The EduPort Demonstration Project

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Abstract

This paper reports on project EduPort designed to demonstrate how to apply the digital libraries and communications networks of the future to education; and to explore what roles these technologies may play in shaping the teaching and learning environments of the future. EduPort is a conceptual and intellectual link between the information of the world in digital form, as it will become increasingly available, and its use in the classroom. It is intended to serve as a testbed for understanding how we might be able to utilize digital media on-demand for educational purposes. We focus on the intellectual concept, relate the importance of the collaborative that was formed to carry out the project, and outline the underlying technology platform that was used. It is suggested that more extensive demonstrations are needed before studies can be meaningful conducted on the use and effect of these new opportunities that technology will make available.

Introduction

By the end of this century large-scale digital libraries containing the collective legacy of human knowledge and information will be accessed in real-time, on-demand over gigabit networks. The use of these technologies in education holds great promise for both students and educators. Digital libraries will provide access to information currently available in books, videos, and other traditional forms, while digital museums will provide access to content that is not currently available in these media. The potential to be able to interact with limitless sources of educational content, on-demand, both from classrooms and homes will change the way in which our teaching and learning environments are organized. Curriculum, from the perspective of a methodology used to organize information in such a way that learning can be manageable, may have to be once more reformed to take advantage of these technologies should they become pervasive as expected.

Demonstration projects are extremely important at this time of global technical changes because they will give parents, educators, and decision makers the ability to envision the kinds of things that we want to get out these technologies for our schools. EduPort is such a demonstration project designed to suggest and explore specific ways in which the digital libraries and communications networks of the future might be used in the classroom. Its goal is to enhance learning through teacher support and student motivation. This project was first launched in the US during National Science and Technology Week in April of 1994, at Lincoln High School in Lincoln, Nebraska, where it is currently in use, and was later demonstrated in Singapore, in May of 1994 at a technology conference.

This paper reports on the current activities surrounding EduPort in Nebraska; and it is meant to share the experience with the broader worldwide communities that will participate in the development of the education infrastructures of the future.

The purposes of the project were:

To put in place and use the technical platform and media repository upon which we envision that the education infrastructures of the future might operate, using a testbed for video on-demand and high speed delivery of digital media, in order to explore the role that video these technologies might play in education. And also, perhaps more importantly, to help guide and influence the policies that will determine the use and access to the information and communications infrastructures of the future.

As more of these kinds of projects are attempted the formulation of such policies will become a more informed process. In addition, solutions that are not currently being considered within the scope of what is possible today need to be visualized through demonstrations because these are very hard to consider without profound understanding of the technologies. The use of these technologies is expected to remove the physical and temporal boundaries of all forms of information. These new opportunities for information access can be best understood in the context of education when explored in the classroom, by teachers; and can gradually be extended across all learning arenas (classroom, home, independent learning centers), as the communications and information infrastructures evolve and become more accessible. The premise being that the infrastructures will be in place much sooner than the time required to understand how they will impact education.

Description of the Demonstration

EduPort is a function of key aspects in educational practice, and educational technology. Within the broad scope of educational practice two of the most critical and straight forward issues were directly addressed: concerning how to support the teacher in motivating learning, support and motivation. The use of technology was guided by the goal of targeting a networked education infrastructure. EduPort is made up of a digital library containing newly digitized materials, approximately 80% of which is digital video. One goal was to make hard to access and manage media available in real-time on-demand. Therefore, a high-speed fiber optics line was installed for that purpose. Digital video with synchronized audio poses the most severe technical problems for real-time access on-demand. In its current implementation EduPort explores not only the problems of access of video on-demand but also the potential of very frequent accessibility of this media for educational purposes, in terms of how to integrate it with classroom activities dynamically, and later with curriculum.

The materials for EduPort came from organizations in the US that have large inventories of content in the public domain and that wish to make their content-base available to education. The opportunity to explore new ways in which technology might be used to disseminate their content was both appealing and useful to these organizations and they were eager to cooperate. Once the content was obtained and digitized it was stored in a superserver at the University of Nebraska. From there it is then transmitted to a classroom in Lincoln High School over a fiber optic line that was installed for that purpose. In that classroom the media is accessed by remote control from a single large electronic blackboard in the back of the classroom. The teacher is free to walk around the classroom and interact with the students and with the media at will.

The EduPort Content-base

The content of EduPort can be video, images, audio, and text. Content that is already available in digital form and that is currently accessible over networks can be downloaded using any available methodology and added to EduPort from where it can be integrated into media blocks for real-time access, when needed. Other kinds of content that are not currently available in digital form over networks had to be digitized using a multimedia authoring tool, cataloged to a verbal index, and added to the EduPort digital library. Once in this digital library the dynamic real-time on-demand access enhances the value of the media for the teacher.

In the context of an education infrastructure it will be possible to work with a vast library of digital media, and this will create great technical challenges. To illustrate why consider an information-base of thousands of multimedia documents describing various aspects of the physical sciences. How can this information be disseminated to all the school systems in the country? How can this be done so that multiple schools can work with the same information concurrently, and at the precise times when it is needed? How can the information be kept current and evolve as human knowledge evolves? How can disparate pieces of related information from multiple sources be brought together in such a way that they can all be accessed, interpreted, and presented coherently to educational audiences?

Given the amount of information that it is possible to bring on-line, how can an appreciation of the content of a large digital library be effectively conveyed? How can an instructor find the appropriate six-minute video segment that is needed to reinforce a particular point in a science lesson? How does the instructor know that it is there, how can it be found, how can it be accessed, and how can it be presented to the students at the point in time when it would have the most impact?

These are information management problems that the traditional information access approaches, and the stand-alone multimedia approaches cannot begin to raise. And these are problems that current models of curriculum cannot possibly take into account. But this are problems that need to be examined as the information infrastructures are being built, and the communications mechanism are put in place to access these information infrastructures. How will solving these problems redefine curriculum design? Classrooms? Schools?

Use and Organization of the Content

What makes EduPort different and interesting is the content and the way in which it is accessed in the classroom. However, this would not be at all possible without the technical infrastructure behind it that makes accessing this kind of content, in this fashion possible. The scenario is very simple: a teacher has access to a vast library of educational video clips from a digital library in real-time, on-demand from the remote digital library (that is, the videos are played directly from the repository at the university without having to download them to a local workstation, as is all other media accessed). Access is real not deferred. An infrared remote control allows the teacher to place virtual bookmarks on the videos, by stopping and restarting at any time. Typically each teacher plans the bookmarks and has strong feelings regarding when to stop and engage in the kind of pertinent dialogue that promotes the creation of knowledge from the information that is being provided by the teacher, by the video, and by the additional traditional materials that exist in the classroom setting. The direction that the discussion takes decides how the teacher and the students interact with the digital media. They navigate the media at their

pace, depending on what is going on in that classroom, with those students, at that particular time, something that only that teacher knows and can guide and influence.

Many times "extemporaneous hyperlinks" are created when teachers or students access a diversity of media from the digital library, stimulated by the active discussions that are generated. These discussions are not unlike the kinds of discussions that go on in any classroom, and the extemporaneous hyperlinks are not unlike the kinds of educational digressions teachers and students often engage in when in active dialogue. The only difference is the added resource of media on-demand that makes these digressions exciting, motivational, in this case often motivating the discussions.

The digital content for EduPort was created from materials that were collected from organizations such as NASA, the Franklin D. Roosevelt Presidential Library, the Smithsonian, the National Gallery of Art, the Kennedy Center for the Performing Arts, and many others. The materials from these organizations that went into the creation of EduPort were not previously available in digital form. Thus a digital subset of these organizations now resides in a digital library at the University of Nebraska. Indeed the reasons for creating and using these digital libraries are preservation and access.

A key aspect of being able to access digital media in a timely manner and when they would be most effective is organization. The use of video on-demand in the classroom will drive many new information management requirements. The media available to EduPort was organized in the form of "media blocks". Each media block contains a combination of "media objects", typically video clips, images, or text (an example of text would be the digitized manuscript of an FDR speech). The teachers who made the selections based on existing curriculum combined Media Objects to create Media Blocks. The educational context is thus created by the teacher, guided by existing curriculum, and modulated by the current needs and interest of the students. The process is not automated at this point and a lot more experience with the environment is needed to understand how this could be done.

Each media block could contain media objects from one or more source or organization. And, in addition to the new materials that were digitized specially for EduPort existing available sources of media can be downloaded, added to the EduPort digital library, and made available to the teachers for integration into any given media block. The concept is to provide a methodology for bringing this media into the classroom within the context of specifically what is going on, in a systematic, organized manner.
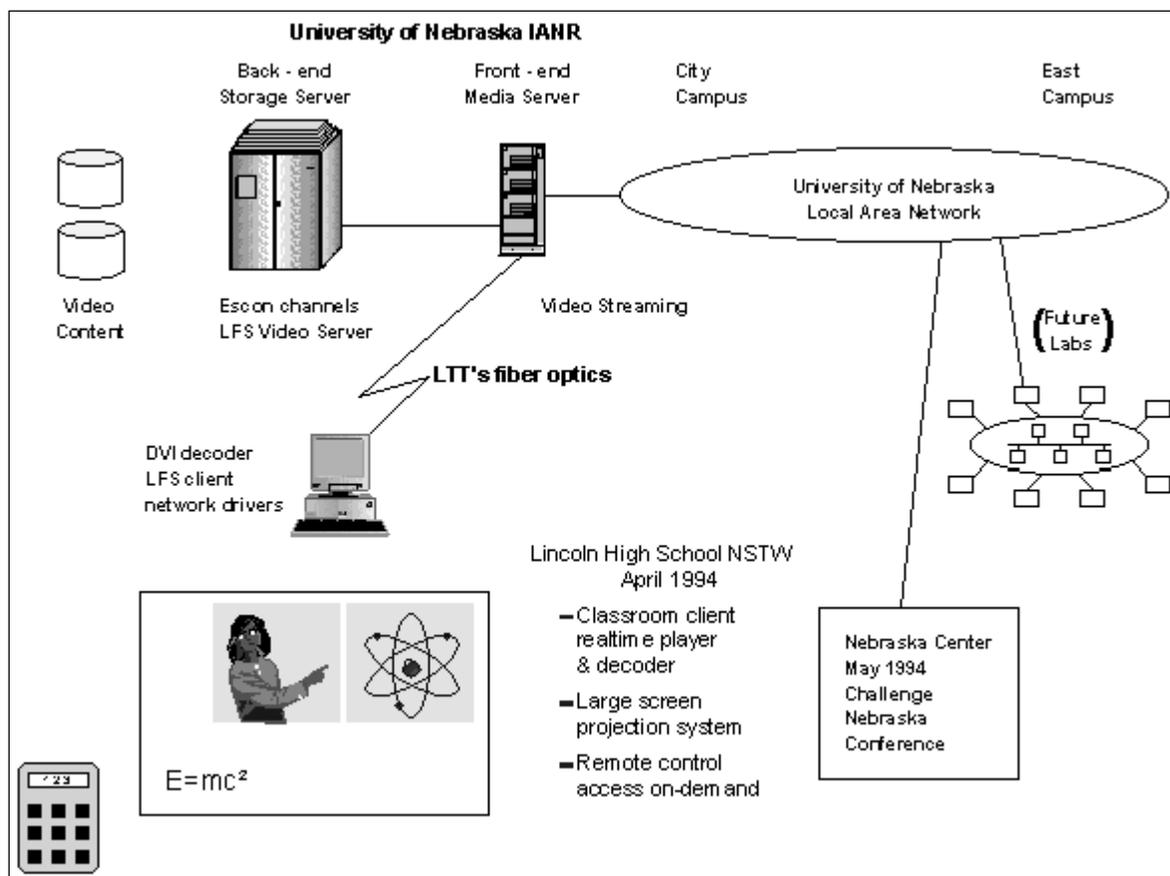
The EduPort Technology Platform

The information and communications infrastructures of the future are expected to greatly enhance the ability of teachers and students to access media, but also to share knowledge and initiatives, to reach and participate in these, and to relate and compare accomplishments to world class standards. But the technologies to capture and move information must be coupled with technologies for representing, organizing and disseminating the information in such a way that it is useful and does not lead to greater functional complexity for the teachers and incoherent proliferation of technology tools in the schools.

A networked information infrastructure for education must have as its fundamental goal to make available resources and media of all sorts to teachers in such a way that they can be integrated

with classroom instruction when they would be most useful, when they are needed. Simply designing and testing a delivery platform, or experimenting with new ways to create multimedia educational software will not advance the potential of a networked infrastructure for education. Its potential lies in how it can help teachers by supporting education in the classrooms and at homes. But this requires complex and powerful computer systems.

The processing power required to manipulate multimedia can be achieved in workstations, but until now has been confined by the limited capacity of local storage. Using currently available technology a single hour of compressed digital video requires 700 megabytes, or 1.5 megabits for each second of video. A library of 1,000 hours of digital video would require 700 gigabytes of storage, far beyond the capacity of any workstation. At 1.5 megabits per second, about 10 digital video streams would quickly exhaust the capacity of most existing local area networks (LANs). It would be difficult to manage and integrate information in this manner.

For the EduPort demonstration a superserver located at the University of Nebraska supporting a LAN server and token ring-network of clients at Lincoln High School delivers multimedia on-demand over a high-speed fiber optics cable. A channel attached PS/2-95 is used as the front-end to the video server. The workstation runs LAN Server and is capable of supporting 48 concurrent video streams through 4 T-R connections. Lincoln Telephone and Telegraph provides the Wide Area Network (WAN) connectivity to Lincoln High School through their LAN Emulation Services. Figure 1 shows the infrastructure that was engineered for the project.

Figure 1. The EduPort technology infrastructure.

Powerful server technologies are required to store and manage large libraries of information that are digital video intensive; to support simultaneous access by many users; and, to provide the communications support that allow both mass delivery of interactive multimedia with full motion video over local area networks, and wide area networks (WAN) access by geographically dispersed users to superserver information through high-speed network. These resources had to be integrated into a newly engineered infrastructure for demonstrating the project.

Contrasting Uses of Media in Education

Students frequently ask how is this approach different from television. The difference is clear but profound. The control of the information that they view is at the receiving end, not at the sending end. That makes it possible for a teacher to show an educational video clip when it is relevant, and not depend on when it will air on TV. From the technical perspective a TV broadcast is significantly less complex to accomplish than the delivery of full-motion video on-demand in real-time. It is more difficult to see the difference between media on-demand coming from a server and the collection of tools and devices that could provide the same kinds of content, such as CD-ROMs, laser discs, and even video players (VCRs). These pose a media and information management problem. Even if a teacher had access to all that exists, how would it be possible to select the one that applies? A large server with much stored content will facilitate access to media, and also provide the management platform to deal with vast numbers of these. In the case of K-12 education, that would be an underlying curriculum model.

Finally, while it is possible to acquire much media by downloading from interconnected networks and online libraries, the difference here is the provision of an organization fabric to deal with large quantities of media available for accessed. This fabric is the layer or link between all that information of the world and that which is filtered for specific purpose, use in the classroom, much like a chapter in a book.

Conclusion

EduPort is a tool for exploring ways in which to systematically and automatically exploit the use of media in for education. It is a resource to support the use of media. It is designed specially to support the teacher in the classroom. It can be extended to support the work of the teacher by means of student access of teacher-selected media from home, when interactive television becomes available. Thus it has the potential of integrating the two learning environments, and coordinating learning across the home and the school. And, to facilitate the exploration of media by students that are not able to easily search, retrieve, and download media. It is an approach to filter the vast collection of media that is available, into one education infrastructure that can be managed and studied.

Acknowledgements

Raffle Girls School in Singapore also enthusiastically embraced ideas and contributed their own. The Lincoln Public Schools Foundation patiently coordinated every aspect of this activity making it literally possible for it to happen.

The contribution of content never before available in this fashion by many organizations is a very special aspect of this project.

The University of Nebraska, taking what may be an unprecedented action, put their powerful computing resources to work for the delivery of educational media to Lincoln High School, even before they made used of their new video on-demand technology for their own purposes.

The demonstration would not have been possible without the participation of Lincoln Telephone and Telegraph in Lincoln, Nebraska; not only because of the donated use of fiber optics cables, but because they did this with a sense of community care and service.

Many individuals in IBM Research, in IBM Singapore, and in many other areas of the IBM Corporation contributed expertise, resources, and a lot of hard work of every sort to help make this happen.

Finally it was through the leadership of Senator Robert Kerrey (D-Nebraska) that this demonstration came to be in Nebraska, as a challenge for Nebraska to explore.

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