Classrooms of the Future

an inquiry into

The Evolution of New Media in Canada

Prepared for:

DEPARTMENT OF COMMUNICATIONS

Ottawa, Canada

Prepared by:

COMMUNICATION SCIENCES RESEARCH CORPORATION

Ottawa, Canada

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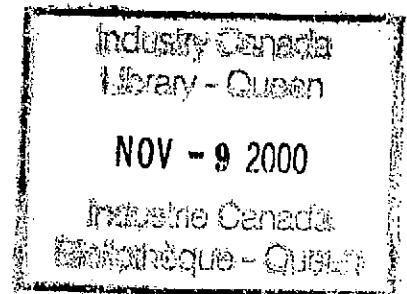
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part of an ongoing study into

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Preface

The term *"multimedia,"* according to computer and telecommunications experts, is now entering into the basic language and culture of the industrialized world. As this report is being written, the huge, annual Consumer Electronics Show in the United States, held in Las Vegas, Nevada, is just ending, and news reports inform us that consumers are "not quite ready" for multimedia, because they don't understand what it is yet and are thus not ready to buy. Multimedia <u>is</u> ready for consumers, though, and manufacturers, software developers, content developers, and many others are 'ready to sell.'

The purpose of this report is to investigate one class of what are purportedly going to be major buyers of this new technology, namely, users in the fields of education and training. As we have described elsewhere,[1] new media and multimedia have a virtually unlimited range of potential applications, from wide-bandwidth video and data, to compressed video, virtual reality, hypertext and hypermedia, highly interactive graphics, and sound, animation, and full video all on one's own computer--that is, a situation somewhat akin to combining all the content and capabilities of film, video, television, computers and telecommunications into <u>one</u> delivery device.

Such a transition will come about gradually, of course. Its beginnings are already here, however, as only a cursory perusal of trade magazines, newspapers, and the business press will confirm. What is <u>not</u> known, but needs to be, is how these developments will emerge and unfold with *real users*. This is the subject matter of this report, for one class of potential users.

The report itself has taken shape in the overall context of an ongoing program of research and investigation into new media and multimedia, undertaken by the Telematics and New Media Branch (DGNM) of Communications Canada, the Canadian (federal) Department of Communications. This Department has for many years been keenly interested in, and charged with formulating policy for, new technologies of many kinds in the fields of computers, telecommunications, broadcasting and other high technology sectors, and "new media" is but the latest of these. Of particular importance, naturally, is helping to assess how such new fields are developing, both in Canada and elsewhere, with a view toward the development of policy assistance to Canadian companies entering the market, as well as Canadian companies and institutions learning how to *use* the new technologies. New media and multimedia have great potential in our view; therefore, it is appropriate to find out more about them, 'from the ground up.'

As will be seen in the document, this report was constructed largely around a brief series of interviews conducted at the end of 1991. We are greatly indebted to all of our interviewees (a list is given in Table 1 of the text, p. 3), for their generosity in providing time to talk with us, sometimes for

several hours at a time, and sometimes with repeat visits. <u>All</u> of our respondents gave of their time generously and graciously, and our only regret is that the report, by its nature, could not hope to contain more than a small amount of what we learned. Nevertheless, our hope is that even this much will be enlightening, with respect to a portion of this new field.

It is also appropriate to express appreciation to our sponsor, DGNM, for the opportunity to participate once again in an investigation of this type. Most especially, we would like to thank Pierre Leduc, Director, New Media, and Gareth Sansom, Policy Research Analyst, for their assistance in completing the project. In addition, Will Dubitsky, Thérèse Rivest and Jaime Hum, also of the Branch, and Richard Simpson, Director General, provided data, contacts, other research reports, and excellent feedback toward the objective of producing a credible and reliable document. We hope we have accomplished this, but if not, the fault is the responsibility of the consultant, not interview respondents or the Department of Communications.

Finally, a word needs to be said about trademarks. We have referred in this report to a great many names, of both companies and products. All of these, or certainly most all at any rate, hold trademarks or registered trademarks assigned to their respective owners. We acknowledge this fact, and make note of it here.

Executive Summary

The major thesis of this report is, that classrooms and other training facilities of the future will be *different* from what they are today, as a result of the introduction of new media and multimedia technologies. For example, computers and other · technologically sophisticated equipment will be integrated into classrooms, and into educational curricula; will be spread and networked throughout schools and between schools; and will be used by students for all subjects, academic as well as technical. Moreover, major shifts will occur in the way children and adults are taught, because learning, in both education and training settings, will become far more 'student-centred' and far less 'teacher-centred.' This will lead, in particular, to 'self-teaching'--particularly for training and adult learning--at each individual's own, regular workplace or workstation, in business and industry.

These eventualities will occur, because sophisticated technology, both computer-based and telecommunications-based, is making it possible. However, the driving factor is not 'technology-push,' but 'user-pull,' as these findings demonstrate:

1. Educators, as well as organizations needing to train large numbers of people, are looking for more efficient ways to do the job, more effective ways, and more interesting ways--especially

to capture and hold the attention of children and young adults still in what we have traditionally called, 'school.'

2. Costs of training are rising, when carried out using traditional, teacher-at-the-front-of-the-room, methods.

3. Computers are <u>everywhere</u> in the workplace now, in every industrial sector, be it resource-based, manufacturing, services, or government, and not only computer 'literacy' is required of more and more people, but computer <u>competency</u>, <u>skill</u> and <u>ease</u>. More and more companies and other business organizations know this now, and are doing something about it.

4. Education <u>including</u> computer competency and ease has been shown to be entirely feasible, even for young children, provided equipment is easy to use, intuitive, and user-friendly. And, this is indeed the way computers are being designed today, across the board, signifying that within a very short period of time, Apple Macintosh machines, IBM machines and IBM clones, 'IBM/Apple and Apple/IBM machines'--(that is, products of the recently announced cooperative ventures between these two companies)--and all other equipment as well, will be 'windows-based,' with pull-down menus, mouse pointing, audio and video capability, and highly sophisticated but still easy-to-use hypertext and hypermedia software for controlling videodisc,

CD-ROM, and other multimedia equipment. These tools and devices will assist in the transformation from 'old schools, classrooms and shops' to '*new* schools, classrooms and shops,' and, indeed, to learning <u>outside</u> classrooms, in training-in-business, and training-at-the-workplace, environments.

Contents

I   Introduction

This project continues an undertaking begun during the Department of Communications' fiscal year 1990-91 into *The Evolution of New Media in Canada*. Our first report, subtitled Phase I, *Overview*, was completed and published in March, 1991.[1] In it we described three aspects of the recently developing fields of new media and multimedia, namely,

- Enabling Technologies — (such as computers, telecommunications, data compression, printing technology, and 'connectivity');

- Convergence -- (e.g., multimedia, computer graphics, simulation, games, and so on); and

- Beneficiaries — that is, users and other recipients of the technology who stand to benefit from its development. Among these groups and individuals are those involved in:

  - Education and training
  - Business data and information processing
  - Cultural and communications activities, such as museums, entertainment enterprises, and so on.

For the current report our focus is on only <u>one</u> of the above sets of beneficiaries--i.e., those in the fields of **education and training**. To do the work it was decided that, within the context of limited time and funding, a brief interview program covering some 12 interviews would be sufficient to at least learn 'something' about new media/multimedia vis-a-vis education and training in Canada--though by no means could the study hope to be comprehensive. As a consequence, approximately one dozen firms and organizations were identified covering a wide spectrum of

- Manufacturers,
- New media publishers--(also known as 'courseware producers'),
- Users, and
- Funding agencies and other interested parties

within Ontario and Quebec. These were contacted, and personal, on-site interviews were carried out during November and December 1991. In addition, the contractor, Communication Sciences Research Corporation (CSRC), contacted more firms and organizations and went back two and three times to some, so that in all a total of 24 interviews were conducted rather than 12, covering 18 different companies and other organizational entities. (See Table 1 for details).

The purpose of these contacts and interviews, was to ascertain 'what,' if 'anything,' was going on in the domains of the companies and organizations

Table 1

Interviewees

New Media Publishers	- DVS Communications Inc.
	- Compris Incorporated
	- Le Groupe Micro-Intel, Inc.
	- Logo Computer Systems Inc.
	- InContext Corporation
	- Interactive Image Technologies Ltd.
	- The Training Group Inc.
Users/ Educational Institutions	- Holy Family Education Centre
	- River Oaks School
	- Carleton Board of Education
	- Sir Wilfrid Laurier High School
Manufacturers/Equipment Distributors	- IBM Canada Ltd.
	- Apple Canada/Up and Running
	- Sony of Canada Ltd.
Funding Agencies and Intermediaries	- Ministry of Education, Quebec
	- Ministry of Education, Ontario
	- Secretary of State (Jean Talon Project)
	- Ontario Training Corporation

with respect to new media/multimedia <u>right now</u>, and secondly, if possible, to get a sense of developments to come. Without exaggerating, it is crucial to point out that it is *the latter* that is difficult if not impossible to get a clear idea of from interviews. What is eminently successful, however, is gaining first-hand knowledge of what is happening *now*, and this will consequently be a major focus of our report.

II Background

"Hydrographic surveyors for the federal Department of Fisheries and Oceans are learning how to run complex equipment thousands of kilometers away from their ships.

Using a desktop computer in Ottawa, the surveyors are taking a multimedia course that includes pictures and audio explanations so that when they step on board they'll be ready to ship out.

'There's absolutely no doubt the learning curve is vastly improved with multimedia technology if the content is well done,' says Neil Anderson, the director of planning and development for the Canadian Hydrographic Service.

'We see it as reduced time, reduced cost and improved training.'"[2]

This brief quotation, excerpted from an article appearing recently in Toronto's *The Globe and Mail*, describes succinctly and well what new media/multimedia and education-and-training are all about. In essence, it is three things that will cause these developments to grow and prosper:
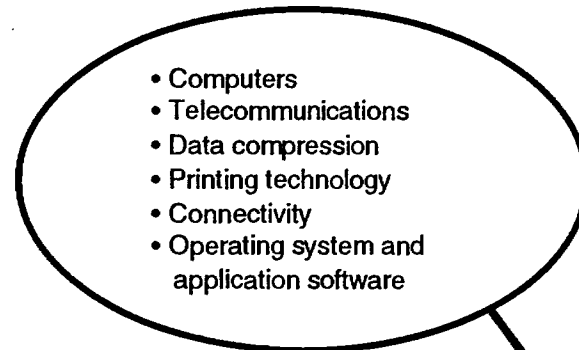
1.	Greater efficiency at conveying information to learners--whether children or adults;

2. Ease of use and greater accessibility and transferability of the data and information; and

3. Lower cost and improved training, just as outlined in the article quoted.
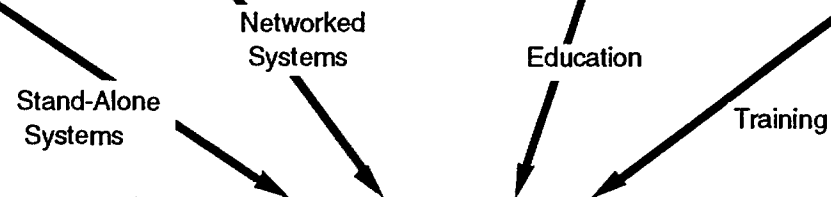
At the present time, we are only at the early stages of these developments. However, as suggested in another recent article, "Multimedia is the hottest topic in the computer field today," because combining sound, graphics, and video with other things computers can do, has caught peoples' attention. On the other hand, this not a terribly easy thing to do either, despite the enormous amount of publicity about it. In fact, as we will find out in this report, real, present-day activities are not particularly concentrated on the more 'esoteric' aspects of the technology--(such as, say, full video on everyone's computer screen)--but on very practical approaches, such as controlling videodisc players, developing multimedia training and education material then transferring it to videotape for wide distribution, and so on.

The purpose of this chapter is to briefly set the stage for the report. Figure 1 outlines, in graphic form, just what is involved. First, in the upper left hand corner, are depicted the enabling technologies (computers, telecommunications, data compression, etc.), mentioned earlier. It should be noted that new media and multimedia encompass both stand-alone and networked systems, as shown.

Enabling Technologies

- Computers
- Telecommunications
- Data compression
- Printing technology
- Connectivity
- Operating system and application software

The 'Learning Industry'

- Hardware and software manufacturers
- New media publishers/ courseware producers
- Systems integrators
- 'Champions'

Networked Systems

Stand-Alone Systems

Education

Training

Users/ Recipients

- Students
- Teachers
- School boards
- Corporations
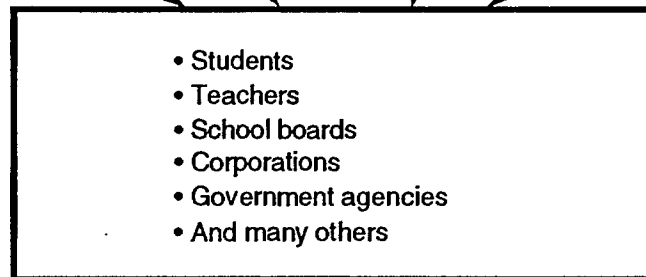- Government agencies
- And many others

Figure 1. Components of New Media/Multimedia in the Context of Education and Training

Next, on the right, the 'Learning Industry' (as it has been called) reflects both education <u>and</u> training--where the first refers to elementary and secondary school and to some extent college (as this term is used in Canada), while the second in the main implies adult training in the workplace. These two fields have had .much in common over many years.[3] As we will see, however, this is changing, as new methods and new technology are introduced.

In the oval figure on the right, illustrating the learning industry, are identified four separate categories of participants. First, from a group classified as hardware and software manufacturers are all those people and companies participating, from a technical standpoint, on the supply side of the equation. We wish it were possible to cover this part of the picture even to a *modest* degree. We have tried, however, and utterly failed, because the field is already so large, varied, and intricate that it would take almost the whole report just to document it superficially. Moreover, since this is not the <u>purpose</u> of the report, our recourse is to refer only 'in passing' to important elements, letting interested readers investigate technical aspects more thoroughly on their own, using the references and bibliography found at the end of the document.

New media publishers, on the other hand, are key to our analysis-- particularly, of course, Canadian publishers. This industry has for a number of years been of interest to DOC, and in particular to the Telematics and New Media branch (referred to internally as DGNM), since its establishment some

two years ago. Thus, one of DGNM's recent initiatives has been to find out more about the industry by means of a mail survey to approximately 175 identified participants, both small and 'large.'[4] (Large is in quotation marks, incidentally, because <u>all</u> firms in the industry, with rare exception, are either small or very small, reflecting the fact that 'publishers'--again, often called producers--can easily be 'individuals,' and often are). As shown previously in Table 1, this study had contact with only seven of these organizations-- although they were selected based on knowledge of their products, and history of participation in the field.

The last part of Figure 1 illustrates that students, teachers, school boards, corporations, government agencies, and many others are now, and will be even more in the future, users and recipients of these teaching and learning products. One book, we have found, has treated one aspect of these changes (adult training in the workplace) especially well.[*] Even here, however, despite the fact that the book was published as late as <u>1990</u>, virtually nothing is said about the most recent events, discussed herein, and the word 'multimedia' is not even in the book's index. We see, therefore, that the field is changing extremely rapidly, due virtually entirely to *advances in both hardware and software capabilities of personal computers and workstations.* Some of this, we discuss below.

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[*] Eurich, Nell P., *The Learning Industry*. (See Ref. 5 for complete citation).

The Relevance and Importance of Hardware and Software

. Multimedia, it seems, means many things to many people. Briefly, though, it can be characterized as adding to a personal computer's capabilities anything people have not 'ordinarily' been using PCs for, up to now--that is, applications such as word processing, spreadsheets, data base manipulation, desktop publishing and so on. Such additions could include sound capability, with speakers, (either voice, music, or other sounds are acceptable here, or of course all of the above, if they are desired and 'meaningful' in the context of the education/training content being developed). Then, one could move up to *animation*--that is, 'generated' moving images. Such files and documents can now be easily created using software for IBM and IBM-compatible machines, Macintosh computers, NeXT computers, Commodore Amigas, and Unix machines made by Sun, DEC, Hewlett Packard, Silicon Graphics, and many others.

Finally, the holy grail of multimedia, at least for some, is *full video, in colour*, on the computer screen--just as we are used to seeing such images on a television set. Unfortunately, a computer is not a television set (at least it isn't now[6]), so trying to do this has been vexing computer designers, programmers, and many others, for a long time.

The problem, of course, is storage and processing of huge files. For example, most of us, currently, are used to thinking of our computers as quite adequate if they have 40 or so megabytes (40 million characters) of hard drive

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storage. After all, that's plenty of room to store a document over 10,000 pages long...and who writes documents that long anyway?! Of course, programs take up space also, so we might allow 20 MB for, let's say, 20 programs at one MB each. That means our document could only be *5,000* pages long, or we could store, simultaneously, five 1,000-page reports, fifty 100-page reports, and so on--still an enormous number of words and characters.

Video--(as is now well recognized)--changes this picture completely. In brief, and without explaining *why* it is the case, the same 40 MB hard drive would be able to contain, in total, and without any programs, only 3 *seconds* of a normal, conventional, every-day-garden-variety U.S. or Canadian television program. *This* is why video-and-data compression is so critical, to successful, advanced, multimedia on a computer. On the other hand, as we have already mentioned, there are legitimate intermediate steps possible, and we will get into some of these as we discuss the interviews, beginning in the next chapter.

III   The Interviews: New Media Publishers

Table 1 (page 3) indicated that there were four categories of interviewees in our project, identified as new media publishers, users/educational institutions, manufacturers/equipment distributors, and funding agencies/intermediaries. Information from all these companies, institutions, and government agencies was unique, and important in its own right. For the sake of readers of this report, however, condensation, amalgamation and compression are required. The interviews are discussed in three major groups, therefore, beginning with publishers.

Perhaps the most important result of visiting, personally, with seven important new media publishing organizations in Canada (details are given in Table 2), is to confirm that indeed, new media and multimedia are coming --though perhaps at a slower pace than news reports and marketing bravado would tend to imply. Having said this, however, it is important to note, very carefully, that the underlying benefits of new media and multimedia are *real and substantial*.

As an example, take the case of Compris, Incorporated, the second of our entries on Table 2. This organization, based in Ottawa, has been in business for many years, developing and perfecting sophisticated, artificial-intelligence-based software to teach people how to read better, write better,

Table 2

Selected Characteristics of New Media Publishers Interviewed

Location/ Producer Name	Product Categories	Principal Technology Platforms	Major Product, if Applicable	Principal Funding Agencies or Clients	Users/ Recipients	Geographic Distribution for Major Product or Majority of Products
Ottawa						
<u>DVS Communications Inc.</u>	Videotaped and interactive instructional/ promotional material	IBM PC with special purpose multimedia software for development. Distribution on videotape mostly, with CBT interactive a recent addition	Exclusively special purpose work for individual clients	Government agencies and business clients in finance, manufacturing, high technology, consulting, and other industries	Over 100 government and private clients	Mostly Canada, some U.S.
<u>Compris Incorporated</u>	Computer based training in reading, languages, literary criticism, critical thinking, business communication, report writing, etc.	PC/DOS, Unix, and DEC platforms. Software is artificial intelligence-based, and supplemented with audio, via cassette tapes.	Over 18 individual courseware products are available, all sold as separate courses or as packages of related courses	Government, business, educational, and institutional clients	60+ clients/recipients	Worldwide market, including North America, Europe, Asia
Montreal						
<u>Logo Computer Systems Inc. (LCSI)</u>	LCSI is, to a large extent, a one-product company because the product, LogoWriter, is so successful	Apple II, Macintosh, and IBM PC and compatibles	LogoWriter, a school-age-level programming language system. (Also, HyperWriter, LogoExpress, and LogoEnsemble)	Schools	K-12 students	Primarily U.S. and Canada. (Seventy-five percent of the company's market is in the U.S.)

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Table 2 (continued)

Location/ Producer Name	Product Categories	Principal Technology Platforms	Major Product, if Applicable	Principal Funding Agencies or Clients	Users/ Recipients	Geographic Distribution for Major Product or Majority of Products
Montreal (continued)						
Le Groupe Micro-Intel, inc.	Educational software for schools, public exhibition organizations, and others	Macintosh, primarily, although porting to other platforms is being considered.	Knowledge-based program language systems (e.g., PRISM, LOUTI), used for creating multimedia education and training products	Centre APO-Quebec, Quebec Ministry of Higher Education and Science, Quebec Ministry of Education	Schools, universities, private companies, general public--(at kiosks and public exhibition facilities	Mostly Quebec, with entree to U.S. market beginning this year (1992)
Toronto						
InContext Corporation (formerly Educational Software Products Inc.)	Traditionally, educational software. Now, however, moving to training at the workplace (i.e., "embedded"	Ontario Ministry of Education's 'ICON' computer, + MS-DOS	English 1, an educational courseware program used very heavily in Ontario schools from 1983 to present	Ministry of Education, Ontario, + private clients for training-in-the-workplace activities	Schools, students, private companies in finance and industry	Traditionally, Ontario. Now moving to wider base, including international markets
Interactive Image Technologies Ltd.	Hypermedia programming tools (i.e., 'authoring' software), and CBT/educational software products	MS-DOS primarily	HyperCASE, Electronics Workbench	Ontario Ministry of Education, plus worldwide sales of Electronics Workbench and other products	Schools, colleges, universities, developers	Worldwide export of products, including U.S., Europe, and Pacific Rim countries
The Training Group	Information and training systems. Also, Canadian distributor for 'Authorware Professional,' a major authoring system	Macintosh used, usually, for initial development, then porting to IBM takes place for broader market opportunity	Custom-developed training systems, integrated information systems, CBT, etc.	Primarily Canadian and U.S. petroleum industry clients. Currently expanding base to other industries	Trainees in large corporations, principally, as well as licencees of Authorware Professional	Canada and U.S.

think better, reason better, and learn languages much more efficiently than is usually the case with conventional, classroom methods. In fact, this matter of *efficiency* was a theme that occurred over and over in the interviews. Ted Davies of Compris mentioned, for example, how interactive, artificial-intelligence-based CBT (computer based training) enables many people to learn to use another language in 100 hours, as opposed to up to 3,000 hours, using classroom teaching methods--and other interviewees reported exactly the same kinds of results and experiences with their products, and other products.

To relate directly to multimedia though, Davies' response was immediate: "Sound/audio would be terrific!"--and, he was able to back up just what he was talking about by relating the fact that many of the courses Compris has in its catalog already use audio, but they do it by means of cassette tapes--i.e., using separate equipment, not delivering sound through the computer itself.

This aspect of sound, with the computer, was emphasized as a welcome, needed, and highly beneficial addition over and over throughout the interviews. LCSI for example (Logo Computer Systems Inc., developers of the extremely successful LogoWriter program for school kids), indicated that they expect to have a Macintosh version of LogoWriter, with sound, available very shortly, and DVS Communications in Ottawa confirmed similar expectations for its new interactive products, also. (DVS, incidentally, is the organization that produced the "Hydrographic Survey Training Program"

referred to in the quotation at the beginning of Chapter 2.[7] In addition, this company has a number of other projects for interactive systems, already under contract).

DVS also, like Compris, has built its products with multimedia for a long time--but, without the benefits of the kinds of machines and equipment that are just starting to be available. Instead, seeing a need and opportunity before most others, they built and had built for them, special purpose *digital video software* for development, then used this software to create highly effective training and educational material on <u>videotape</u>--i.e., a medium that inherently <u>uses</u> sound, as an integral part of its delivery mechanism.

What becomes clearer and clearer from these indicators are the following conclusions:

1. Sound, at least, is an *inexpensive* and *highly desirable* addition to even a modest computer platform--and its usefulness can be demonstrated with current programs;

2. The cost of such additions is well within reach of new buyers, as well as present owners of machines;

3. Programs are right now in the process of being upgraded to include sound, for both Macintosh and IBM PC platforms as well as other computers; and

4.   Over time, this kind of hardware and software will filter out into the marketplace. It may not come as an 'explosion,' perhaps, but it will come eventually, because it has an immediate and obvious usefulness--for enhancing computer-based training and education delivery, as well as, we will see in later reports, for other legitimate and useful applications.

More Advanced New Media and Multimedia,
Including Hypermedia

As readers of the previous report and many other reports and articles will know, new terms and phrases have been coming fast and furious since the introduction of multimedia. One of these is "hypermedia"--an idea that surfaced in the technical world several years ago, but that has now begun to filter out into more general use also. It is an important concept, but (it appears) not generally understood.

To explain it, consider the following situation. A sixth-grade student, let us say, sitting at a computer in his school's resource centre (otherwise known as 'library'), has been given an assignment to write an essay on birds-- three, preferably, with the choice being the student's. The specific assignment is involved; in fact, the requirement is to describe in detail, or illustrate some other way, what kinds of birds these are, where they live, their species, migration patterns, eating habits, mating and courtship, and as many other descriptive features and characteristics as possible. Moreover, grades will be

given depending on the extent to which the 'spirit' of the assignment is carried out--that is, with due attention to creativity, producing a document that is challenging, very complete, and above all interesting and 'attention-getting' when it is presented to the rest of the class.

Now, this student knows that he is fortunate enough to have a computer in front of him that is multimedia-capable, plus a CD-ROM player and a very new and impressive optical disc on birds, created and offered for sale by CMC Research, Inc., of Portland, Oregon.[*] The young student intends to use this disc--plus the computer's resident word processing and desktop publishing programs--and another piece of software called 'HyperCard,'[8] to carry out his project.

The logic behind HyperCard (and now many similar programs) is essentially based on the notion that, as one sees on a screen a block of text, say, or a picture, drawing, map, etc., one can use the 'mouse' to point to and 'click' on a word, or a part of the picture, and instantaneously the screen changes to a description of the word (or a picture of it if it's a noun, for example), or if the original were a map of a province and the mouse were pointed to and clicked on a city, a street map of that city might appear--again virtually instantaneously--on the screen. What the program enables one to do, then, is to <u>embed</u> more and more detail about a subject deeper and deeper into the

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[*] *Multi-Media Birds of America,* part of a set including *Multimedia Audubon's Mammals.* These discs, incidentally, are two of many now available for purposes of this type, a point discussed in more detail later in the report.

program, enabling the <u>user</u> to extract it and in a sense <u>browse</u> and <u>explore</u>, through an enormous number of branches. This, then, is the essence of hypermedia, and it is precisely this capability that the young student intends to utilize for his project.

First, he outlines his report, deciding which birds to talk about. Then, using encyclopedias and other resource materials in the library he fills out much of the text material that is appropriate, and types it in on a sequence of 'cards,'--one set, say, for each type of bird he has chosen to write about.

Next, there are five types of illustrations he wants to use:

1.   The birds' songs, mating calls, and so on--that is, *audio* material;

2.   Close-up photographs of them, in full colour;

3.   Photographs of their habitats;

4.   An animation sequence showing the birds' migration patterns, superimposed on a map of North and South America; and finally,

5.   A full colour video sequence of each of the types of birds in flight, both gathering food and feeding their young.

Without going into further detail, suffice it to say that this student completes his project by extracting appropriate material from the videodisc, inserting either the material itself or control mechanisms into his report, then 'publishing' the whole by (a) creating program copies in the machine, for interactive use, and (b) printing paper copies of the static portion of the report, including drawings and colour photographs, on the by-now-inexpensive colour printer* attached to the machine.

It is *imperative to recognize*, in our view, that this is not a futuristic, 'year-2000-scenario' we have just described. To the contrary, everything in the depiction is available *now*, and can be accomplished just as we describe. Moreover, in a later section we outline how these very activities are being undertaken on a daily basis, even by young children, in a selection of outstanding (but admittedly still in the minority), Canadian schools.

Courseware Publishers as a Whole

Table 2 identifies, much better than can text alone, the activities in which the seven producer/publishers we spoke with are engaged. As a whole these companies, like virtually all other similar organizations, are just beginning undertakings that include multimedia as we have described it above. All though (including the three we referred to earlier), assured us that

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* Such printers are already highly affordable, for example, Hewlett Packard's DeskWriter C for the Macintosh, at $1,095 U.S. And in the IBM world, more colour printers are available, at even lower prices.[9]

more programs of this type have either just been announced, or are 'in the works' for announcement and release very soon in the future, for example,

- Interactive Image Technologies' HyperCASE, a visual application development tool for multimedia authoring in the IBM PC/MS-DOS environment. New, multimedia features of this program (Version 2.0, due to be shipped 1st Qtr. '92) include record and play digitized audio, record and play music (using MIDI interfaces), CD-audio, and video-in-a-window, using VideoLogic's add-in board for that purpose. Both versions of this program are 'windows-like,' with pull-down menus, mouse control, and all the other features of modern, user-friendly, graphical user interfaces (GUIs);

- Micro-Intel's two new multimedia projects, one for Employment and Immigration concerning human resources, training, hiring, and job strategy (this project will use sound, animation, colour, and perhaps video), and the other concerning the Biodome project in Montreal, for a public exhibition kiosk, also utilizing multimedia features. Other possibilities, according to the company, include projects for museums, utility companies, CWARC (Canadian Workplace Automation Research Centre), and others.

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- InContext's new emphasis on Performance Support Systems (PSS)--that is, *embedded training at the workplace.* According to the the company, the potential market for these kinds of systems, especially in the U.S., is very high, because organizations like the U.S. Department of Defense have essentially mandated such systems for all their prime contractors and major subcontractors, in coming years. In this context, video is especially attractive, for its ability to make maintenance manuals much more understandable, easier to use, easier to change, and easier and more efficient to employ for training purposes; and finally,

- The Training Group's recent taking on of the Canadian distributorship for Authorware Professional, probably the most sophisticated and certainly the most expensive of authoring tools for multimedia education and training projects. As shown in Table 2, TTG has been in the customized training and information system design business for many years, and its choice of Authorware Professional (which runs in both Macintosh and IBM environments), signifies a commitment to substantial quantities of multimedia output for its clients in the future.

What we see from these accounts, is that *all seven* of the new media publishing companies interviewed are heavily into multimedia development projects already, (though, admittedly, these moves are most often quite

recent), and all seven also indicate that more such projects are to come. Obviously, then, users are asking for these new and more advanced products, and in the next chapter we find out, for one class of users, how they are being applied.

IV   Users/Educational Institutions

In this chapter we again use the device of a table, to summarize quickly a large amount of informational material. In this case it is the matter of 'who we went to see in the educational community' (Table 3), and as will be noticed the concentration is on three schools or school environments, Holy Family Education Centre, Sir Wilfrid Laurier High School, and River Oaks Elementary School. We begin with the latter.

River Oaks

Just over a year ago, in September 1990, a completely new school was inaugurated by the Halton Board of Education in Oakville, Ontario. This school, new from the ground up, was designed from the start with computers and new technology in mind. So complete was this vision that, though the school is quite 'ordinary' in many respects, (since it is simply a public school built to accommodate new growth within the Halton Board's boundaries), nevertheless it is quite extraordinary also, since computers are everywhere-- in classrooms, in the library, in Creative Applications areas, music rooms, arts and crafts areas, on teachers desks, in the office, and so on. In fact, there are over 200 computers at the school, (for 650 students), and they are almost all sophisticated, highly modern, Apple Macintosh machines, running software that is as up-to-date and capable as that found in many businesses today. Not

Table 3

Selected Characteristics of Schools Visited for the Study

Name/ location/grades/ opening/ computers	Number of computers, students, & c-to-s ratio	Types of school/ academic programs-- (i.e., what are the computers used for?)	Location of computers	Software	Amount of time computers are used per day	Objective of computer use
River Oaks, Oakville, Ontario/Jr. Kindergarten to Grade 8/September 1990/Macintosh, some Apple IIs, for younger grades	Approximately 200 computers for 650 students/ (ratio = 1:3)	All classes, including art, history, drama, mathematics, language arts, music, library research, creative projects, cooking, sewing, industrial arts, and every other aspect of the student's school experience	In all classrooms, library, Creative Applications areas, music rooms, arts and crafts areas, teachers desks, office, etc.	HyperCard, easy-to use word processing (e.g., Ready-Set-Go), MacPaint, Mac-Draw, games, CD-ROM and videodisc control programs, LogoWriter and other educational courseware, simple spreadsheets, electronic mail, and many other programs	Not known exactly, but estimated to be at least 1-2 hours per day, per student, and in some cases even more than this, when work is being done on specific projects	Objective is to assist even young students to be as comfortable with computers as with pencil-and-paper in times past. This appears to be happening with great regularity.
Holy Family Education Centre, Guelph, Ontario/ high school, Feb. 1990/ IBM, plus some others	(Computer-to-student ratio less valid to Holy Family, because of student rotation method of operation)	Primarily organized in response to Ministry of Education's Broad Based Technology initiative for upgrading technical education curriculum (i.e., design, communications, shops, etc.)	All areas of the Centre, including drafting, computer-aided-manufacturing, cosmetology, television production, photography, etc.	Heavily into IBM software for CAD/CAM, spreadsheets, design work, multimedia for high-end video production, computer-based auto mechanics, far broader range of materials, and more extensive use of sophisticated computer design and construction tools	Computers are used all day, every day, because the Centre serves all Separate high schools in Wellington County. Students are, thus, bused to Centre on a rotating basis, each day	To provide a more interesting, modern, challenging and up-to-date way of imparting knowledge of technical subjects to students, while at the same time *broadening* their areas of interest
Sir Wilfrid Laurier, Gloucester, Ontario/ high school, Sep. 1990/ Macintosh exclusively	230 computers, 1260 students (ratio = approx. 1:5)	Computers are used at Sir Wilfrid Laurier for all courses, academic and technical, including languages, math, history, geography, design, graphics, art, music, shop courses-- i.e., *everything*	A number of special 'labs' are maintained but much use is also made of computers on carts that are moved from room to room	Word processing (Word and WordPerfect, in particular), PageMaker, Adobe Illustrator, PhotoShop, Macromind Director, Aldus FreeHand, Authorware Professional, MacDraw, MacPaint, Farallon MacRecorder, and many others	Probably same amount of time, approximately, as at River Oaks, per student, with again special projects requiring more time. Also, depends on student's particular course of study	Objective is exactly the same as at River Oaks, that is to familiarize students thoroughly with computer technology, so that they are *skilled* with it, and *at ease* with it

only that, but all these computers are networked together, just as they probably would be in a business 'out in the real world,' and they have access to laser printers, colour photocopiers, laserdisc players, CD-ROM devices, sound systems, and virtually everything and anything else one could want or need, to demonstrate and actually use, for learning. The school is, thus, a *new media and multimedia paradigm for the future.*

Our conviction in this regard is based on two principal sets of rationale. First, a now very substantial amount of research,[10] supports the view that traditional, time honoured methods of teaching need to be supplemented with *new* ways of teaching and learning such that the focus is less on the *teacher* and more on the *learner.* This principle has been referred to in many ways--for example, student or learner 'empowerment,'[11] letting teachers become facilitators of learning or 'coaches' rather than strictly instructors in the learning process,[12] and so on.

Secondly, the River Oaks model is a valid one because it integrates technology with learning, rather than putting computers off in a room somewhere, where students only 'meet up with them for computer class,' a few times a week at most. Instead, at River Oaks the innate, thoroughly modern capabilities of today's machines are available to the students for all their work, whether it be in art, history, drama, mathematics, language arts, music, research in the library--(such as described earlier, for example)-- 'making things,' and so on.

To do this, requires that new media and multimedia equipment and software be available, for example:

1. Hypertext and hypermedia software (in River Oaks' case they are using HyperCard and its derivatives for the Macintosh);

2. Graphics packages with increasing sophistication, to handle high resolution images, in colour;

3. Simple and easy-to-use desk top publishing packages;

4. Sound capability, for composing, recording and playing music, as well as other uses;

5. Videodisc and CD-ROM players to access the now very impressive educational and other courseware being produced for these machines;

6. CD-ROM-equipped machines in the library and resource area, to access the many text databases now available on this medium; and finally,

7. Network mail and bulletin board software to provide communications capability among all the machines; to and from other schools administered by the Halton Board; and,

eventually, to and from the 'outside world,' including students located elsewhere in Canada and in other countries.

All of these capabilities are now available at River Oaks--and curricula are being designed to thoroughly integrate the machinery into the learning process for the students. Since the school is so new, of course, how well this will turn out is not yet known. However, a full and comprehensive research program is being carried out, with a number of long term longitudinal studies, and consultations with parents, other educators, and the Ministry of Education are included as an integral part of the program of research and evaluation. As these results are developed they will be made public, thus enabling other schools to embark on ambitious plans also, to the degree that they are able to do so.*

Holy Family Education Centre

Next, the first of two high school settings, that of Holy Family Education Centre, Wellington County Roman Catholic Separate School Board, Guelph, Ontario. This educational facility is also very new (see Table 3), having begun operation only in February 1990.

Principally, Holy Family is an outgrowth of the Ontario Ministry of Education's 'restructuring' initiative announced in 1987, and in particular its

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* This point is dealt with in more detail at the end of the chapter, and in endnote 13.

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emphasis on five *Broad Based Technology* groupings of subjects that are intended to replace traditional technical courses such as carpentry, automotive repair, welding, electrical shop, sheet metal shop, and so on. These technology groupings (which are, incidentally, communications, construction, manufacturing, services, and transportation, plus 'design and technology' for 7th and 8th graders), are intended to consolidate some 65 different technical subjects that have been taught, at various schools, for many years. Additionally, the objective is to <u>modernize</u> what is being taught, using new, much more up-to-date equipment, again reflecting what is happening 'out in the real world' of computerized manufacturing, computerized auto repair and servicing, and the like.

Holy Family Education Centre epitomizes both the theory and the practice of this new way of providing training in and familiarity with technical subjects. However, it goes much farther than that also, in that it strives for a great <u>broadening</u> of the traditional trade skills (and corresponding emphases on wood, metal, and automobiles) to include graphics, photography, television production, art and design, work with fabrics and plastics, services such as cosmetics and cosmetology, and many other subject areas, some of which, at least, will appeal to young women students as well as to teenage males. Traditionally, this has been a very hard sell (that is, attracting women to technical subjects), but Holy Family has succeeded in doing just that, by making the subject matter more *interesting*, more *modern and up-to-date*, more *challenging*, and *broader* in its base of interests.

What we found, in fact, at Holy Family, was a centre totally dedicated to introducing as many high school students as possible to a completely new concept of what 'technical' subjects are all about. And they have succeeded in this because enrollment in the program is far higher than that for technical subjects in traditional high schools; students like the program because it gives them more opportunity to use their own initiative and creativity; and, at the same time, it prepares many more to go out into the real world--where computers are indeed everywhere, including on the shop floor as well as in offices and business--with far more than a passing glance at what 'programming' consists of, something few of us will ever do anyway.*

In sum, Holy Family's use of new media and multimedia mirrors that already described herein, in that it takes advantage of new programs and products available, particularly in the area of graphic arts, photography, television production, computer aided design, and other creative endeavors. And, as more programs and applications are announced for IBM PCs and compatibles (IBM's latest 'Ultimedia' machine, for example), the Centre will incorporate these capabilities into its curricula as well.

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* This is a reference, of course, to the fact that 'programming a computer' is often still central to what students are exposed to in computer labs, purportedly in order to help them become 'computer literate.' In today's world, however, it is not programming that is required, but skill, competency, and confidence in using a computer, with the same ready-made software that businesses use, for engineering, computer aided design, drafting, architectural drawings, accounting, word processing, communications, desktop publishing, and all the other hundreds and hundreds of applications these machines are now used for, on a daily basis.

Sir Wilfred Laurier

The last of our three schools is also a high school--this time in the Ottawa area--and part of the Carleton Board of Education that stretches from west of Kanata to east of Gloucester, Ontario, surrounding the city of Ottawa. This school again is a new one, having been completed and prepared for occupancy only within the last two years.

Sir Wilfrid Laurier (SWL) has many features in common with the other two schools/school settings just described. In a sense it goes farther than either of them though, in that it is far less a demonstration school supported by product manufacturers, and far more an example of what can be done with 'conventionally-allocated' building funds. In other words, by using creativity in the design of the building complex, planning for multiple use of the facilities and so on, enough money was saved to equip the school technologically, as well as with respect to its physical plant. The result, interestingly enough, is a school with a student-to-computer-ratio almost as high as River Oaks' (SWL = 5:1, River Oaks 3:1), meaning that again, Macintoshes are 'everywhere,' networked, integrated into the curriculum, used for all courses and so on. What is unique about this school, however, (and highly encouraging in our view), is that it totally capitalizes on this machine platform's currently available multimedia capabilities, for sound, graphics, animation, high resolution colour imaging, and, with the recent availability of QuickTime (Apple's system software for handling dynamic, time-based data), storage and processing of video as well. Moreover, students

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and teachers are learning, 'together' in a sense, how to make profitable use of virtually all of the high-end products for this machine--products such as Adobe Illustrator and Photoshop, Aldus' PageMaker, Macromind Director, Authorware Professional, and many others these students will encounter in their academic and working careers.

Users, thus--at least in the academic world--are more than ready for multimedia. Of course, cost is still a factor, but these schools and others prove (1) that where there is a will there is often a way, and (2) <u>overwhelmingly</u>, the result of exposing students to *good* technology--that is, equivalent to or better than that which is being used in business on a regular basis--reaps benefits far beyond the cost, because it gives them a head start on skills, competencies, and knowledge they will need throughout their careers.

<u>On the Relationship Between These Schools and Others</u>

It will not be lost on readers that the schools described above are unusual.[13] On the other hand, it is our conviction that, over time, the principles embodied here will indeed filter out to other schools in Ontario, and to schools in the rest of Canada as well. Why? Because

1.   *Businesses work this way*--and schools and businesses are becoming increasingly aware of each other, and of the need to become more closely aligned, so that students can contribute immediately, when they finish school and join the workforce;

2. Computers are not so 'foreign' anymore, nor so esoteric in the way they interact with their users. In fact, many of the intuitive, user-friendly aspects of Macintosh computers are now available to users of IBM and IBM-compatible computers also, as a result of Microsoft's Windows 3.0 software--(the program has reportedly sold more than five million copies, since its introduction some eighteen months ago);

3. Advanced programs, especially those involving graphics and other multimedia aspects, such as sound, expand the base of relevant subject matter for computers and teachers to tackle--i.e., art, music, drawing, architecture, language arts, foreign language teaching, history, geography, and so on--thus making the transition to curriculum-based use that much easier; and, finally, the fact that

4. Prices for all this equipment have been plummeting so fast and so far in recent weeks and months, that buying sophisticated, highly capable equipment and software is far less expensive than it once was, naturally allowing more schools and school districts the opportunity to take advantage of hypermedia- and multimedia-capable machines.

We do not know, of course, what the rate of expansion will be at this point. What we do know though is that at least from a technological

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standpoint, the industry is ready for some quite remarkable changes in schools' use of computers over the next five years. Moreover, in five to ten years' time, full video on computers _will_ be a reality, at modest prices and with excellent quality, judging from trends in this direction already evident. As a consequence, our forecast for computer and multimedia use in schools is clearly bullish, provided the recession we are in at present does indeed turn around, as politicians and economists (and the stock market also, incidentally), suggest that it will.

V   Manufacturers/Distributors

In this last chapter prior to 'Conclusions,' we discuss briefly the three manufacturers/equipment distributors we visited with, including some of their recent announcements, and plans for the future.

IBM

We begin with IBM, obviously the largest personal computer manufacturer, and the company largely responsible for initiating the industry's growth, beginning ten years ago.

IBM's approach to multimedia is an interesting one, because (according to most reviewers) it is a far more 'hardware-oriented' one than Apple's.[*] For example, in announcing its new 'Ultimedia' machine (Box 1) substantial emphases were placed on distinguishing the equipment, from a speed, capability, and (again) hardware equipment standpoint from Microsoft's highly publicized MPC standard (Box 2), while at the same time paying very little if any attention to software. Instead, IBM has concentrated on providing users with a highly robust and reliable OS/2 Version 2.0 operating system

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[*] Interested readers may, perhaps, be inclined to look up a recent and worthwhile review article on this and related matters, entitled "Wrestling with multimedia standards," *Computer Design*, January 1992, pp. 70-88. (Ref. 14).

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│                  Box 1                   │
│                                          │
│         IBM's 'Ultimedia' Computer       │
│   • Standard configuration               │
│                                          │
│      - Upgraded version of PS/2 Model 57 │
│        (Intel 386SX chip, modified for   │
│        faster processing)                │
│      - CD-ROM drive                      │
│      - XGA graphics (1024 x 768          │
│        resolution)                       │
│      - M-Audio Capture and Playback      │
│        Adapter, with MIDI port           │
│      - Windows 3.0, OS/2 2.0, and DOS 5.0│
│        operating systems                 │
│                                          │
│    • Options                             │
│                                          │
│      - ActionMedia II cards (for         │
│        compressing and decompressing     │
│        audio and video data streams      │
│        using IBM and Intel's             │
│        DVI technology)                   │
│      - NTSC and PAL video capture and    │
│        playback cards                    │
│                                          │
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(windows-based, pull-down menus, etc.), leaving it to third parties to add their _own_ multimedia software, running on top of OS/2.

The exception to this, of course, is DVI, because IBM and Intel have been cooperating on this digitizing and compression/decompression system since Intel took it over several years ago from RCA. Thus as part of the Ultimedia package, users have, as an option, purchase of what IBM calls its 'ActionMedia II' board (or boards), that perform compression and decompression of audio and video data streams. These are then manipulated and displayed by the computer in a digital format, and, if necessary, reconverted to analog for playback or recording on, say, a VCR.

In addition to the above, it is worth noting that, according to our interviews and other information, IBM is strongly committed to _networked_ as well as stand-alone multimedia. For example, Paul Koch and Phil Chaput of IBM's Ottawa office kindly furnished us (on loan) a videotape of a very

interesting scenario for the future in which students, professors and researchers in different locations interact over high speed digital networks such that real time, moving images of participants can be displayed on each other's computer

screens, simultaneously with supporting graphic, text and numeric information that also needs to be transferred from one participant to another. Obviously, this is very similar to what videoconferencing has been providing for years.[15] What is new, however, is displaying the images in *movable and resizable windows on a computer screen*--as opposed to television sets at each location. Recent announcements indicate that these kinds of ideas do have an attractiveness to them, one such announcement being IBM's collaboration with PictureTel Corporation, a very important leader, so far, in video compression for teleconferencing purposes.

Apple

This report has hinted, at least, at the notion that Apple's place in multimedia is (or at least appears to be) clearly assured. The reasons for this are convincing, including the fact that the Macintosh computer line has been image- and graphics-oriented from the beginning; even early Macs had sound

capability (though, of course, it was rudimentary compared to what is available today); and, most importantly, high-end users and producers of multimedia have tended to favor this computer line in significant numbers, ever since the Macintosh was first introduced. This does not mean, of course, that Apple has 'sewn up' the multimedia computing market, because it will never come even 'remotely close to that,' considering the overwhelming share of MS-DOS machines in the installed base of personal computers worldwide.

What does seem, though, to be significant, is Apple's attention to software--and in particular, the recently announced *QuickTime* system.

Those who have seen QuickTime, interestingly enough, seem to be uniformly impressed (especially high profile reviewers for computer magazines), because it is *easy to understand, easy to use, simple in concept* and above all, *inexpensive!* We have tried to stay away from quotations as much as possible in this report, but the following says far better than we can, what QuickTime is all about and why it is important:

QuickTime is an extension of System 7.0, the latest version of
the Macintosh system software, which was released last spring.
By dropping the QuickTime icon into your System Folder, you
make your Macintosh aware of a standard way of displaying,
compressing, reexpanding, cutting, copying, and pasting

multimedia data (e.g., color images, animation sequences, and sounds).

QuickTime is designed to insulate you from the complexities of multimedia applications. For example, you won't have to worry about which decompression algorithm to use when viewing an animation—QuickTime automatically calls the correct code. When developers start including QuickTime in their programs, you will be able to manipulate multimedia data as easily as you manipulate pictures today.[16]

What is obvious, then, from this excerpt, is that the distinguishing feature of QuickTime is that it is *software* based--including compression and decompression algorithms. As the article goes on to say, if hardware is available to the system for these latter functions, the system knows it and uses that hardware. On the other hand such hardware is not required, in order to make the system work. Therefore, with only the addition of the QuickTime software itself, even a modestly priced Macintosh (a Classic II, for example, at less than $2,000 Cdn) can become a multimedia machine, complete with compressed and decompressed graphics, pictures, sound, and video. Moreover, the LC machine, the next step up in price, provides the same capability, with colour, for only a few hundred dollars more--that is, a very reasonable colour computer with all the bells and whistles one could want, for less than $3,000. For this reason, many of these machines have already

found their way into schools across the country, and more seem to be on their way.

<u>Sony</u>

Finally, one of the most interesting and perhaps even controversial aspects of our project, concerned the fact that there has been a <u>resurgence</u> in, of all things, the *analog videodisc*. This technology, when compared to what else is going on, is almost 'ancient'--and, in fact, has been pronounced 'dead' on more than one occasion.[17]

During our interviews, we first heard of this situation from Michael Quinn at LCSI in Montreal. The examples he cited, at that time, included the state of Texas, which had made a large purchase of several thousand machines for its schools, California the same, and, Quinn thought, perhaps Florida as well. When we visited Sony, of course, we wanted to check this out, because it contrasted so noticeably with all the *extensive* talk--in the media, at conferences, and in conjunction with multimedia hardware announcements--about CD-ROM.

Sure enough, there has been a resurgence with videodisc machines, largely because of two things:

1.   Controllability is better now, because individual frames can be addressed and controlled by computer programs--(such as

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Macintosh's HyperCard, IBM's LinkWay, and these programs' progeny); and

2. Using a videodisc player and a television set <u>combined</u> with a computer for control and other functions, allows sound and video segments to be utilized and displayed *without* compression, thus providing far better pictures, at far lower cost.

Moreover, content manufacturers, publishers, and distributors have all been aware of this for some time (companies such as Voyager and Videodiscovery, for example[18]), and now have extensive catalogs of videodiscs for educational purposes, many of which have content-based computer software to go with them.

To meet this market, both Sony and Panasonic have new, highly capable machines (at very low prices in the U.S., incidentally, which presumably will be but as yet have not been matched in Canada), and which respond to computer control, bar-coded control (keyed to textbook material, for example), and computer connectors. These indicators suggest, at least, that there are <u>alternatives</u> to CD-ROM drives for storing and playing video and sound material (as well as pictures and photographs)--so the market for <u>all</u> these devices is, obviously, still to be determined.

IV   Conclusions

We have attempted, in this report, to convey to readers *a little* of what is going on with new media/multimedia in the education and training field. If a muted message of frustration has come through, it is warranted, simply because there is so much more we want to say.

For example, the whole area of <u>why</u> training is taking on a new flavour, and the experiences of those who have tried it, has necessarily been left out. And, enormous amounts of material have been generously provided to us by respondents--only to find no room for it in the report. Finally, the whole field of the technical basis for these changes has been given short shrift, and we know that as well. Nevertheless, many important points have been established, and we list some of them here:

1. Above all, is the fact that *schools are changing.* How this will happen overall and how long it will take is unknown at this time, but that it will come is not in doubt, just as has happened in business and industry--(i.e., the personal computer 'revolution');

2. In industry also, training will change, because methods are not efficient enough, and not effective enough. Moreover,

techniques we have not even discussed here, such as video and computer conferencing, tutored video, and other innovations, are available for this purpose, and have also proven to be more effective than classroom teaching in many circumstances;

3. <u>Simple</u> ways of providing increased technological content are improving daily, thus suggesting that users stand to benefit not only from reductions in cost of hardware but from faster, more efficient, and 'handier' ways of doing things. This is especially demonstrated, of course, in software like Apple's QuickTime, but IBM and all other manufacturers will meet this challenge in their own ways, and users will inevitably benefit, and sub- stantially, from the competition;

4. As to educational and training content, publishers, developers, and producers are by no means 'sitting on their hands,' waiting for a market to develop. On the contrary, projects are being established everywhere, and opportunities for innovative software, for sale on the open market, are unlimited, thanks to the *phenomenon* of the personal computer revolution itself;

5. Finally, education and training have an opportunity to improve as a result of these innovations. However, whether they will or not, depends on the <u>quality</u> of the instructional material. It is not enough simply to throw technology at students, whether

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children or adults. Instead, the content must be meaningful, lesson plans must make pedagogical sense, interactivity must be effective and appropriate, and tracking must be clear, fair, and accurate. If these things are accomplished, new media and multimedia will prove to be a real boon to students, teachers, school boards, and companies.

References

1. The Evolution of New Media in Canada: Phase I, *Overview*, Report prepared for Department of Communications, Communication Sciences Research Corporation, Ottawa, Canada, March 1991.

2. Multimedia making its mark, *The Globe and Mail*, October 15, 1991, p. C2.

3. We are referring here, in particular, to the fact that for the most part both young students in school and adults being trained in the working world, learn their lessons in classrooms.

4. This survey, developed during the summer and fall of 1991, has now been producing, for essentially the first time, reliable and well-documented statistics on the Canadian new media publishing/ courseware industry. Initial results are in process, and are expected to be published sometime in early- to mid-1992.

5. Eurich, Nell P., *The Learning Industry: Education for Adult Workers*, The Carnegie Foundation for the Advancement of Teaching, Princeton, N.J., 1990.

6. Some writers, notably George Gilder of *Microcosm* fame (*Microcosm: The Quantum Revolution in Economics and Technology*, New York, 1989), hold to the theory that it is only a matter of time before television as we know it today will be "dead," inevitably to be replaced with 'telecomputers,' i.e., digital devices that provide all the knowledge and information people could possibly want, through optical fibres, and on demand. In our view this is a simplistic scenario for many reasons.

However, seeing moving video images on a computer _is_ coming, in many forms, from many sources, and using both hardware and software means of implementation. Thus, though Gilder's ideas may seem far-fetched and inaccurate, we have no doubt that despite current challenges, _successful video compression and storage will come eventually,_ for useful, market-driven purposes.

7. See also, Pugh, David, J.G.M. Parkes and L.W. Stokes, "Empowering the Learner: The Application of Interactive Multimedia Technology-Assisted Learning to Hydrographic Knowledge," a paper to be given at the forthcoming U.S. Hydrographic Conference '92, Baltimore, Maryland, February 25-28, 1992.

8. HyperCard, Apple Computer's original hypermedia program, was written by Bill Atkinson and released into the market just over four years ago, in August, 1987. Since that time, it has spawned not only a tremendous amount of additional research and development effort--including new and even more sophisticated hypermedia and what has now come to be called 'authoring' software--but a wide and extensive following from enthusiastic users, both children and adults. (As a shrewd marketing move Apple has been, since its inception, packaging the program free, with every computer sold). More to the point though, it is the ideas embodied in HyperCard that are important, and that are being implemented in all multimedia projects, whatever the hardware platform.

9. It should not be assumed, from this footnote, that inexpensive printers are all that is required for reproduction of colour images. On the contrary, even high quality black and white printers--(e.g., laser printers with PostScript capability)--are still expensive, and high resolution, photographic-image-quality colour machines are even more so. Our point, though, is that for school projects of the type described, modestly priced equipment is available, and it will perform entirely adequately in such a setting.

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10. See, for example, Eurich, op. cit.; U.S. Congress Office of Technology Assessment, Worker Training: Competing in the New International Economy (Washington, D.C., 1990); Hannum, Wallace, The Application of Emerging Training Technology, American Society for Training and Development (Alexandria, Virginia, 1990); Senge, Peter M., *The Fifth Discipline*, (New York: Doubleday, 1990); and the extensive references and bibliographies in all of these citations.

11. See, for example, Pugh, Parkes and Stokes, op. cit.

12. Stahmer, Anna, and Associates, Use of Technologies for Training in Canadian Business and Industry, Toronto, March 1991, p. 5.

13. One factor, of course, is that computer-to-student ratios in Canadian schools overall are nowhere near those at River Oaks, Holy Family, and Sir Wilfrid Laurier. Though accurate statistics on this measure of computer use are difficult to obtain--(and often inconclusive, incidentally)--current estimates are that the average for Canada is about 1:20, and that this number varies dramatically by province. (A 1988 survey by *Computers in Education* magazine for example, showed a range of from one computer for every eight students to one computer for 55 students, with the average for Canada 1:26). Nevertheless, this ratio is going down (that is, it is improving, as more computers are purchased), and as we describe in the text, new machines are far more capable than old ones. The trend, thus, is very much in favor of more uses, better equipment, better software, more trained teachers, more knowledgeable <u>kids</u> (many have pointed out, it might be noted, that students often know more than teachers, with this kind of equipment), and a far wider <u>variety</u> of uses, in the future. These factors, we maintain, suggest that the trend is decidedly upward vis-a-vis schools and new media, despite the fact, perhaps, that specifically *Canadian* courseware production for schools, using these techniques, may be modest for some time.

14. This article is one of the best we have found in our research on new media and multimedia. It is <u>current</u>--(January 1992)--it is <u>realistic</u>, especially as to the challenges and difficulties of digital video; and it is *devoid of hype*. Because so many articles and papers have been written for which that last statement <u>cannot</u> be made, we suggest strongly that readers wishing to follow the field further, seek out this review article, and peruse it for themselves.

15. Videoconferencing goes back at least fifteen to twenty years now, as we reported ourselves in, Teleconferencing Systems: A State of the Art Survey and Preliminary Analysis, Stanford Research Institute, Menlo Park, California, April 1977. Many other documents, of course, have been produced since, as this is still an actively growing and developing field.

16. Inside QuickTime, *Byte*, December, 1991, p. 189.

17. One very interesting article on this subject is, in fact *titled* "The Videodisc Is Dead" (Interactive Multimedia Incorporated, London, October 1990), but it is put forward in a completely tongue in cheek manner. Instead, the article discusses digital optical media, including CD-ROM, CD-I, and DVI, as perhaps being 'logical for the future' (but not necessarily the present), while analog videodiscs, an older technology, are still better on many counts, and are likely to last many more years after all. This meshes, of course, with what we found in our work also.

18. Voyager and Videodiscovery are both based on the U.S. west coast, Voyager in the Los Angeles area at 213-451-1383, and Videodiscovery in Seattle, Washington, at 206-285-5400. Each has catalogs of excellent, "new media," videodiscs (and in the case of Voyager, CD-ROM discs, also.

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