Video-on-Demand for Teachers and Students

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Introduction

EduPort is a demonstration project that was presented at two education technology conferences in May of 1994, in the State of Nebraska, USA, and in the Republic of Singapore. The project is currently active in Nebraska, with plans for several pilot sites in Asia [1]. The purpose of the project is to explore and study the use of networked digital libraries in education [2]. The technology used provides real-time on-demand access to media, mostly digital video with synchronized audio. Initially the focus of the project was on implementation of the video delivery platform. Representation and organization of content followed, with special emphasis on presentation of the media within a given educational context. Currently the research effort focuses on facilitation of content selection and presentation design, referred to as the Teacher WorkCenter Scenario.

Background

The ability to access large scale digital libraries of multiple media types, in real-time on-demand, will present problems in organization and presentation of content, that are different from the problems that are currently being addressed by research. Via a system like EduPort it is not necessary to download media before presenting it for a specific educational use, but rather it can be used directly from the stored source. This new capacity that the emerging technologies will offer raises important questions regarding how (in this case) a teacher will be able to display the information most effectively in the classroom and how students might be able to independently but coherently have access it. These questions regarding presentation of content in a dynamic and vast multimedia environment were identified early on in the project [3], and three scenarios were designed to explore them.

The Classroom Scenario

The EduPort classroom is connected via highspeed communications to a video server that delivers on-demand media in real-time, to an electronic whiteboard controlled by an infrared remote control device. There is no media stored at the receiving end, but the control of the media is at the receiving end. The teacher can select and control the media at will. For example, a science teacher may enhance a lesson, or activity on energy and alternative energy sources, by selecting NASA video footage of the recent space shuttle mission to replace the solar panels on the Hubble telescope. Supportive materials and activities are available to help fill in experiences as necessary. For instance, the science teacher could also decide to take her students on an electronic field trip to a museum, and

the students could engage in interactive multimedia hands-on science at the museum, experiments with sound and light, for instance that relate to chapters in the students' textbook.

A history teacher might include manuscripts with handwritten comments, of speeches given by President Franklin Delano Roosevelt, to enhance an American History class. English, Art, foreign languages, and staff development examples such as these ones have been tested. Many teachers can use in many ways and the media. Students might ask questions that a teacher answers with the reinforcement of video clips or still images. In some cases a teacher might promise to find more information relating to the question "for tomorrow's class". In other cases, the teacher may encourage the students to conduct their own independent search using traditional resources, such as the library, or if possible to search through the Internet for additional information. In the future, however, we expect that EduPort-like facilities will be available to students as a special kind of media center that will exist in schools, libraries, and at home through interactive television (ITV).

Community Media Center Scenario

Access points to systems like EduPort will become more available as the communications infrastructures of the future begin to take shape. At home, students will use their TV to connect to an EduPort-like server and preview the next group of learning activities, or review content topics already presented in the classroom. While independent exploration of media will always be a possibility in environments like this, some form of organized presentation of specific media that meets curriculum requirements will also be necessary. Media presented in the classroom in some organized way by the teachers will simplify the task of sorting media by students, and will help to keep them on task.

Teacher Work Center Scenario

Results of group learning and individual learning supported in a media on-demand environment are yet unknown. But in general the issue of teacher preparation and support is paramount to the success of new technology-supported environments. [4]. It will be much more difficult, as we have seen with this project, to guide outcomes, and define learning paths. With so much media so easily available curriculum plans will have to become very flexible and adaptable to student development, and student interest.

A WorkCenter scenario is envisioned for this project, where teachers will be able to dynamically modify curriculum plans, and students will be able to stay on track with curriculum, but also be able to move at their own pace. Subsets of information will have to be automatically selected to narrow down the search, and in order to do that, search frameworks will have to be designed and coupled to meta-level descriptions of the media available in these environment. The search frameworks themselves become another meta-structure. The EduPort Classroom and MediaAccess scenarios provided examples of how to organize and present media for this environment. Media from many sources and in many domains was sorted, organized, cataloged, and combined to create media blocks. These media blocks helped to characterize the design requirements for the system.

Several classes of media blocks were identified and will be refined and assessed for validity. The goal is to find ways to intellectually connect the student with the media. While

this issue will undergo exploration for some time, the problem of automating the construction of media blocks begins to increase in importance. The problem becomes important because we need to be able to generate many examples that can be tested, and that task is currently very labor intensive. Facilitating this activity will help to shift focus to the more interesting aspect of the research: are students connecting with the information.

Media Block Design Issues

These scenarios drive seemingly obvious, but very complex requirements. The requirements described raise many questions and suggest many possible solutions. Solution were implemented that map to existing video-on-demand technologies. Another important consideration when implementing solutions for these environments is to select approaches that have the potential of evolving with the evolving technologies [5]. The experience provided by working on, and testing these scenarios helped to identify three major issues in design and development of video-on-demand systems for education: functionality, structure, and linkages.

Design Functionality

Functions need to be designed differently for different users (e.g. student, teacher). Yet the scenarios described are almost identical with respect to systems and communications infrastructures. Only the player or receiver of the information (e.g., electronic whiteboard, PC, or ITV) is different. But because these end-user devices provide different kinds of functionality, the design of the information structure has to be made compatible with all possible devices.

For example a PC, as a student workstation provides a great deal of functionality and can support, in terms of hardware and software, a variety of user interfaces. Not so with a TV equipped with a set-top box. Those devices are not as functional, and access to a server from a TV, via the telephone network, or CATV, requires that only the telephone keypad, or remote control be used to control the functions of the environment. The solution currently in place to deal with this problem, is to limit the level of functionality across the Classroom and MediaAccess Scenarios to start/stop, and a simple functional menu of 1-9 with special functions keys 0, #, *. This will allow use across all the arenas for learning: home, school, and tutoring environments, where these technologies might reach.

Structuring Content

While different users may need different functions, the same user may need different views of the information, [6]. Facilities are needed for students and teachers to personalize remote resources by annotation, excerpting, and reorganization. It should be noted that these needs must be met in an integrated way. For example, a real-time discussion among students (whether they are together in a classroom, or connected via a network) about a particular topic (e.g. ozone depletion) needs to be tied to the appropriate information (e.g. satellite images of the earth) so that other students who did not participate in the discussion may benefit from it.

Another approach to providing multiple alternative structures to content is to let the user interact with the system through one of several guides. For example, in the sound and light

unit, users might explore the experience with a physicist, artist, teenage rock musician, or their own high school teacher as the "guide". Unlike the forms and menus of the standard desktop interface, these personae might each have a distinctive point of view. In deciding how to organize resources for different purposes, it is important to consider that the appropriate structure of information will depend on the user's characteristics (e.g. age, level of subject matter expertise) and task. For example, an organization that is good when the resources are used like an encyclopedia may be frustrating when what the user needs is a textbook. In the latter, ideas may be initially introduced in simplified and incomplete form and elaborated as the user acquires other relevant knowledge. Encyclopedias, in contrast, tend to make a complete presentation of an idea or topic, and may provide references to other possibly relevant material.

The VOD technology used in EduPort allows for the content to be organized in a kind of networked video encyclopedia. Given the multiple purposes for which the remote information will be used, it may be useful to impose multiple structures on the information, (e.g., fractals in Math and Art). Furthermore, since it is not possible to anticipate every possible way in which a large body of resources might be organized, it may be necessary to provide tools to allow students and teachers to easily reorganize information for their purposes. On the other hand, the benefits of multiple organizations for the same information might need to be balanced against the benefits of consistent organization for a given user, or even different groups of users. For the individual user, consistent organization makes it easier to find resources that have been used before and can help give the user a sense of where he/she is in the information space. Different groups of users might find it easier to communicate about the resources they are using if they have the same structure.

Structuring Information About Content

For education, annotation and discussion of the information is also information. This becomes a meta-level structure associated with the media, and in itself information that needs to be organized, cataloged, correlated, and retrieved. This meta-level information becomes the linking mechanism. But in very large search spaces hyperlinking structures are difficult to manage. How should user annotations be integrated with the remote resources is another important research issue magnified in importance by the new environment. One of the potential benefits which information technology brings to distance learning is the possibility for users to share their ideas by sharing their annotations of remote resources. The way in which annotations are integrated with the resources may affect the way in which both are used. For example, the annotations might be sequentially organized as a document to which users append their comments (like our current forums). This would preserve the distinction between the resource and the annotations and encourage users to peruse them separately. Alternatively, the annotations might be more closely integrated with the resource so that an annotation is attached at the appropriate point. In the case of the Freedom video, for example, the student might attach a comment to the point in the video where she became confused about its relationship to Science Fiction. This comment should become available for viewing as the video plays, and would encourage users to peruse the resource and annotations in tandem.

The concept of frameworks, as a higher-level meta-structure is needed to manage domain specific use of media. A framework may provide the perspective of the user with respect to

the data (e.g., teacher, student, politician, voter). While a lower level hyperlinking mechanism may provide insight into the media itself, the higher level framework links the media to the view of the user. In education the teacher will always be the best hyperlinking mechanism possible. No dynamic or hardcoded linking, especially of media, can with today's technology provide the kind of structuring that a teacher can. The deficiency in the automated approaches lies in the inability of a system to know what is going on in a classroom at a given time; and in the inability to substitute with available when exact matches are not possible. For example an Art teacher resorted to fractal images available through EduPort under Math, for discussing shape and form in a jewelry making class. An English teacher used NASA clips of space station Freedom in her Science Fiction class. Another English teacher combined FDR speeches with Howard Gardner lectures to discuss organization of ideas, and delivery of speech. By studying these interesting combinations and the way the media is being used by the teachers new kinds of meta-definitions are emerging.

Conclusion

The research described is very new (started in May of 1994) and the system itself has had limited use at the school due to the complexity of introducing new sources of content with established curriculum and established practices. The reported results are based on observation. More empirical data is needed to confirm findings. The issues described, however, have significant validity from both a technical and educational perspective, with respect to at least this application of VOD to education. In addition, because the infrastructure put in place with this project for use by the school in Nebraska is several years ahead of the current available technology, we feel that these issues will be valid for some time and merit further exploration.

The next phase of the project will focus on extending the infrastructure (more users and more content), and in more precisely defining the characteristic of the user interfaces needed for the Teacher WorkCenter Scenario.

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