse had found a way to use electrical energy to code and transmit information. Around the time that Samuel Morse was working on his invention, an Englishman named Charles Babbage was deep at work on his Analytic Engine, the precursor of the modern computer. Babbage recognized the relevance of the use of electronics for his machine, but given the state of the art, this was not feasible. In a little more than a century however, the paths initiated by these two inventions would converge in the form of the ENIAC computer. In the years between the telegraph and the computer, other ways to use electrical energy to transmit information led to the invention of radio and television. All of this laid the foundation for the beginning of the ICT era which we can date from around the middle years of the 20th century.

Even though it is early, it is clear that the impact of information and communications technology on civilization will be at least at a level comparable to the invention of writing and may even prove to be as transformative of the human condition as was the invention of speech. There are some very conspicuous ways in which ICT have transformed the culture. Economic/social status and place are becoming less and less significant determinants of access to the stored products of the culture than anytime in human history. This trend will continue if efforts of those with commercial interests who wish to make proprietary more and more of the culture can be held within reasonable boundaries. While printed media is still significant, television, radio, and the Internet have become dominant sources of accessing and sharing the culture. A business or industry leader of 30 or 40 years ago, who would be reborn into the contemporary world of business and industry, would be as if on another planet. No field of human enterprise has been immune to ICT. While the estimates for the current doubling of information in five or ten years are of somewhat dubious construction, it is clear that the growth of knowledge is occurring at a rate which is incredibly faster than ever before in human history.

The literary tradition profoundly influenced how we came to think about the nature of knowledge and as pioneers we have one foot in the new world and one in the old world. (I printed out a draft and did some of my editing with pencil on paper because I felt more secure editing on paper with a pencil.)The structure of the book became the dominant metaphor for the structure of knowledge. The book is divided

into chapters, each of which in a logical sequence established by the author contains a cohesive segment of the whole of it. Similarly knowledge was thought of as a series of discrete disciplines each of which had an intrinsic linear structure. Just as the traditions of the literate culture and the structure of the book shaped the conception of the nature of knowledge; the emerging traditions of the information culture are providing a new conception of the nature of knowledge. Knowledge becomes a network of concepts with many connective pathways. Print on paper is static and immutable. Words on a screen are dynamic and transitory. The electronic tradition, like the oral tradition, is much more congenial to a communal approach to the construction of knowledge than is the print tradition. Just as there were no Einsteins or Newtons in oral cultures, the advance of knowledge in an electronic tradition is likely to involve fewer advances attributable to the work of a solitary genius. The difference in the way we have come to think of the totality of knowledge is typified by the shift from the Dewey Decimal System to Google as a metaphor for that totality.

Information technology has substantially elevated the importance of iconic learning. Today most people learn about their current events in their world in pictorial form through television. Pictures are particularly potent in engendering an emotional response. A picture of a starving child in Mogadishu or of students resisting repression in Tiananmen Square has an immediacy of emotional impact greater than what a written account can typically engender. I wonder if we in the U.S. would think about the Middle East differently if we did not have the images which we have seen so often on TV of screaming faces calling for "Death to America." Yet, the power of images is not confined to engendering emotion. Increasing attention has been devoted to the use of visualization as a means of presenting in pictorial form vast quantities of information. The user of such information might drown in the sea of this information in verbal or quantitative forms.

I make no claim for myself as a futurist and admit to being a bit skeptical of anyone who professes an ability to foretell the future. I take to heart the remark of J.B. Priestly: "Solemn prophesy is a futile proceeding, except insofar as it makes our descendents laugh." It is impossible to foretell the future by extrapolating from existing trends with regard to information technology since events and developments which have nothing directly to do with information technology and which cannot be foreseen may have major impact on our future, and may even determine whether we have a future. I want to briefly mention a few lines of development which I believe will be particularly salient for education.

The Internet provides access to a greater percentage - and a rapidly growing percentage - of the world's population, to quantity of information and knowledge which even a few years ago would have been accessible to not even the most privileged elite. When effective computer translation becomes available the amount of information accessible to any individual will take a further giant leap. Google is very good at finding needles in the Internet haystack. So good, in fact, that it often finds millions of them. (Google found 32,000,000 hits on recent search of mine for information about neural networks.) Specialized information resources such

as the excellently designed EdNA (developed by ***education.au limited***) provide a model for mediating the vast resources of the Web with the needs of a clientele. In the case of EdNA the clientele is educators. Advances in [knowledge processing](#) will enable services such as EdNA to become even more powerful by providing personalized access as well as providing syntheses compatible with the objectives of the person searching. They will cut through the massive quantity of online information with a scalpel rather than with a chain saw.

Along the same line, [intelligent agents](#) and [intelligent tutoring systems](#) will increasingly provide rich learning opportunities, particularly as the relevant knowledge base on human learning expands and as that knowledge base is used to design learning appliances and applications. Another important development pertains to the advances which will continue in [brain-computer](#) interface. These applications, at present, are centered on the development of neuroprosthesis for individuals with disabilities but, we can expect to see new applications that might be called cognitive prosthesis which will enable the mind to be augmented in ways via direct interface. Additionally, and I believe of particular significance, are advances which are occurring in creating new social forms and in particular those which make use of human networks to produce knowledge and information artifacts. Blogs and [Wiki](#) applications are early examples of the use of social networking which challenge conventions about who are legitimate knowledge and information workers and how the new knowledge and information workers make and disseminate the products of their work.

Whether we are moving toward what some have called [singularity](#), which would be a future that some expect when artificial intelligence will result in computers with intelligence surpassing humans, is open to debate, but the best opportunities to improve human welfare and the greatest threats to the human condition are yet to come.

EDUCATION

Civilization would be a progressless sequence of one generation episodes were there not some means to store and transfer the culture from one generation to the next. We lack a term in common usage to indicate the combined totality of resources and processes that accomplish this process. The lack of a term tells us something; it is an indication of how infrequently we consider the issue of transfer of the culture from a holistic perspective. For lack of a better term, I use the term "education" to encompass that totality of processes and means used to perpetuate human culture. In this usage, "education" is not a synonym for "schooling"; rather, schooling (primary, secondary, and tertiary) is a sub-set of education. It also includes training in business and industry, vocational training, and [non-formal](#) education or that which occurs outside the aegis of an agency, which establishes the curriculum for the learner, and/or which issues a certificate of accomplishment. Increasingly, non-formal education entails the substantial educational role played by the Internet and by electronic media. What does this shift to the "Third Era"

mean for education? Six conclusions:

First: *The basis for the needed developments in education is the reconciliation of education with the realities of the culture as it now exists.* My tour of human history was intended to give a sense – albeit with broad brush strokes – of how humankind has constructed, shared, and transferred the culture in the past and how the emergence of information and communications technologies have led to cultural transformation. Merely getting computers used in schools, vocational or corporate training programs does not necessarily mean that the program is harmonized with contemporary reality, that it is any better now than before computers, or even that it is substantially different now than before ICT was used.

Those favoring the use of ICT in schools in the U.S. frequently talk about “integration of technology” into schools. What this means is finding ways to fit ICT into what currently exists. Larry Cuban has referred to this as the “preservationist scenario” and involves the use of computers and other technologies to improve productivity, raise test scores, while not making any substantial change in how the school is organized to deliver instruction. It is certainly easier to do new things than to think in new ways, but if we do new things within the context of an old mental model we inevitably sell out the present to the past.

For those who believe, as I do, that much of the existing curricula in our schools has been rendered obsolete by advances in knowledge in all fields of endeavor, the use of a tool, even if it is a good one to do the wrong job (i.e. become more efficient at teaching an outmoded curriculum) is no advantage. For those who believe, as I do, that “learner centered” deserves to be more than a vacuous public relations slogan, the use of ICT provides an opportunity to disengage from the “one size fits all” curricula and pedagogy and to be effectively responsive to individual differences among learners in a way envisioned by many of the great educational reformers of the past but generally achieved in only quite limited fashion. For those who believe, as I do, that information and communications technologies provide an opportunity which expands the potential of education beyond our wildest dreams of even just a few years ago, it is clear that integrating ICT within the existing parameters of schooling guarantees that the potential of ICT to help us generate vibrant learning environments will not be realized.

ICT has led to dramatic changes in processes and perspectives in the world of business and industry. The knowledge and skills that a person has acquired in pre-work training and in the first few years of their working life are far less likely to be able to carry them through their entire career. Job security is no longer in the employing corporation but in the person. Lifelong learning has always been a privilege of an educated elite; it now becomes a functional necessity for an increasingly large segment of the working population. Despite the frequent reference to *lifelong learning* in the training literature, it is often treated as *lifelong teaching* or the need for trainers to continuously upgrade the skills of workers. Lifelong learning is fundamentally dispositional on the part of the learner. Additionally, lifelong learning entails the acquisition of skills at being an

independent, self-directed learner. Schools, vocational and corporate training agencies share a common imperative to ensue that young people experience learning in a way that leads to the motivation to be a life-long learner and to enable them to have the skills to take advantage of the learning resources which are now available to them – and particularly the rich and growing online resources.

Our challenge is to recognize the new realities and opportunities and to develop practices and policies that bring education into harmony with the way the world is, rather than how it used to be or even how we might wish it to be.

Second: the hegemony of the formal education - school - as the educational agency for society has ended. Urbanization, which was a consequence of the Industrial Revolution, played a key role in the establishment of schools as the institution charged by society with responsibility for education. The model for state supported universal schools originated in Prussia in the eighteenth century and by the early part of the nineteenth century it had spread to many parts of the western world. Over the span of the later part of the 19th and through most of the 20th century, schools (and in the U.S. this was the Public School) were seen as the dominant place where education took place. Even now, a person is likely to answer the question, “Where did you get your education?” by naming a school. The 19th century was, at least in the U.S., a high point in the perceived credibility of institutions. This faith has waned and there is less trust in the institutions in general and the school in particular, in meeting society’s educational needs.

The other factor affecting the educational role played by the schools is the availability and potency of non-formal educational resources much of which are provided by the Web. Of course, in the 19th and 20th centuries there was an array of non-formal educational resources and more and more people had access to books, magazines, and newspapers, but the information which is now available to a large and growing percentage of the world’s population has vastly expanded access and the capability of individuals to educate themselves far beyond what was possible a few decades ago. Primary and secondary schools will not disappear, if for no other reason than there needs to be a safe place for children to be during the day. However, the schools which will have the most positive value for their students and for society will be those that know how to function in an educational world that they do not control. Those schools will be adept at relating to the out-of-school educational resources and incorporating them into the strategies and tactics of the school.

Third: there is a need for more educators. I am not referring to a response to a teacher shortage; rather I mean that there is a great need for more individuals who take a more holistic perspective on education. This is not to suggest a professional training program to create a new type of specialization; rather, it is to advocate that those who serve in the various education venues adopt a perspective of constructive disregard of turf. It is a rare and good experience for me to attend a conference such as this one, which brings together as many sectors which comprise the

education resources of society. In the U.S, dialogue across educational venues is scarce. It is good to have stakeholders representing the major education venues in the same room. It is even better when we understand and act on the understanding that we are partners involved in a common enterprise. To the degree that we are willing to allow others onto our turf and meet them on theirs to figure out how we work together, we are better situated to serve the needs of those whose education is entrusted to us.

The basis for some of the most valuable and innovative work can occur at the intersections of the various educational agencies. A good example of that, and one that some of you know about, was the ThinkQuest program which cut across secondary schools and a variety of outside-of-school venues. It was not designed to fit into schools but to provide a rich educational experience where teachers were disposed to take advantage of it and for use in the home when schools were unwilling or unable to make use of it.

Fourth: *the forces that tether schooling to a world which is rapidly disappearing are both internal and external.* Those who recognize the need for major changes in schooling often point to the intransigence of school personnel in facing up to the changes which are needed. Indeed, those inside an organization are often resistant to change. As a resident of Michigan, I am aware at close hand of the story of U.S. auto manufacturing. We saw that those responsible for making U.S. cars were living in a world which no longer existed in the face of the challenge of the Japanese auto industry. When those inside finally got the message, they could and did take action. Certainly we have our share of school personnel who are seemingly unaware of the implications of the changes in the world for the conduct of schooling. Yet, there is not a one-to-one correspondence of the restructuring issue in industry and in schooling. School reform efforts exist within a framework of public policies and laws which themselves constrain significant reform. Even worse, some of the recent public policy actions in the U.S. are intended to return schooling to the “good old days.”

There is another way in which the comparison with restructuring in industry and in schools diverges. The success of an auto company is determined by the ability of the company to produce a car that has the features and cost which the market desires. Customers are concerned about the product that is delivered not the process used to build the product. This is not so with regard to schooling. Parents, citizens, and policy makers carry with them notions about the process of schooling. They have convictions about *how schools should be* as well as what outcomes they should produce. The standard against which the school is assessed is often the image of the good school – real or imagined – which they carry in their mind from their own schooling experience. While there is often resistance to reform from school personnel, anyone who has been seriously engaged in school reform at the implementation level can identify external forces which have confounded or sometimes defeated their effort to achieve the needed changes. Major efforts of reform need to “take on” the external challenges as well as the internal one and not assume that the external constraints will melt away when the good work

done within the school is recognized. I have written in more detail about the educational and school reform and this is available on my [Website](#)

Fifth: ICT as other technology of consequence generates both positive and negative consequences. Neither the technophiles nor the technophobes have it right. Information technology will neither bring heaven or hell to earth. The history of other important technologies shows a mixed bag of outcomes. Certainly, in the case of the other two cognitive tools, speech and writing, it is possible to find many examples of the use of them to do harm as well as good. ICT is no different. The ICT community has often been glib with regard to the axiological issues which ICT raises. Those of us involved with the use of ICT in education need a balanced perspective and ought not to react defensively to those who find fault with the use of ICT in education. Certainly some of the criticisms are ill-informed and do not warrant either response or reaction. But, the knee-jerk reaction to criticism should not be in a rush to defend. Thoughtful critics such as [Larry Cuban](#), [Todd Oppenheimer](#), and [Neil Postman](#) provide a point-of-view which can help to advance our thinking on ICT in education. We do not have to agree with all that they say to derive benefit which comes from leaving our comfort zone and facing up to problems and issues which they raise.

Sixth: the future for education will be as varied as the present. Predictions made for the impact of ICT in education are typically unambiguous. There is no reason to expect a historical determinism with regard to the use of ICT which will inevitably lead education to a point where ICT is manifest in education in a particular way. Rather, there will be many manifestations of ICT in education. I see no reason to believe that we will come to a point with ICT where we have finally “got it right.” We will continue to see ICT in schools, vocational and business/industry training, and non-formal education which vary on every descriptor, high use-low use, progressive-conservative, innovative-unoriginal etc. The technology of textbooks which has been in place for a couple of centuries has still not evolved to the point where we have the recipe down with regard to producing good textbooks. The task of taking full advantage of ICT for the benefit of education will not be determined by a Hegelian dialect but by the continuing commitment of educators to use every resource at their disposal to create environments and develop products that continue to advance the cause of education.

IN CONCLUSION

There are many adjectives that might be used to characterize our moment in time. Boring would not be one of them. The word that best characterizes this moment for me is “opportunity.” In our lifetime humans have gained the opportunity to do the best and worst for humanity that can be imagined. When many of us began our professional careers, no one could have guessed the capability that is now available to us. So, there has never been a better or more important time to be an education professional than now. I admit to some frustration because of the sense that we could be doing much, much better than we are doing with the educational resources that ICT has provided. Thus, the future is on my mind, but it is not what will be happening three years from now but what we can and should do next week

to redouble our efforts, to take full advantage of the unprecedented opportunity which is before us.