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The Electronic Highway and Education: New Doors to Keep Open

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1. Introduction
2. Questions
3. Domains and Levels of Knowledge
4. Levels of Access
5. Media
6. Space
7. Time
8. Goals
9. Tools
10. Meters
11. Heritage vs. Business
12. Business and Education as Products and Commodities
13. Entertainment, Info-tainment and Edu-tainment As Business
14. A Larger Business View
15. Conclusions

1. Introduction

Al Gore's vision of an electronic highway conjures up images of fibre optics used to pipeline information. This opens up immense possibilities. Materials which were scattered in different libraries, galleries and other institutions are becoming accessible on line. It also introduces new problems and dangers. How do we navigate on this highway without being inundated by titles and images? In traditional printed books the claims of an author rested on their footnotes and references. What will the electronic versions of footnotes be? How can we keep attentive to the veracity and dependability of sources when the material that appears on the screen is ever more impressive? The System for Universal Media Searching (SUMS, Copyright 1992) being developed at the McLuhan Program offers a model for conceptual navigation on this new highway and explores some alternatives for keeping open our awareness of sources.

SUMS is a software programme that grew out of three scholarly projects: Leonardo da Vinci; a standard bibliography on perspective and the proportional compass. This work on one man, one word and one object raised questions of knowledge retrieval in the case of complex materials. This project is by no means finished. The version being demonstrated at Learntec '93 is part of a prototype using off the shelf software including Toolbook for Multimedia, drawing upon database material in DBase, graphics using AutoCAD, Animator Pro and 3-D Studio as well as materials on video, CD-ROM and

laser disc. A version of the complete project is being re-written in C++. Many of the features described below are already working. A number of the features are still in development. Basic to SUMS are a series of concepts: questions, domains and levels of knowledge, levels of access, media, space, time, goals, tools and meters. Part one of the paper describes these briefly. Part two examines some of the larger issues surrounding the electronic highway in terms of dangers and possibilities.

2. Questions

How will we enter a database with millions of books and images? SUMS begins with six basic questions: who, what, where, when, how and why? Each of these leads to lists of persons (who?), subjects (what?), places (where?), dates and events (when?), instructions (how?) and reasons (why?). Subsets of these lists are reached using the function of limit by, which is effectively a refinement of the questions approach in order to make more manageable lists that would otherwise be overwhelming in their length. For instance a list of all persons and institutions would include many names that are of no interest to a given search. Hence one limits the list by using the basic questions anew in defining a profession (who?), a topic (what?), a place (where?) and a time (when?). If one chose, say, artists dealing with perspective in Europe from 1500-1800 the list would be reduced to approximately 1400 names. This would include both practitioners and theorists. To further limit this list one could choose only to view practitioners or theorists.

Limit by has a second function of offering different views of the same material. Titles of books (level four) offer an excellent case in point. One might wish to see titles as a simple alphabetical list such that one can type in "how" and find all books beginning with this word. Alternatively one might wish to see the same list arranged chronologically such that one can view all books printed between 1540 and 1550 or some other date. One might wish further to limit these lists by country and/or city, by language and/or by key word. Limit by thus effectively includes aspects of Boolean logic.

3. Domains and Levels of Knowledge

If we have access to millions of documents the problem is not in finding material, but rather in finding too much. One strategy in dealing with this problem is to distinguish between three basic domains of knowledge: pointers, objects and interpretations. Pointers are the tools we use to get at knowledge, i.e. the materials traditionally associated with the reference sections of libraries. Objects are facsimiles of the works themselves be they books (primary literature), paintings, or other materials. Interpretations or analyses are the secondary literature, i.e. commentaries and studies which use the original objects as their point of departure.

Levels of knowledge constitute a refinement in this basic strategy of identifying different domains of knowledge. Pointers are subdivided into five levels: classifications, definitions, as in dictionaries; explanations, as in encyclopaedias; titles as in bibliographies; and partial contents, as in abstracts and indexes. In the past classification systems served as a means of physically positioning books on shelves. In the electronic

age this function remains, but since other classification systems are effectively different methods of cubbyholing information, they can be treated in the manner of "see also" terms such that their different treatments of the same books serve as practical glimpses into elusive problems of how culture affects mindsets, and the history of mentalities.

Objects form a sixth level as full contents. Interpretations are divided into four further levels: internal analyses, which studies the object in its own right, i.e. close reading in the case of literature (level seven); external analyses which relates the book or painting to other books or paintings (level eight); restorations, where the object of study has built into it the interpretation of the restorer (level nine) and reconstructions, where this built in interpretation is even greater (level ten). In addition to this traditional archaeological sense, reconstructions also include all attempts at creating interpretive models of objects, be they physical or conceptual. This entails Computer Aided Design (CAD), animations and potentially also virtual reality. Distinguishing between these ten levels of knowledge, which should not be seen in a simple hierarchical manner, a user is able to focus much more efficiently on the kind of knowledge that interests them: whether they want merely a rough definition, a more thorough explanation or a standard tome on the subject.

4. Levels of Access

The amount and detail of information which a person needs varies with their age and education. A series of ten different levels of access is therefore planned ranging from pre-school to research. For instance in the case of geometry, a pre-school child will be offered definitions of basic terms such as point, line and circle, whereas a geometer at the research level will wish definitions of concepts such as descriptive, analytic, projective and algebraic geometry. An educator will want a different version of the curriculum than a member of the general public. Some of these levels of access, notably the professional level, will require further subdivision. For example, in the field of medicine, the needs and interests of a general practitioner will be very different from those of a cardiologist, an ear, nose and throat (ENT) specialist or the world authority on a single organ or function.

It is foreseen that these levels of access will affect not only the content of available databases but also the process of learning itself. As Brian Algers, Director of Technology at River Oaks School (Oakville, Ontario) noted in a recent letter:

The ability to use frameworks of knowledge and appropriate levels of access to the database is a powerful concept. We could literally have students create "A view of the World" by grade or division level which could be pressed onto CD-ROM using the facilities at River Oaks. In this sense, the school environment becomes a knowledge building community and the students become knowledge workers. Through telecommunications, we could again extend this knowledge building community to a global level.

16. Media

The Renaissance which brought many valuable contributions also brought some curious developments such as the tendency to use different media as a criterion for the separation of knowledge. Hence books went to libraries, paintings to art galleries, prints to print rooms, engravings to engraving cabinets and so on. At one level this was very practical. At another level it made comparisons across different media well nigh impossible. One could, for example, bring together systematically the books and articles on the Parthenon, but could not confront these with all the paintings, drawings, engravings, woodcuts and photographs let alone the videos and films of the same building. The new electronic media have the enormous advantage that no single medium is privileged to the exclusion of others. As a result electronic versions of different media will no longer relegate them to different physical locations. In SUMS a simple list of media allows one of ten choices including diagram, film, photograph, text, and video. In the case of experts, who need more options, a list of twenty four media is available. Hence a person reading about the Parthenon simply needs to call up the media meter, and choose photographs in order to see which images taken with cameras are available. Alternatively, if they then wish to see film clips of the same there is no need to go to a new building. The next medium is merely a button away.

17. Space

Maps, as a kind of Geographical Information System (GIS), form another point of entry into the system. Entailed here are a series of ten scales whereby a person can move from a world map to an object in the ten steps. This permits basic orientation. Intermediate scales can be reached by using macro-scales which permit one to choose the limits of the scales that interest one, for instance all maps with a scale between 1:100,000 to 1:1,000,000.

There are a number of other functions connected with the concept of space including size, area, volume, (x,y,z) co-ordinates, longitude and latitude, micro-scales and kinds of maps. In the past records of spatial information were usually scattered and often haphazard. For instance, one would tend to find maps in atlases. Information concerning the size of a building or other object might be in an encyclopaedia, a specialized book, a city archive, in the records of an architectural firm or even a construction company.

SUMS is creating a framework for systematic access to all spatial information. For instance, if one were studying the Empire State Building, information concerning its size, volume and exact location could be called up systematically.

7. Time

This same principle is being applied to time in terms of dates, calendars and different kinds of periods: chronological (e.g. years, decades, centuries), historical and geological periods, as well as micro-periods (e.g. seconds, milliseconds and nanoseconds) needed at the atomic level. In the case of calendars, for example, it is well known that there are differences between Babylonian, Hebraic, Roman, Gregorian and Arabic calendars. Computers allow an automatic conversion between these different recordings of the same

phenomenon such that a person reading an Arabic document about an event in the 43rd year of Islam would merely press the appropriate button in order to be reminded of the equivalent year in the A.D. version.

8. Goals

In the past, goals were often unclear to the persons concerned. For instance, in education, enormous efforts were put into curriculum guidelines which were at best studied by teachers but usually never seen by students. Even today, when there is much rhetoric about the importance of outcomes, students are often unsure as to precisely what is expected of them. The proverbial question: "Will it be on the exam?" may madden teachers but remains indicative of an enduring lack of clarity concerning what is expected.

In Ontario the outline for the new curriculum is now being made available in electronic form and there is discussion of extending this approach to the so-called benchmarks and the more detailed curriculum guidelines for individual subjects. The SUMS project foresees that these electronic versions of goals should be linked directly with relevant textbooks and other learning materials. Hence if a student or teacher is looking at a text, they need merely press the goals button in order to see which curriculum requirements this text is intended to fulfill. Such a strategy will be particularly useful in the case of traditional subjects where there are clearly established goals. In the case of new or emerging fields it will be desirable to develop methods for establishing dynamic goals. Here, distinctions between different kinds of learning, such as cognitive, affective, perceptual and psychomotor will be useful.

In the course of the past century psychologists have become increasingly aware that goals vary with different types of learner. Fundamental in this context was the work of Carl Gustav Jung whose study of archetypes led him to suggest that there were basic personality types. These inspired the more rigid oppositions of Myer Briggs in terms of extraversion-introversion, sensing-intuition, thinking-feeling, judgment-perception which led to a systematic approach in the testing of personality. Others such as Sternberg (1990) have identified a series of different intelligences, namely, geographic, computational, biological, epistemological, anthropological, sociological and systems. One of the challenges of the next generations will be in identifying how these different kinds of personality and intelligence affect goals in learning.

The implications of these developments are as problematic as they are profound. Evidently if a person has a marked geographical intelligence, then entering knowledge bases in terms of maps and geographical information systems (GIS) will be easier for them than some very abstract method. Should everyone then be encouraged to develop only the particular kind of intelligence at which they are best or should the purpose of an education lie in making every person aware of the value and importance of different kinds of intelligence? At some stage it might be desirable to create knowledge bases which have a different view of the same facts in terms of each kind of intelligence such

that one could see how the same material appears in altered form through different kinds of minds and not just through the proverbial different kinds of eyes.

9. Tools

A majority of commercial software packages have focussed on providing single tools in isolation. For instance, some have been dedicated to editing or commenting on an existing document (Word, Word Perfect) or database (DBase, FoxPro), excerpting from an existing document (e.g. the notepad function in Windows); adding information from another database (e.g. the DLL functions in Toolbook and newer products such as Oracle Glue); creating a new document or image (Corel Draw or AutoCAD), transforming (Winmorph at the low end and Alias products at the high end), presenting and publishing (Aldus) knowledge.

Some of these tools, notably the print function, are already becoming a regular feature of software programs. One of the aims of SUMS is to integrate all these functions as regular features accessible through the tools button. Hence a user consulting a dictionary (at level two of the system) could use the tools to excerpt or copy a definition with a view to editing it. Alternatively a person might take a diagram which they had found in an encyclopaedia (at level three of the system), and import it into an AutoCAD environment such that they could reconstruct it. For instance, they might take a two dimensional view and develop it into a three dimensional one such that it can be viewed from all sides. In this way the specialized functions of the individual software packages would acquire new value. A help function is also included amongst these tools. Also foreseen is a more complex search function with tracking features called Knowledge Engine (Copyright 1992 with Gary MacGregor of Greenfield Projects).

10. Meters

In order to simplify as much as possible the problems of conceptual navigation in large databases, SUMS reduces all of the above functions to a series of eight initial meters arranged alphabetically, namely, access, goals, levels, media, questions, space, time and tools. Each meter is effectively a short list of choices, each of which functions as a button activated when clicked on by a mouse. In most cases an initial list leads to further lists. Partitioning the complexities of a topic in this way has the great advantage that the user is always offered a small number of choices appropriate to their level of training and interest.

The meters can be used in whatever sequence a person chooses. Meters impose no restrictions on the freedom of movement within databases. At the same time, in cases where some choices are more obvious than others, these may be highlighted. For example, with respect to the meter for levels, if one has just chosen a term in a classification system one is most likely to wish a definition or a title so these options will be highlighted. If one chooses instead to go directly to an explanation, this can be done.

11. Heritage vs. Business

With respect to technology, the vision of an electronic highway which will give new access to the world's knowledge is now possible. Some amazing preparatory steps have already been taken. For instance, 150,000 pages of manuscripts at the Vatican Library are already available on three laser discs. Under discussion is a project that would scan in all 150,000 manuscripts of that library. In Washington there is discussion of a project to scan in 10,000,000 books. Projects involving millions of photographs of paintings and other museum objects are also being explored.

There are two fundamentally different approaches to this whole process. One view is that since the great libraries, galleries and museums were paid for by taxpayers' monies, their contents belong to the national heritage of the respective countries. In this view any electronic version of the same heritage belongs equally to the people. Another faction looks at information and knowledge as a new market, another source of profit. If this view prevails then access to knowledge and culture will be strictly in terms of financial ability: money, not depth of learning or devotion to scholarship will decide who gets access to electronic versions of materials. This view is perhaps most popular in the United States, particularly in cities such as Cambridge, Mass., where even professors of neighbouring universities such as Boston have to pay considerable fees to use the libraries of Harvard University on a regular basis. It should be noted however that these trends are by no means limited to the United States. Scholars wishing to use the venerable Bodleian Library at Oxford now find that they have to pay a daily fee.

12. Business and Education as Products and Commodities

The obvious danger in these trends is that scholars, who are the only ones trained to use these sources in different languages and difficult scripts, will no longer be able to do so. A more pernicious danger lurks elsewhere. Businessmen are beginning to speak of intellectual property in the manner that they speak of real estate: something that can simply be bought, sold and speculated on for profit. Ideas and scholarship are being treated as if they were products that can be packaged and commodities that can be sold the way in which one sells consumer goods. On the surface this may seem flattering to a world of scholars who have traditionally been rather neglected in terms of material gain. At a deeper level these trends pose a fundamental threat to the world of learning. Why? Because the highest scholarship has traditionally been concerned with finding out the truth about a matter. In the arts this typically involves studying a number of paintings in great detail. In the humanities this usually requires reading many books or when appropriate manuscripts or archival materials. In the sciences careful experiments are a basic part of this process.

The way to truth is almost never the cheapest way. A scholar wants to include all the evidence. A businessman will constantly remind the scholar that if there were less evidence the publication would be cheaper. Nor does this reasoning remain at a purely theoretical level. Major publishers such as the University of Chicago Press have explicit policies limiting the number of illustrations in most of their books to a few hundred. As a

result Leonardo da Vinci, who alone produced nearly a hundred thousand images in his writings, could never be published by that press.

13. Entertainment, Info-tainment and Edu-tainment As Business

If these trends are applied to the electronic highway such that it too is viewed mainly as a business proposition, these problems will be greatly magnified. It is one thing to produce entertainment on the basis of what is most popular, but if one takes seriously seductive phrases such as info-tainment and edu-tainment, then that which is packaged in the most entertaining way will win the day and that which sells most will win the places tomorrow. This is not to say that one should not use playful and even entertaining methods in education. Rather, it is a plea that entertainment and profit should not become criteria for the contents or the scope of education.

Marshall McLuhan spent his life warning about the dangers of some of the new media. Anyone who has tried to make a serious television film will have first hand knowledge of the problem. One is faced with a spool of tape. One has only a few seconds to discuss each scene. So most of one's energies go into eliminating what one knows about a picture. A famous Professor at a university in Northern Germany once told me that one could not show more than one slide in a lecture of an hour. Needless to say that person never appeared on television. Television, film and much of electronic entertainment favour a smooth flowing narrative which typically provides a single point of view. Often the narrator is hidden in an authoritative voice and stance that makes it seem as if it were objective. Watching CNN during Desert Storm, it took a considerable effort to remember that they were telling one side of that story. If the growing rhetoric concerning info-tainment and edu-tainment is taken seriously, and entertainment becomes the model for how we approach knowledge, we are in great danger of having a one-sided approach to a many-sided reality.

When I was in school I learned about the fall of Constantinople. One day, many years later I went to Istanbul and discovered that in the eyes of Turkish persons that same event was the rise of the Ottoman Empire. As irony would have it, I had learned about the Ottoman Empire separately at school, but the connection was never made. There are some brave voices who point out that every victory for one side is a defeat for the other side, and conversely. From a narrow business point of view it is cheaper to publish only the winning side. From a wider viewpoint those who are winners today will very likely be replaced tomorrow. Three thousand years ago Hattusas was one of the greatest centres of civilization. Today many persons do not even know that it is in Turkey. In the thirteenth century while Thomas Aquinas was recovering ancient learning and writings his Summas, and Rumi was writing the greatest mystical text of the Sufi tradition, the greatest city on earth was Pagan and the city of Anghor Wat was approaching its mature form as the largest planned city in the history of mankind. Today it is in ruins but it retains that distinction. These were the winners of yesteryear. Today, for the most part, they are forgotten. There is no superficial economic value in studying them. In terms of popularity ratings a la television they are a failure. Should we therefore forget them?

The world of entertainment is concerned with external impressions. In this context the rhetoric of equality is very attractive and almost plausible, although there is a strange contradiction between the lip service paid to these ideas by actors and the treatment they assume as stars. In this context the rhetoric of political correctness is also appealing, since it is usually a boon to popularity. While these trends are spreading to the university campuses it is instructive to recall that historically scholarship has had little to do with popularity, equality, or political correctness. Ibn al-Haitham, one of the greatest mathematicians of all time, spent much of life feigning madness to avoid being killed because he said the "wrong" thing to his employer. Bertrand Russell wrote one of his great works while he was in jail for being a conscientious objector. Poncelet also wrote the standard text on projective geometry in jail. Milton, author of what has been called the greatest defence of freedom of speech, the *Aereopagitica*, wrote that treatise in jail. Meanwhile, the man to whom we owe the phrase Socratic teaching was forced to drink hemlock. Viewed from a narrow business point of view the only "worthwhile" information about these men is in their products, not in the suffering and struggles that they had in reaching those products.

14. A Larger Business View

This is by no means a criticism of business per se. The SUMS project is extremely grateful for financial support from BSO/Origin and software from companies including Autodesk, Cartologix, GTE, Rizzoli, Softdesk, and Worldsat. Under attack is a particular, narrow view of business that sees everything in terms of short term products and profit. This narrow approach is threatening not only universities but also the research labs of industry itself. Seduced by a rhetoric that the fastest and loudest solution is best, there is a race for results rather than a patient attention to the principles on which results are based.

In a sense there have always been two fundamentally different approaches to life: one that concentrated on the universal, the enduring, the eternal; the other which emphasizes the particular, the spontaneity of the moment, the present, the now, which is also the fleeting and the ephemeral. The electronic media, particularly radio and television have been used primarily to focus attention on the flashy things that happen to catch our attention at the moment. This is entertaining and sometimes extremely valuable. It should not, however, become that which guides all our decisions.

An integral part of human civilization and culture lies in the development of a collective memory, not just in Jung's special sense. In science and technology a fundamental aspect thereof lies in discovering unchanging principles of nature whereby we can achieve a man-made world of buildings, machines and other objects that are both reliable and capable of sustainable development in an interdependent environment. In the sciences, "progress" often means refining our standards of measurement, frequently our means of measurement and sometimes even our entire framework of explanation. For these reasons even though science builds on knowledge of and from the past, the collective memory in this domain is not a purely cumulative process. In the realms of the arts and the

humanities, this collective memory has a greater cumulative dimension, and it is this whereby long term standards for quality, excellence, and other virtues are established.

If we apply the experiences of this long term collective memory to the realm of business we discover that the most incredible enterprises often lacked glamour when viewed in terms of instant success. Columbus had funding problems in getting to America and his successors had problems getting the colonies started. (The notion of colonialism as a profit venture did not really get started until the late nineteenth century, had major critics from the outset, and only lasted a few generations before its fate as an idea was sealed. Even so this idea prepared the way for our global view of the world). Gutenberg had great problems in establishing the printing press in the West, went bankrupt in the process and it took a good century before the majority of materials were available in printed form.

We are slowly becoming aware that these are problems of psychology as much as of technology. Printing was actually invented around the year 708 in Korea. It took over 740 years before Gutenberg developed the applications with which we are now familiar. The automobile was invented decades before Ford had the idea of making it a device for everyman. Charles Babbage conceived of a reckoning machine in the 1820's that led to a mechanical device in Manchester in the 1870's (now in the Science Museum, London), and led eventually to the computer as we now know it. The fax machine was invented in the 1860's and is only now becoming widespread. In short the seminal ideas and inventions that truly changed the world of business and created epochal changes in economics and ultimately in lifestyle were those where there was no quick product or commodity and even when the product existed it took a long time before the implications of the product were appreciated. It is now a cliché to speak of thinking globally and acting locally. The challenge is creating a mindset that sees beyond the profit margins of the second quarter or the projected interest rates of the third quarter and explores the seminal, enduring problems, not quick fixes or flashy demos, but methods that will keep pace with rapidly developing technologies.

An essential ingredient in this larger view of business is that we get beyond the simplistic mentality that inspired war in the past: viewing the world as us against them, the good versus the enemy, supporting the victors and oppressing the vanquished. The narrow view of business perpetuates this view and remains fixated on the winners of the moment. We know from the past that this is not an enduring solution. Those who supported only the narrow views of the ruling court in France were the losers when the revolution came in 1789. The deeper meaning of the global village that McLuhan described and which some would have us rename the humane village, is that there is no longer any simple faction that is victor or loser. It may be tempting to deceive ourselves into believing that North America and Europe are on top, that Russia is below and that India and Asia are on the bottom, but ultimately the reality is much more complex. If there is complete turmoil in any country of the world there will be world-wide repercussions. If there is major turmoil in a large country such as Russia, China, India or even Japan, there will be world-wide problems. In the past solutions, used to deal only with the victors, the winners, the

heroes of the moment. In the future, solutions need to include both winners and losers, else they will not really be solutions. They will be rhetorical stop-gaps, nothing more.

Herein lies one of the greatest challenges of the emerging electronic highways. It will be relatively easy to hook up the top executives of the world with new versions of cellular gadgets, that may even allow them to teleconference in virtual reality as their limos and private planes whisk them from one place to the next. Indeed, it will not be very difficult to link up all the great libraries, museums and galleries. We need to remind ourselves that the technology to do that is already there, and that the greater challenges lie elsewhere. How will we ensure that this is accessible to everyone, not just the executives of the Fortune 500 group, but also to children, to the unemployed, to persons in the lesser developed and even the so-called undeveloped countries? In the short term this view goes totally against all the glib talk of salesmen who want to make another fast buck. In the longer term we need to recognize that the big time is not about small time salesmen and quick con jobs. It is about creating a framework that transforms the cliché and acts globally as well as locally.

15. Conclusions

Perhaps it is appropriate that this paper should close with questions rather than answers. What will become of the deeds of men such as Socrates, Milton, Poncelet cited earlier, or women such as the Queen of Sheba, Hildegard of Bingen or Joan of Arc? Will the electronic highway reduce them to titles and citations, or will the new media cast new light on the mysterious strength that guided the great creative spirits in spite of or even because of their great difficulties? That is one of the questions. Will the new means of access truly provide greater access? Technology makes universal access possible, but will we use it to do so? We can and should. Indeed our survival may depend upon it. Will the electronic highway increase our sense of wonder or decrease it? Will it open new doors to understanding? It can. They are doors worth opening, worth keeping open. The System of Universal Media Searching (SUMS) offers a model of how this might be done. Will you use it?

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