User Adaptation of a Networked Technology:
Internet CNN Newsroom in a High School Classroom

by

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Abstract

In this thesis, we examine the integration of Internet access into the work practices of one high school social studies classroom in Lexington, Massachusetts. Technologically, this classroom is several years ahead of most of its peers, with a dedicated high speed connection to the Internet and several computers capable of displaying video and audio material. These capabilities include a new service called Internet CNN Newsroom, which enables the retrieval of current and archival news footage through the World Wide Web. While the students and teachers have integrated some of these capabilities into their learning and teaching, other features have been neglected. We enumerate the capabilities of this technology, and for each, we will consider its demands on the users and the educational objectives which it supports. We test the hypothesis that the successes of the technology in the classroom depended critically on the flexibility of the technology in allowing partial and incremental implementation, and required active adaptation by students and teachers. We consider the implications for technology planners and designers, and develop a strategy for deploying the Internet CNN Newsroom service and other multimedia information services more widely.

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Chapter 1

Introduction

Across the United States, public schools are going on line. Deployment of networking connectivity and infrastructure in the public education is ongoing and accelerating. The Clinton administration has articulated a new “moon-shot” goal for the nation: to connect every classroom to the Internet by the year 2000. The latest of these deployments in the schools include high speed networking which will enable new networked multimedia applications. It is certain that this infrastructure will make possible ever more sophisticated applications of networked information technology. What is not so certain is how these applications will be integrated into the practice of education in the classroom. As the first wave of these schools go on line, we have the opportunity and the imperative to ask, how do these technology innovations become effective tools for education in the classroom?

In Lexington, Massachusetts, this deployment is already underway. Through partnerships with local corporations, the town of Lexington has enjoyed high speed access to the Internet since 1993. Despite this connection for the district as a whole, the infrastructure to access this connection is only available in a handful of instructional rooms. Like many other municipalities, it is in the midst of increasing the penetration of computers in its classrooms, the connectivity of these computers, and the active use of computer technology by students and teachers. This new deployment will enable a new generation of applications, but it will also require a substantial new investment. Like many other municipalities, Lexington also faces
a debate over the size and the emphasis of spending on educational technology. Implicit in these debates is some estimate of what it will take — in terms of time, support staff, and materials development — to make these technologies effective for education.

This thesis is a case study of how a new network application, Internet CNN Newsroom, was introduced into one high school classroom in Lexington. With the help of local foundations and this research project, the technology in this class is a few years ahead of its peers in the district and most of the country. The class has five computers with continuous Internet access, including access to the World Wide Web. However, these grants of equipment left the task of integrating these applications into the classroom to the teachers and students. This thesis documents the results in this classroom and the factors which contributed to its successes and shortcomings.

Internet CNN Newsroom is a new network application which takes advantage of — and requires — high speed networking and multimedia capabilities which are now being planned for other classrooms in Lexington. CNN Newsroom is a daily half hour of news produced with an accompanying study guide for secondary school students by Turner Broadcasting. Video material for its stories are adapted from CNN (Cable News Network) broadcasts. The study guide provides an index to the day’s stories, vocabulary lists, and questions for discussion.

Typically, these shows are broadcast on cable television in the early morning, recorded by teachers on video tape, and played back during class. The study guides are available separately by fax, email, or through on line services like America On-Line. Internet CNN Newsroom, developed at MIT through the Networked Multimedia Information Services project, makes all of this material available through the World Wide Web.¹ Using a Web browser such as Netscape Navigator, users can browse, search, and play these video segments, read transcripts of the stories, and

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¹The development of Internet CNN Newsroom was supported by the National Science Foundation (NCR-9307548), Advanced Research Projects Agency (A0-B231), IBM, and Turner Broadcasting. See [Compton and Bosco, 1995] for a description of the architecture of the Internet CNN system, and section 1.3 for details on how the system is configured in Lexington.
download the program guides. Internet CNN Newsroom also provides an archive of past stories and the ability to search the text of transcripts and program guides.

In Lexington, Internet CNN Newsroom has been put in the service of a new social studies course called Global Studies. Unlike the alternative social studies courses available to second year students (10th grade) at Lexington High School, it takes a global perspective and emphasizes current events.

Internet CNN Newsroom is now in its second year of active use in this classroom. By the assessments of the teachers and students, it has been a success. Internet CNN Newsroom and other resources on the World Wide Web are used several times each week by the students and teachers in a variety of ways. Along with regular use of Internet CNN Newsroom for the study of current events, this classroom uses the World Wide Web at large for student directed research projects. The teachers have been able to build on their expertise with other media in putting these new tools to use in their classroom and are beginning to take advantage of the unique capabilities of the Web. Students have become sophisticated about information resources on line.

With little guidance from the designers of Internet CNN Newsroom or other intervention, this classroom has adapted this technology to their purposes and has integrated at least some of this new technology along with others into their classroom practices. On the other hand, some features of the technology remain underutilized. How can we explain this pattern of selective adoption of the technology? What would it take to replicate these successes elsewhere?

1.1 The challenge of educational technology

There is a growing understanding among planners and practitioners that it takes more than hardware to make educational technology effective in the classroom. However, there is not yet a clear understanding of what else is required for specific applications. The process of integrating technology into classroom practice remains something of an art. As with all innovations, the deployment of new technologies
must be tailored to the requirements of the particular technology and the needs of the individual site.

This thesis is a case study of how a single class in suburban Boston has integrated Internet CNN Newsroom and the World Wide Web into their classroom practice. We document how one classroom was able to adapt a new networking technology to their work and how they have begun reshape that work to take advantage of the new capabilities of this new technology.

It is clear that this classroom was able to capitalize on a set of conditions which are considered by some to be prerequisites for successful implementation. Through a series of local and corporate grants, this classroom was equipped with several dedicated computers and with full time high speed access to the Internet. The administration supported the staffs’ experiments with technology, created a flexible scheduling system which allowed extended class periods for project work, and provided technical assistance.

What was missing from this support was guidance on the integration of this technology with their curriculum and their educational goals. To some extent, the teachers were able to create this integration themselves. With clear educational objectives in introducing the technology into the classroom, the teachers were able to incorporate some but not all of the features of these tools into their classrooms. The presence of administrative support and technical facilities accounts for the extent of adoption that we observed in the classroom, but it is not enough to explain this particular pattern of adoption.

Our discussion is governed by two related questions. First, why was this technology successful in this classroom? Second, why were some features of the technology in active use while others were not adopted? Our hypothesis is that these factors were critical to the successes of Internet CNN Newsroom in this classroom:

1. the active role of the students and teachers in adapting the technology to serve their needs,

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2We define success in terms of increased usage of the technology in the classroom. We make no formal claim about the learning outcomes as a result of using the systems.
2. flexibility of the technology in allowing partial or incremental implementation,

3. the suitability of the implemented feature for satisfying an existing curricular requirement of the course work.

1.2 Educational connectivity, content, and curriculum

The confluence of a number of forces is at the heart of the latest wave of investment in educational technology in the schools. One of these forces is the momentum of rapid innovation on the Internet. As we describe in the next section, recent innovations are making a range of new networked applications available to the average desktop computer user. Another of these forces is the ongoing movement to reform education in the public schools. With widespread concern about the economic competitiveness of the United States in the global economy, many observers call for a remaking of public education to prepare students for a future where traditional manufacturing work will be replaced by jobs in an “information economy.” Central to many of these discussions are proposals to expand the connectivity of schools to the emerging National Information Infrastructure.

This thesis documents what one classroom was able to achieve with a connection to the Internet. While this is only one classroom in this district, the town of Lexington has partially funded plans to deploy this level of technology across the district as a whole. While this is a relatively well endowed district, it is only slightly ahead of its peers in planning for this kind of deployment. Massachusetts has a state-wide program to encourage and fund this kind of planning by all towns in Massachusetts. Looking at this classroom is like looking forward several years into the future.

Loosely speaking, this is a participant observer research project. We evaluated the deployment of Internet CNN Newsroom at this pilot site with minimal intervention. The research staff of NMIS provided just enough support to get the system working in the classroom. Development of lessons plans which incorporated the technology was left to the teachers and students.

We assessed student attitudes and knowledge about the system through surveys
and focus groups. This data was gathered as part of [Rothstein, 1996], and is summarized in section 4.1. We also made our own assessments of the extent and range of system use through periodic classroom observations over the course of several months.

In this classroom, the adoption of Internet CNN Newsroom was a conscious effort to expand the course curriculum by including coverage of current events. In this classroom, the new educational goals of the course drove the adoption of these tools, which expanded the range of available course materials. At the same time, these new materials and tools drove the expansion of the curricular objectives.

1.3 The Internet CNN Newsroom system

We have argued that the capabilities available in our study classroom will soon be available widely. This was not true during the period of this study. The applications which were used regularly in Lexington required installation of specialized hardware and software. In this section, we describe the Internet CNN Newsroom system from the user perspective, and describe the requirements for using the system.

CNN Newsroom is a daily half hour news broadcast produced for secondary school students. It is broadcast in the early morning on the cable television channel CNN. Its format follows the conventions of television news, with a pair of regular and recognizable anchors announcing each story, and regular correspondents providing narrative over highly visual presentation of news events. Many of the stories on CNN Newsroom are edited from stories appearing on CNN, with the same correspondents who can be seen on CNN. Leading the broadcast is the day's "Top Story," which focuses on a headline event of the day. Other stories are presented in ongoing topical series, such as coverage of the 1996 U.S. Presidential campaign.

See [Erdman, 1994] for a content analysis of CNN Newsroom which is free of advertising, in contrast to another commercially produced news program for students, Channel One, from Whittle Communications. Distribution of Channel One involves packages which include cable television access and video equipment in exchange for a captive audience: these schools are required to air the entire Channel One program, including commercial advertising, every day. In contrast, teachers can pick and choose from the stories broadcast on CNN Newsroom. [Burkart-Roberts et al., 1992] is a study of the use of CNN Newsroom in the classroom.
Like television news, a fair portion of the daily broadcast is devoted to "features" which include human interest stories and entertainment news.

These stories are indexed in the program study guides, which are available separately from the show's producers by fax, email, or through on-line services. These guides also include suggestions for using the material in the classroom, including questions for discussion and vocabulary words. Typically, teachers record the programs the night before class at home, then play the stories for their classes the next morning. CNN Newsroom is used this way in roughly 30,000 classrooms across the country.

The Internet CNN Newsroom system makes this same material available on the World Wide Web. At MIT each night, the CNN Newsroom broadcast is automatically recorded, archived as high quality digital video\(^4\), segmented by story, and posted to a page on the World Wide Web. In addition, transcripts of the broadcast are extracted from the closed captioning text which accompanies each broadcast and made available for browsing and retrieval alongside the digitized video.

Used as simply a video-on-demand system, the Internet CNN Newsroom streamlines access to this material for teachers. Instead of recording the broadcasts late at night for use in the classroom the following day, teachers can instantaneously play selected stories by accessing the Internet CNN server on the World Wide Web. Furthermore, previewing and selecting stories for use in class is simplified since the Web presentation of the broadcast provides a separate accessible link for each story. Finally, the video and the study guides can be found there on the Web at the same place.

Another difference is that users can also select from an archive of broadcasts of the past several months. These past stories can be retrieved by date or by

\(^4\)Video encoding is MPEG-1. Real time transfer of MPEG requires roughly 1.5 Mbits/s of bandwidth.

\(^5\)Internet CNN Newsroom is accessible on the World Wide Web at [http://mis.nmis.org/NewsInteractive/CNN/Newsroom/contents.html](http://mis.nmis.org/NewsInteractive/CNN/Newsroom/contents.html). See appendix A for details on system requirements for using the full features of the system. See [Compton and Bosco, 1995](http://mis.nmis.org/NewsInteractive/CNN/Newsroom/contents.html) for details of this system architecture.
topic, by searching the text of the transcripts and program guides. As we discuss in chapter 4, it is these features of the system which provide the greatest potential opportunities for innovative classroom work, but which are also the most difficult to integrate into classroom practice.

During the first year of the study, this system required specialized hardware and software in the classroom to support the innovative capabilities of this system. The computer in the Lexington classroom was equipped with specialized video hardware (decoders), which allowed immediate playback of the digital video on a large external TV monitor. It used software which was modified to allow video “streaming,” so that the user can begin watching video before the entire segment is downloaded. This allows the user to rapidly preview video segments. This machine is connected to the Internet through a high speed dedicated connection.6

At the inception of this study, this streaming capability was one of the primary innovations of the NMIS research project, and were not available commercially. With recent advances in technology, these capabilities are now commonly available. Video decoding and streaming capabilities are now available as “plug-ins,” software extensions for the widely used Netscape Web browser, to enable these features without specialized hardware or software.7

Besides processing power, the other limitation is sufficient bandwidth in the Internet connection to support video transfer at real time rates. A variety of new alternatives now exist to expand the networking capabilities of schools. For instance, it is possible to provide high speed Internet access through the coaxial wires of the cable television system using cable modems.8 Even with limited wide area network

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6The town of Lexington receives Internet service through a dedicated line which provides fixed bandwidth of 10 Mbps. This bandwidth is shared by the schools and the town administration. The effective bandwidth available to the computer was roughly T-1 rate, 1.5 Mbps. This is at least two orders of magnitude larger than typical connection speeds through dial-up services such as America On-Line.

7These decoders are only available for the latest generation of microprocessors. Converting the digitized bit stream to video is a computationally expensive process. With the specialized video hardware and high speed connection used at Lexington, the quality of the picture approaches that of VHS video. Even with these new software decoders and the fastest new microprocessors, video conversion is only possible with either smaller windows or lower frame rates. But with the rapid advance of computing power, this is not likely to be true for long.

8Several Boston area cable television providers now also offer Internet access to the home through
bandwidth, it is possible to take advantage of local area networking to improve performance by caching remote information at a shared local file server within the school.\textsuperscript{9}

Internet CNN Newsroom at Lexington is one instance of an educational application which requires and takes advantage of the expanded capabilities of newly deployed network infrastructures. To any classroom with the current generation of hardware and software and a high speed Internet connection, these kinds of applications, including the CNN Newsroom system, are now available. In this thesis we consider what it takes in addition to this technical infrastructure to make this system useful.

1.4 Overview of this thesis

In this chapter, we introduced Internet CNN Newsroom as an example of the new networked applications which will become widely available as classrooms connect to the Internet. This thesis is a case study of the deployment of this system in one high school classroom. We hypothesized that the successes of this deployment required the active work of teachers and students in adapting the technology to their needs and adapting their work practices to take advantage of the technology.

In chapter 2, we survey part of the literature on the design and deployment of new technology in the classroom. The deployment of World Wide Web technologies like Internet CNN Newsroom is similar in many regards to other forms of computer technology in the classroom. We discuss what is unique about the Web. We also describe our study methods and our sources of evidence.

In chapter 3, we describe the setting for our case study. We introduce the teachers, students, and community, and describe other sources of support for the study classroom. While the study classroom is situated in a relatively well-endowed

\textsuperscript{9}A component of the NMIS research was the development of local caching schemes. Typically, local caches of information store recently requested information so that repeated requests are delivered quickly. Given a predictable pattern of use, such as watching the current day's CNN Newsroom broadcast, it is possible to pre-load the information that is likely to be requested.
school district in a well educated and affluent community, the population of the study classroom includes a mix of diverse races and abilities. Through the efforts of the classroom teaching staff, the class is a few years ahead of its peers in access to networked computers. We describe ongoing initiatives to deploy similar levels of technology across the district and across the nation.

We present our observations of the classroom in chapter 4. We compare the results of surveys of student attitudes and knowledge about computers and networked applications in the study classroom to two control classrooms. We describe three distinct applications of the Internet CNN Newsroom system and the World Wide Web at large that we observed in the classroom, supplemented by comments from students gathered in focus group interviews, and in interviews with the teaching staff.

In chapter 5 we revisit our classroom observations in an effort to isolate those factors of the deployment which were critical to the adoption of these technologies in the classroom. In addition to the supporting factors in the school and district environments, we identify features of the technology and the roles filled by the teachers and students. The technology allowed incremental and partial adoption of its features, and could be used in ways that capitalized on the existing expertise of the teachers. The teachers and students actively created new uses and new ways of working with the technology.

We conclude in chapter 6 with recommendations for designers of new information technology for the classroom, and for planners of new deployment of network technology for schools.
Chapter 2

Networked education: Theory, Policy Perspectives, and Research Methods

Investment in educational technology is being propelled in part by a new educational reform movement in the United States. In this chapter, we outline the theoretical and political movements underpinning this reform, noting where these ideas have found expression in the goals, curriculum, and practices of the study classroom. To summarize, there is a widespread sense that the existing system of public education no longer suits our needs as a society.

First, the goals of education have changed because the world has changed. In the next century, students will be entering a global marketplace in an information driven economy where rapid adaptation to change is a necessity. Second, we have at hand the tools and techniques to achieve these goals. [Bruer, 1993] With new methods based on a better understanding of the learning process, we need not continue to practice education as we have since the last century. To many reformers, technology is one essential tool for the implementation of these new methods. [Melmed, 1994, Starr, 1996]

In Lexington, planners of educational technology echo these calls for change.
Their planning documents cite the changing workplace and the coming “information society,” which will be “characterized by rapid change and a constant flood of new information.”[Lexington, 1996] In these planning documents, two themes emerge. First, they argue that schools must equip students with a new literacy, the ability to find, evaluate, and make use of information which comes increasingly from electronic and online sources. Second, they argue that new technology can support new ways of learning.

At the same time, other reformers call for a return to the basics, and question the wisdom of teaching a “new” literacy when we could be doing a much better job of teaching the old literacies of reading, ‘riting, and ‘rithmetic. One place where conflict between these philosophies is manifest is the battle over new statewide curricular frameworks for social studies. These frameworks are stalled by the debate over whether education should emphasize the acquisition of facts or development of the process of learning.

In this chapter, we survey this contemporary debate over educational technology. We first overview the progressive ideals cited by planners of education technology in section 2.1.1. We discuss the role of new network technology — in particular, the World Wide Web — in supporting these ideals in section 2.1.2, and the potentials and pitfalls of implementing technology based innovations in the classroom in section 2.1.3. We describe current initiatives to promote this technology in the classroom and the current public debate in section 2.2.

In section 2.3, we describe our case study design, noting the differences between this study and other studies of new technology in the classroom.

2.1 Educational technology and education reform

2.1.1 The new progressive education and technology

The themes which emerge in contemporary arguments in support of educational technologies have their roots in educational theory. In Lexington as elsewhere these themes find expression in the planning documents of the district and in the planning
and practices of the classroom. They include new definitions of literacy, with explicit
attention to the process of gathering, learning, and using knowledge and information
for a lifetime of learning. They explicitly acknowledge the multiplicity of individual
interests and learning styles. They call for students to learn by “constructing”
knowledge through “authentic” work. Table 2.1.1 lists goals for students education
in Lexington which are to be advanced by introducing technology in the classroom.

Students should be:

Problem Solvers able to respond creatively, flexibly, and critically
to continually changing problems;

Information Managers able to access and select relevant infor-
mation from a rich information environment;

Self-Directed, Life-Long Learners able to continually acquire
new knowledge as the world changes; and

Collaborators and Team Players able to work with other indi-
viduals to solve increasingly complex problems.

Table 2.1: Goals for students as articulated by the Lexington Town

Nationally, the need for “information literacy” has been featured prominently in
the SCANS (Secretary’s Commission on Acquiring Necessary Skills) report of 1991
and in the National Educational Goals (also known as Goals 2000\textsuperscript{1}). Information
literacy includes the “ability to access, evaluate, and use information from a vari-
ety of sources.”[Doyle, 1994] Table 2.2 lists the elements of information literacy as
defined in the SCANS report. This definition explicitly recognizes the ability to
use computer technology. It also implicitly recognizes the growing importance of
electronic information systems by recognizing the problem of selecting and finding

\textsuperscript{1}Goals 2000 provides federal matching funds to encourage state development of standards for
education.
An information literate student:

- recognizes that accurate and complete information is the basis for intelligent decision making
- recognizes the need for information
- formulates questions based on information needs
- identifies potential sources of information
- develops successful search strategies
- assesses sources of information including computer-based and other technologies
- evaluates information
- organizes information for practical application
- integrates new information into an existing body of knowledge
- uses information in critical thinking and problem solving

Table 2.2: Elements of information literacy. Source: [Doyle, 1994]

relevant information in an information-rich environment.

These "computer skills" can do more for an individual student than simply help them get to more information. By enabling visual, audial, and other modes of interaction with information, computers can also support more effective learning through different kinds of information. [Hasselbring et al., 1992] and others have shown that learning of complex ideas is enhanced with the addition of visual presentation of information. [Gardner, 1993] has argued that we should recognize many kinds of intelligence — linguistic/verbal, mathematical/logical, spatial/visual, kinesthetic, interpersonal, and intrapersonal — and has argued that the multimedia capabilities of computers can support these multiple paths to knowledge.\(^2\)

\(^2\)The potential for multimedia technology to support these multiple intelligences is also cited
The point of access to new media is not simply to accelerate the absorption of facts. The constructivist view of education is that learners build their own understanding through experimentation and exploration of the world around them. For constructivists, the challenge of computer system design is to create environments which invite and reward this exploration. [Papert, 1980] describes how students use LOGO to actively "construct" knowledge of geometry and computer science through their experimentation with the formal world represented and manipulated through the computer.

For many problem domains, it is not necessary to build or simulate complex environments to enable this kind of constructive learning. We need only look to the world around us. Students can learn by doing "authentic tasks," work which is not fundamentally different from work by professionals in the society at large.³ Real tasks can motivate and contextualize classroom work.⁴

Networked computing can support this kind of work by provided access to real and current data, by supporting communication with peers and working professionals, and by providing a channel for publication of the students findings and results. The National Geographic Kids Network allows students to track the progress of expeditions to remote and exotic places around the world. The TERC Global Lab Project enlists students around the world to collect and analyze climate and environmental data. Both of these projects also support two way communication between working scientists and students.

These ideas — learning to learn, learning through multiple modes, learning through constructive, authentic work — are not new.[Whitehead, 1929, Gragg, 1940, e.g.] As we describe in section 2.1.3, the idea that technology can support these reforms is also not new.[Bush, 1945, Melmed, 1994]. In the next section, we consider how the newest of these computer technologies, networked computing and the World Wide Web might also support the implementation of these educational ideas.

³[Brown et al., 1989] defines authentic tasks as the "ordinary practices" of the culture.
⁴This work need not be grand in scale to be authentic. For example, [Riel, 1989] found that the quality of students' writing for a distant audience of peers was significantly higher than writing solely for a grade from their teacher.
2.1.2 The Web as a tool for education reform

The World Wide Web is the latest technology being advanced for the sake of education reform. Its deployment is the latest episode in a history of computers in the classroom which extends nearly two decades. [Means and others, 1993, Glennan and Melmed, 1996] and others have enumerated the potential applications of computer technology in supporting educational reform, but they say little about the Web. [Glennan and Melmed, 1996] does not explicitly distinguish the World Wide Web from other networked computer technology. While [Means and others, 1993] does offer a systematic review of the capabilities and requirements of different educational technologies, it predates the popular rise of the World Wide Web. We consider the uses of the World Wide Web in terms of the roles that it can play in supporting education.

The World Wide Web is an infrastructure rather than an application. Table 2.3 lists the common standards which form the foundation of the Web. While using the World Wide Web typically consists of interaction with only a single software application, a browser such as Mosaic or Netscape Navigator, there are a multitude ways in which this technology can be used in support of learning. These uses continue to change with the evolution of technologies of the Web and the expansion of communities connected to the Web. Acknowledging this multiplicity and continual evolution, we consider the World Wide Web as an aggregate of multiple educational uses, rather than as a single system or medium. In chapter 4 we describe how many of these uses were implemented in the lesson plans of the study classroom.

For users, the convergence on these standards has created:

A common platform for distributed multimedia and hypermedia. For information providers and users this means that only they need only turn to one network, the Internet. For providers, it means that content developed for the Web can be viewed by users using a variety of hardware and software. For users, it means easier use, since there is only one application to learn, the Web browser, and there are common conventions for navigation on the Web.
The World Wide Web is built on a common set of standards for:

**finding and delivering documents** over the Internet (IP, HTTP, FTP),

**identifying, formatting, and linking documents** (HTML)

**displaying and playing** images, graphics, video, and audio (GIF, JPEG for graphics; MPEG, QuickTime, AU, AVI for video and audio; and others),

**running interactive applications** (Java)

Table 2.3: World Wide Web standards.

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**Global reach and scope.** Because the Internet is global, the World Wide Web is global.

**An “open” channel** with no overall structure and no central editorial authority. While this extreme decentralization and the accompanying unreliability of source material can be challenging for students used to carefully screened and reviewed sources such as textbooks and school libraries, it also provides the opportunity for students and others to participate as providers of information on the Web.5

We can identify several educational uses of the Web which are now available. Some of these uses mimic those of older media. Others extend the capabilities of these media to enable new uses. To the user, the Web can serve as a Video-on-Demand system, a reference library, a hypermedia presentation tool, a publication channel, a simulation platform, or a communication tool for collaboration (see table 2.4).

5In chapter 4 we describe how the teachers in the study classroom explicitly addressed the reliability of information obtained on the Web and elsewhere. They were able to use the available multiplicity of voices and viewpoints on the Web to create novel activities for their students.
**Media-on-Demand** The Web is primarily a “pull” technology. Rather than waiting for the information to arrive, the user can retrieve what they want, be it movies, stock quotes, or news, when they want.

**Hypermedia presentation tool** Content and information on the Web can be “linked” to other information. Links can be local (within documents or within a set of documents) or remote (to documents anywhere else on the Web).

**Reference library** The Internet is a network of peers, that is, it is nearly as easy to provide information as it is to consume information on the web. This has been critical to the explosion of content on the Web. It is easier than ever to “publish” your work to a global audience through the net.

**Publication medium** Students can publish the results of their work to the world at large.

**Simulation platform** With Java and other technologies, it is possible to run interactive applications and simulations through the Web.

**Collaboration channel** Some pages support ongoing collaborations between students or teachers at remote sites.

Table 2.4: Many different applications can be supported on the infrastructure of the World Wide Web.
Research on learning and hypermedia has focused on either standalone hypermedia presentations [Chang and McDaniel, 1995, Lehrer et al., 1992], or on-line searches of compiled databases [Oliver, 1995, Chen, 1993]. Looking for information on the Web also typically involves browsing by following links to other information from within documents and selecting keywords for searches. On the Web, there is no global structure linking documents to support the user’s browsing, and no global record structure within Web documents which supports the user’s searches.

This same openness and lack of predefined structure has been critical to the rapid adoption of the Web across the world. Users of information resources on the Web typically cannot rely on the editorial screening provided in most print and broadcast media. On the other hand, they are freed from the selective attention of these same editors. In chapter 4, we describe how teachers and students have taken advantage of the capabilities of this “open” technology by creating this structure and organization for themselves.

In this section, we have described what distinguishes the Web from other computer technology and described some of the possible applications of the Web as a tool for education. However education reform does follow automatically from installation of the technology. The use of these tools must be integrated into the practice of the classroom and must be consciously applied to support those reforms. With each new set of capabilities comes a new set of challenges for teaching. In the next section we consider the process by which

2.1.3 Implementing technological innovation and reform

In the previous subsection, we listed the possibilities for using the Web for learning. To realize these possibilities, teachers and students must integrate these tools into their work practices. How do we implement this technology innovation in the classroom?

The history of introducing new technology into the schools to revitalize education is long and not very encouraging. [Cuban, 1986] Time and again, technological innovations in education such as television, films, and cable television have failed to
deliver expected improvements in learning. Recent analyses of technology innovation in the schools (such as [Means and others, 1993], [Hadley and Sheingold, 1993], and [Dwyer et al., 1991]) reaffirm the lessons of older educational innovations [McLaughlin, 1976, Williams and Elmore, 1976]: new technology requires new ways of working, but changing practice is hard, especially when it conflicts with existing practices, goals, beliefs, and incentives.

In table 2.5 we distinguish between three aspects of technology implementation: the technology, the organization, and the process. In this subsection, we consider our case in relation to the literature on technological innovation in the classroom.

<table>
<thead>
<tr>
<th>The ease with which new technologies are introduced into organizational work depends on a variety of factors, including:</th>
</tr>
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<tbody>
<tr>
<td><strong>technology:</strong> ease of communication and use, flexibility in allowing partial or trial implementation [Rogers and Shoemaker, 1962];</td>
</tr>
<tr>
<td><strong>implementing organization:</strong> including values, goals, culture of change or resistance to change [Dwyer et al., 1991, Means and others, 1995];</td>
</tr>
<tr>
<td><strong>implementation process:</strong> process for planning, deploying, reevaluating implementation, support and training. [McLaughlin, 1976]</td>
</tr>
</tbody>
</table>

Table 2.5: Factors in the implementation of innovation

[McLaughlin, 1976] looks at classroom innovations such as team teaching which were not primarily technical and argues that successful projects involved a process of “mutual adaptation,” of the staff and classroom to the new innovation and of the innovation to the needs and conditions of the classroom. Describing the introduction of technological change in the workplace, [Rogers and Shoemaker, 1962], argue that successful innovations required technologies which allowed partial and incremental implementation. Looking at several examples of new technologies in the classroom,
[Means and others, 1993] outlines the organizational prerequisites for such a process. The teachers and staff must be empowered and supported in their efforts to experiment with and adapt their teaching methods, curriculum, and schedules to make these innovations work.

In each of these sources, there is an explicit recognition of the evolutionary nature of technological change. One example of this evolutionary process is the experience of teachers in the Apple Classroom of Tomorrow Teacher Development Center Project (ACOT). [Dwyer et al., 1991] In this project, several classrooms were infused with technology, supported through collaboration with project leaders, and followed for several years from 1986-1989. From their experience with teachers in these technology-rich classrooms, [Dwyer et al., 1991] defines five stages in the evolutionary changes in teachers’ knowledge, attitude, and practices. (Table 2.6)

Even with a rich infusion of technology (one computer for every student), generous support and training, and close collaboration with project experts, teachers required between several months to over a year to make the transition from Entry to Appropriation.

The evolutionary change observed in [Dwyer et al., 1991] is also indicated in a much earlier study of new technology in the workplace. [Rogers and Shoemaker, 1962] identify these features of the technology innovation which contribute to their success:

1. ease of communication,
2. ease of use,
3. congruence with existing values,
4. opportunities for partial or trial implementation.

The last of these factors suggests that making innovations work requires experimentation by its users.

As we report in chapter 4 the Web is in many ways well suited to allow this evolving integration into the classroom practice. As a tool in the classroom, the Web was flexible enough to allow incremental implementation of its features, and to allow teachers and students to make use of the web to support existing curricula.
**Entry** Introduction of technology into the classroom. Teaching relies on "traditional" print and blackboard technologies with traditional pedagogy. Teacher effort is directed at getting things working and managing disruptions caused by new technology.

**Adoption** Initial use of computers to support familiar methods of instruction. Teachers starting to use technology regularly in the classroom.

**Adaptation** Classroom productivity increases. As teachers and students become comfortable with computers, they are able to do more in less time. With new expectations for student work, teachers began to revise their teaching plans and to adapt the technology to this work.

**Appropriation** Technology "come to understand technology and use it effortlessly as a tool to accomplish real work." New instructional patterns and new roles for students and teachers emerge.

**Invention** Teachers use technology as a tool for building learning environments. Teachers change fundamental beliefs about the nature of learning and work.

Table 2.6: Phases in the evolution of teacher roles and attitudes during implementation of technology in technology rich classrooms.

Source: [Dwyer et al., 1991]

In a study of non-technical classroom reforms and innovations, [McLaughlin, 1976] posits that successful innovation is also characterized by “mutual adaptation.” Implementors actively adapt the technology to suit their individual circumstances and also change themselves to take advantage of the capabilities of the technology. We also observe this pattern of mutual adaptation in our study classroom.

The ACOT schools demonstrated successes in a few model classrooms with the support of a large corporate partner. Few school districts have the resources to create classrooms with this level of technology. Unlike the ACOT classrooms, where the first step of this evolutionary process was a massive infusion of technology, the computers and connectivity in the study classroom were acquired gradually over several years, through several different sources. In the next section, we describe several current initiatives to increase the penetration of technology in the schools.

In the absence of intensive support for these efforts as in the case of ACOT, the teachers must find other ways to gain administrative and technical support for their efforts. [Means and others, 1993] identifies the organizational elements of school-level education reform efforts which are critical to success (table 2.7). This list enumerates the organizational supports which are necessary for teachers to engage in the experimental work required to use new technologies in their teaching.

The lessons of this literature are that the introduction of technology innovations is an evolutionary process which requires experimentation and fundamental changes in practice. This process requires technology which allows flexible and incremental implementation and administrative and technical support. While ultimately innovations make fundamental changes in practice and belief, these innovations can gain a foothold by supporting existing and familiar practices.

In chapter 3 and in section 5.1, we describe the organizational supports available to our study classroom. We have described the Web in this section as an aggregate of its potential educational uses. In chapter 4 we find that some of these uses dominated the study classroom’s use of the web, and that others have yet to be tried. The presence or absence of organizational factors such as administration support and technical assistance do not explain these patterns of use that we observe in the
classroom.

In chapters 4 and 5 we attempt to explain this observed pattern of adoption in terms of the theories that we have outlined here. Two questions guide our observations and analysis of the study case:

1. Is the observed use of the technology compatible with the needs, goals, and values of the students and teachers in the classroom?

2. At what phase is this class in the evolutionary integration of this technology into classroom practice, and what might be done to accelerate that evolution?

2.2 Technology and policy initiatives

In the absence of a large single donor in our study classroom, the teachers have taken the initiative to acquire computer hardware for their classroom from a variety of sources. In our study classroom, the adaptation of technology by the teaching}

**Clear educational goals** Reform programs disrupt familiar ways of working. The end goals of that disruption must be clearly in focus.

**Culture for learning** Teachers should be encouraged to experiment with new techniques and technologies for teaching.

**Site based management** Local management of curriculum and scheduling is critical to the process of adapting the reform program to the local conditions.

**Professionalization of teachers** Teachers must have opportunities for planning, reflection, and collaboration with their peers.

Table 2.7: Organizational elements of innovation: elements common to successful school-level reform programs. Source: [Means and others, 1993]
staff includes the selection and acquisition of new technology.

The technology in our study classroom was deployed over the last several years. The resources available for educational technology are the result of a variety of public and private initiatives with a variety of goals and educational agendas. In this section, we consider those initiatives which have had an impact on the technology in this classroom.

2.2.1 Public initiatives

In Lexington, most of the funding for educational technology will come from public sources. The town has committed to a wide ranging plan to deploy new network technology throughout its schools. Towards that goal, it is supported directly by state matching funds and planning.

Control and funding of education in the United States is highly decentralized. On average, local funding accounts for half of the total spent on education, state funding accounts for about 40% and federal funding for less than 10% of spending on public education. Despite limited direct funding of technology in public education, state and federal initiatives can have a large impact on the direction of technology programs.

Lexington technology deployment is also supported indirectly by federal initiatives in research and development, such as those once conducted by the Congressional Office of Technology Assessment and the US Department of Education Office of Educational Research. As we discuss in the next section, local implementation can also be bolstered by federal deregulation of telecommunications.

The town of Lexington has funded the first year of a five year plan to integrate technology into the practice of its public schools. Over the next five years, the plan

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6Direct federal funding for educational technology is also available through a number of sources. The largest is Title 1 money which is targeted to schools with a large number of underprivileged students. Title 1 money, while not specifically earmarked for technology, can used to purchase computer hardware and software.

calls for upgrade of the electrical infrastructure of the schools to support networking throughout the district, infusion of technology hardware and software into the classrooms, development of curriculum and professional training to integrate technology into classroom practice, and the creation of full time professional positions to oversee this development. [Lexington, 1996] While the first year of the plan has been funded, funding for the total projected capital expense of over $6 million is not certain, and will likely require an override of State Proposition 2 1/2 limitations on taxation. 8 [Lexington, 1996]

This planning is shaped by guidelines for education technology developed by Massachusetts state. Communities with qualifying plans are eligible for matching funds from the state. The initial technology plan, initially developed in 1994 was revised in 1996 to qualify for these matching grants. By funding research and planning, Massachusetts state has fostered local planning efforts by providing model plans and state level support for planning efforts. 9

Other state level reform efforts include new state curricular frameworks for each subject. As we detail in the next chapter, a primary driver for the introduction of educational technology in the study classroom was the ongoing curricular reforms at the district level. It remains to be seen how well the new district curricula will match the state wide curricular frameworks. Putting technology to work in support of these frameworks is an explicit goal set out in the Lexington planning documents.

2.2.2 Private Initiatives

In Lexington, as elsewhere, public deployment of network technology is supported by private investment and gifts to schools. These private initiatives have allowed local business partners to explore new markets for their services and to develop good will with local regulators and consumers.

Town councils have obtained free or low cost network infrastructure in as part of licenses...

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8 Proposition 2 1/2 is a Massachusetts state ballot measure which requires that increases in local property taxes greater than 2.5% annually must be approved by popular referendum. Local property taxes are the primary source of revenue for most municipalities in the US.

9 Developed by the Center for Leadership and Technology (CELT), see http://www.celt.org.
for cable television monopolies. In Lexington, Cablevision (locally, Adams Russell Cable Company) has provided the physical infrastructure for an institutional network within Lexington, and provided $100,000 for local area networking within the schools. [Lexington, 1996, p. 14]

Local corporate donors have contributed both equipment and connectivity to Lexington. Since 1993, Bolt Beranek Newman (BBN) has provided Internet connectivity to the district via NEARNet. The schools, libraries, and local government share a 10 Mbit/s channel to the Internet. Lexington is physically connected through MIT Lincoln Lab, which has also provided technical assistance. Lexington is also a partner in the National School Network Testbed sponsored by BBN and funded by the National Science Foundation. Volunteer training and technical assistance has been provided by MITRE corporation.

There may be opportunities for more partnerships in the wake of recent announcements by the cable and telecommunications industries. In the new regulatory regime for a competitive telecommunications industry, there are a number of proposals to ensure preferential access rates for schools and libraries. The Telecommunications Act of 1996 calls for "affordable" access to telecommunications for schools. However, wide area connectivity is only a fraction of the total cost of deploying networked computing. [Rothstein, 1996, Liu, 1996] Recently announced national corporate initiatives include promises of Internet access for the schools by AT&T, and by the National Cable Television Association (NCTA).

The Lexington Education Foundation (LEF) provides small grants to teachers in Lexington to support new methods and technologies. The small cluster of computers in the study classroom was obtained through an LEF grant to introduce hypermedia project work into the classroom.

2.3 Methodology

Our goal is to explain the patterns of selective use of technology that we observed in the study classroom. Our hypothesis places critical importance on one of many
possible factors in determining the course of this implementation: the active role of
the clients, the students and teachers, in adapting the technology to their purposes.

That is, we propose that the user of the technology in this classroom played an
important role in creating the innovation. We expected to find that while alternative
factors, such as availability and access to technology, training and technical support,
and administrative and organizational support, were important, they did not deter-
mine the particular features of the technology which were used in the classroom.
Some critical level of these factors is surely necessary to create an environment
where user innovation is possible. But we posit that given this minimum level of
support, the observed pattern of adoption reflected choices that the users made in
selecting features of the technology which suited the needs of the classroom.

2.3.1 Study design and scope

This research is a case study of a single classroom. Primarily, it is a snapshot of
technology in this classroom at one point in time. Our direct observations of the
classroom span primarily a few months late in the 1995-1996 academic year. Survey
data from [Rothstein, 1996] span the entire academic year. We fill in the history of
technology in this classroom through interviews with the teaching staff and public
documentation. We conducted a limited followup in the 1996-1997 school year.

As a single case study, the claims of this study are limited. Our primary aim
is to document how this classroom put these new network technologies to work.
There is little experience with deploying this level of technology on a wide scale.
Most published research on educational technology has focused on model and pilot
programs, and has not focused on the use of networked technology and the Web. As
we describe below, we compare student attitudes in the study classroom to student
attitudes in control classrooms. We make no effort to quantify the results of the
technology deployment beyond estimates of use. We make no evaluations of changes
in student learning as a result of technology.

While this thesis is also a case study of a single classroom, the study site in Lex-
ington is one of a new generation of technology endowed classrooms where invest-
ment in educational technology is being financed primarily by the local taxpayers as part of a system-wide program. While much of the hardware and software in the classroom was acquired through a series of small grants, it is not been driven by a single pilot project, research project, or by a large corporate donor. Unlike many of the pilot programs described in the literature, the deployment of technology was bottom-up: with selection, acquisition, and integration of technology driven by teachers. As such, Lexington is atypical: it is relatively well equipped with technology and technology savvy staff.

While this classroom in Lexington is relatively well endowed with technology and other resources compared to its peers, the resources that it enjoys are likely to be available much more widely in the next several years in the course of further deployment of educational technologies. That is, Lexington is ahead the majority of school districts, but it is ahead by only a few years. The problems and issues facing Lexington today will soon be commonplace across the nation.

This lead has been possible because the town’s population is atypical: relative to its peers in Massachusetts, the residents of Lexington are wealthier, better educated, and spend more on education as a whole. (See chapter 3 for details.) Nevertheless, as elsewhere, these residents share a wariness about technology and other education “reforms,” and share a resistance to new taxes. In Lexington, only 20% of Lexington households include school-age children.

Demographically, the study classroom represents a cross-section of the students in Lexington. As a mixed ability group classroom, it includes a few “honors” and others. Like Lexington as a whole, the group is racially diverse, and includes slightly more female than male students. (See chapter 3.)

In summary, the primary goal of this study is to document how one classroom has integrated network technologies like Internet CNN Newsroom and the World Wide Web into its work. This classroom achieved this level of technology through

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10 Most classes at Lexington High School are “tracked” according to academic aptitude. Honors and Level One courses are traditionally college preparatory courses. As we detail in chapter 3, several of the honors students in the study classroom were selected the course because of its use of computers. Students may be simultaneously enrolled in courses in several different tracks.
a efforts of a motivated staff which faced lower than usual barriers to achieve these ends. As public investment in network technology and private initiatives to put technology in schools accelerate, we expect many more classrooms to achieve this level of technology. As those schools go on-line, we look to our study classroom in Lexington for lessons about how to make this technology work for education.

2.3.2 Sources of evidence

Chapter 3 describes the history of technology in the study classroom and introduces the key players in the school and the classroom. This information is compiled primarily from the public record and from personal interviews with key players.

Personal sources include interviews and conversations with students, teachers, administrators. We conducted informal interviews with teachers, students, and administrators; formal interviews with students in focus groups; and formal surveys of student attitudes and knowledge.\(^\text{11}\)

Public documentation includes agendas and minutes of town meetings, school budget reports, Townwide Educational Technology Committee reports, and local editorials and letters in the local press, the *Boston Globe* and the *Lexington Minuteman*. In these documents, we find a record of public attitudes towards technology, and public debate about the deployment of technology in the schools.

2.3.3 Observations: personal data gathering

Chapter 4 describes direct observations of technology in use in the classroom. After initial classroom visits and focus group interviews with students, we visited the classroom on several occasions over the course of three months in the spring of 1996. Each time, we observed classroom use of the computers over several days for each of the two sections of Global Civilizations actively using the system. These visits were typically timed to coincide with student project work involving computer use.\(^\text{12}\)

\(^{11}\)See [Rothstein, 1996] for methodological description of the first round of focus group and survey data.

\(^{12}\)Appendix B.2 includes a chronology of classroom visits, surveys, and interviews.
As we detail in chapter 4, my presence in the classroom and our conversations with the teaching staff had noticeable effects on how the system was used in the study classroom. In one instance, these conversations lead directly to a change in the assignments used to guide student study of sources on the Web. Besides such instances, which were directly observable, this study may also have had some effect on the frequency and extent of use in the classroom. Statements from the teachers and students suggest that the frequency and quality of class sessions observed in this study were representative of classes conducted throughout the year.
Chapter 3

Educational Technology in a Social Studies Classroom

The uses of network technology in the classroom that we detail in the next chapter took place in a fertile setting. Students and teachers were motivated to use technology and they enjoyed the support of school administration and the community in their work.

Our study classroom in Lexington is atypical in many ways. Nevertheless, our study classroom had a diverse student population and was influenced by forces which are common across the state and across the country. The relative advantages in technology and other resources that Lexington enjoys can be attributed to its affluence and its proximity to centers of education and industry. But like other towns across the country, Lexington faces the challenges of educating an increasing and an increasingly diverse student population in the face of resistance to new taxation and competing demands for municipal spending.
3.1 The Town of Lexington

3.1.1 Demographics

Lexington is relatively wealthy town in the suburbs of Boston. In 1990, income per capita in Lexington was $30,718, compared to an average of $18,666 for all towns in the U.S.\(^1\) Spending per pupil on education was $6498 annually, compared to $5235 for Massachusetts as a whole, and $4407 for the U.S.\(^2\)

While Lexington is more homogeneous racially than the nation as a whole, the study classroom was more diverse. Demographics in Lexington as a whole (92% white, 6% Asian in Lexington compared to 74% white, 12% black, 10% Hispanic, 2% Asian nationally), are not reflected in the study classroom.\(^3\) During our classroom observations, we counted a student population which was roughly 1/3 black, and 2/3 white. Part of this difference is a reflection of an aging population: only about 1/5 of households in Lexington include school aged children.\(^4\)

3.1.2 Public and political support for educational technology

Public support for educational technology in Lexington has been strong, but the debate over whether to continue with the planned spending is recurring with each new fiscal year. In 1996, the schools secured funding for wiring and electrical infrastructure upgrades,\(^5\) despite the grumblings of some dissenters and the myriad of competing demands for local spending.\(^6\)

At the time of this writing, the Town Meeting has approved funding for the 1997-98 school budget which included over $1.2 million for educational technology. However, the spending must also be approved by popular referendum on June 2, 1997.

\(^1\)Massachusetts Municipal Profiles, 1995.
\(^3\)U.S. Department of Commerce, Census Bureau, 1996.
\(^4\)U.S. Department of Commerce, Census Bureau, 1996.
While many teachers in Lexington are enthusiastic about the potential for technology in the classroom, their knowledge and experience is still limited. In surveys of Lexington teachers, over 3/4 of the teachers replied that they believed that technology had the potential to improve education. However, less than 1/4 of the teachers felt that they were skilled enough to make use of those technologies in their classrooms. The first phase of the technology plan tentatively funded for 1997-98 is intended change this by providing “technology immersion” for teachers.

The Lexington Technology Plan explicitly calls for educational technology to support required Massachusetts curricular frameworks. At the time of this writing, the curricular framework for Social Studies had not yet been approved. In the study classroom, the teachers and administrators already have a clear vision of what social studies education should be.

### 3.2 Global Civilizations Course

The Global Civilizations course which is the focus of this study was the direct outgrowth of ongoing curricular reforms and revisions in Lexington High School. Global Civilizations consciously incorporates many of the reform elements discussed in chapter 2. The course incorporates interdisciplinary study, flexible use of class time, heterogeneous ability grouping, and an emphasis on student-driven project based work.

#### 3.2.1 Curriculum and structure

The Global Civilizations course was designed to expand the scope of social studies at the sophomore level in Lexington, with broader coverage of non-European regions and more attention to current events. Each unit of study is organized around studies of geographic regions such as the Middle East.

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7 as required by Massachusetts to apply for matching funds for local planning efforts.
Global Civilizations is a “non-leveled” course. There is no effort to divide students by academic aptitude. Students have the option of receiving honors credit by doing additional work. In 1995-96, only 6 of the roughly 40 students intended to receive honors credit for the course.

Each pair of sections is taught by a team consisting of a social studies teacher and an English teacher. The teachers make an effort to coordinate the literature read in the English section with the history and geography studies of the social studies section.

The English and social studies sections for each pair of sections are scheduled back to back, allowing flexible scheduling of extended class periods. On one day, one section will meet for a double period for English while the other section meets for a double period of social studies. On the next day, they switch.

Each unit culminates in large individual or group projects. The extended periods are often scheduled to allow students to work uninterrupted on these projects during class time. Evaluation of these projects is sometimes conducted jointly by both teachers. These projects include traditional written research reports, multimedia presentations constructed using Hyperstudio, oral presentations, and more “artistic” interpretive work such as drawings. The final project for the course in 1995-96 consisted of designing a “monument” based on a theme which cut across units and geographical boundaries, such as the status and rights of women.

The curriculum for social studies in 10th grade is evolving. The district guidelines, in effect since 1990, are being revised, as the state of Massachusetts drafts its own curricular frameworks for standardization of content across the state. The 1995-96 requirements for social studies in high school simply call for at least one unit of world history and one unit of U.S. history. As a relatively small school district, with only one high school, the social studies department has the flexibility to experiment and revise its curriculum. Global Civilizations was such an experiment.
3.2.2 Students

The course enjoys the support of the administration. More telling is the interest in Global Civilizations by students. Enrollment in Global Civilizations for the 1996-97 school year, 79 students, is nearly double that of 1995-96. Registration for the course next year has grown to 110. According to the lead teacher, this increasing interest by students can be attributed to the use of technology in the course.

At least two of the students in the course were members of the school computer club, and had created their own pages on the school web site. These students and several others were drawn to the course because of its extensive use of computers for course work. Otherwise, students were roughly representative of the school as a whole: over 1/3 of the students were not white, roughly half were female, and only about 15% had registered for honors credit for the course.

3.3 People and organizational supports

The flexibility in scheduling and curriculum enjoyed by the teaching staff is made possible by support from the department and school administration. John Papadonis, district social studies coordinator, is supportive of the new course and is enthusiastic about new methods for learning and assessment. The classroom is local pioneer in network and computing technology, and is frequently showcased for visitors to Lexington by the district educational technology specialist.

3.3.1 Training and technical support

Opportunities for training and professional development have been limited in Lexington. Since training for technology use has not yet been funded, courses have been limited by the number of teachers experienced with technology who are available.

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8Source: Mary Gillespie, 18 May 1997.
9Involvement of the community in these new efforts is significant. In an open letter to the *Lexington Minuteman* ("Thanks volunteers," July 4, 1996), John Papadonis names a list of volunteer readers for a new performance based assessment program for World History II for honors sophomores.
and willing to volunteer their efforts. This is not unusual for public schools in the US. Most of the courses offered have focused on training for specific applications and technologies. Few have explicitly addressed the integration of these tools into the classroom. [Lexington, 1996, p. 23-24]

Outside the district, Mary Gillespie has had other opportunities for professional development. In 1991, she attended a conference sponsored by ELNA in Argentina, where she made contact with other teachers around the world in preparation for linking with other classrooms by electronic mail. She has incorporated these e-mail exchanges into her classroom every year since then. She brought this experience back to the district by leading a workshop called Global Telecommunications. In 1996, she was invited to present papers about their use of technology at the convention of the National Council of Social Studies.

For those teachers who do use technology in their classrooms, a noted shortcoming has been availability of on-site trouble-shooting support. This has been somewhat less of an issue in the study classroom. The offices of the director of network and information services are located on the high school campus. During the period of this study, the classroom was able to draw on the support of the NMIS research team to a limited extent.

More importantly, several of the students in the classroom, members of the school’s computer club, provided their own expertise to support the technology in the classroom. These computer savvy students have also organized and lead workshops for teachers in Web publishing (using HTML).

3.3.2 Teaching staff

In the first year of the study, the student teacher Bob Hill played a large role in supporting the technology. He provided both technical support for the system and pedagogical support, finding and gathering on-line information and designing training for students. After his experience at Lexington High School, he went on to a full time teaching position in the nearby town of Acton. He believes he was hired at least in part on the strength of his experience incorporating Internet technologies
into the classroom.

The lead social studies teacher, Mary Gillespie, was an experienced teacher who now has several years of experience with computers in the classroom. Teaching the Global Civilizations class was only half of her responsibilities for the district. She is also district social studies coordinator for grades K-8. In that, she is perhaps uniquely positioned to introduce new technology and new teaching methods into the classroom. Her duties as curriculum coordinator leave ample time for planning. Furthermore, reforms such as heterogeneous grouping, portfolio based assessment, and flexible scheduling have gained a much stronger foothold at lower grade levels with which she is involved on a daily basis.

The English teacher in 1995-96, Sue Lipsky, was also no stranger to technology. Several years ago, she left teaching to help develop interactive instructional material at Digital Equipment Corporation. She continued to work with them as a technical writer until recently, when she returned to teaching full time.

In the second year of the study, two more sections of the course were added, and another social studies teacher was assigned to teach the course along with Mary Gillespie. A new English teacher was assigned to teach the English sections along with both of the social studies teachers. The new teachers assigned to the course were also enthusiastic about using technology in their teaching, but had had limited experience doing so. For part of the second year of the study, Mary Gillespie also had the part time assistance of a graduate student at the Harvard Graduate School of Education.

3.3.3 Technology and infrastructure

These teachers acquired a cluster of Macintosh computers through a grant from the Lexington Education Foundation (LEF). The original purpose of the grant was to introduce project based work using hypermedia authoring tools into the classroom.

The study classroom is the only one in the high school with dedicated, high speed connections to the Internet. Lexington’s schools, libraries, and town hall
share a high speed connection to the Internet through BBN. The local area wiring bringing this connectivity into the study classroom was put into place shortly before the start of this study.

During the study period, the equipment in the classroom included four Apple Macintosh computers and one PC. Daily attendance in each section ranged from roughly 20-25 students, so that the ratio of students to computers was roughly 4:1 or 5:1. As we detail in the next chapter, the effective ratio in use was slightly lower, since students also had access to similarly connected computers in the library during class time, and the class was structured so that not all students used the computers simultaneously.

All of the computers were equipped with color monitors, sound capabilities, and were capable of running the latest operating systems and software. All were connected to Internet through an ethernet local area network. The effective bandwidth available at each of these computers was roughly comparable to a T-1 line (1.5 Mbps). The Macintosh computers were also connected to a color ink-jet printer. The PC was connected to a large 27" monitor, where it was able to play video segments for viewing by the entire class.

The classroom is physically roughly twice as long as it is wide. All of the computers were set up in a space in the rear half classroom, out of the way of the student desks and blackboards in the front half of the room. There is ample space around and behind each computer for several students to sit in front of a single machine.

3.4 Fertile ground for innovation

We found that conditions in the study classroom in Lexington favored the introduction of new technology in the classroom. The teaching staff was well supported and

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10The first year of the study project was the last year of service to the town donated by BBN. Internet access is now funded by the district as part of the operating cost of the school budget.
11See appendix B for a chronology.
12Including four Macintosh computers in the school library.
13Performance on any given day varied. The network resources were shared across the school and across the district. Also, network and server delays outside Lexington reduce the perceived performance.
highly motivated to make use of educational technology in the classroom. These uses were driven by a clear set of educational objectives. As we detail in the next chapter, they were also able to draw support from local donors, the larger Boston community, district staff, and the expertise of students and student teachers.

The technology available in the classroom was powerful and dedicated to the exclusive use of the class. It was arranged in a manner which allowed teachers flexibility in whether to use the technology or to ignore it. Flexible schedules and curricula also made this choice easier.

Teachers and students did make this technology an integral part of their work. In the next chapter, we describe what they were able to do.
Chapter 4

Observations of Teachers and Students

It's like your choice. You do whatever. If you know what's good for you, you use both [books and computers]. But if you hesitate to use the book, then you use the computer. But if you're just a bookworm, then you use books. — a Global Civilizations student, on whether to use books and on-line resources for class projects.

We found that by middle of the first year of the study, the Internet and Internet CNN Newsroom had become integral tools in the work of teachers and students in the study classroom. We observed significant and regular use of the new technology, despite limited external assistance in developing educational uses for the technology.

In surveys, interviews, and focus groups, we found that students and teachers were positive about technology in their classroom. In written surveys, students in the study classroom indicated greater reliance on technology for their work and were more likely to view computers as tools for learning and work than their counterparts in the control classrooms.¹ In focus groups, we saw that students in the study classroom, like one quoted above, had become sophisticated about their choice of media for work, recognizing the advantages and disadvantages of doing work and research on line. In some ways the technology achieved a certain transparency,

¹For more detail on these findings, see [Rothstein, 1996]
becoming just one of several available tools for doing work.

The teacher also credited CNN/Newsroom and the Internet for part of the motivation and enthusiasm of her students, and for bringing research within reach of students who had difficulty with traditional print based resources.

In site visits and classroom observations, we observed several distinct modes of use. These uses of the Internet and Internet CNN Newsroom supported existing educational values and goals and capitalized on users’ prior experience with technology. Students developed ways of working which fit the capabilities and shortcomings of the technology. Teachers selectively introduced uses of the technology in ways that were compatible with teaching methods that they were experienced with, while also expanding the scope of these methods to take advantage of the range of new sources available on the Internet.

In this chapter, we first summarize the results of student surveys and focus groups from [Rothstein, 1996] in section 4.1. In the next three sections, we describe how Internet CNN Newsroom and the World Wide Web were used in in three distinct educational applications.

§4.2 Teacher directed viewing of video as a class,

§4.3 Directed student research of selected media sources,

§4.4 Independent student research on topics of the students choosing.

Each section focuses primarily on classroom observations, drawing on survey results and quotes from focus groups to help interpret our observations. In section 4.5, we revisit the role of students in supporting the deployment of the technology.

4.1 Early results

While early evaluations of the study classroom in [Rothstein, 1996] indicated some successes of the initial deployment, it also raised some questions about students’ conception and use of the system. In focus group interviews and surveys, students cited computer resources as an important element of their school work. However, in
focus groups, students often blurred the distinction between the Internet (i.e. the World Wide Web) and Internet CNN Newsroom (one site of many on the World Wide Web). In this section we summarize the results of those surveys and focus groups and note the questions that they raised.

Evaluation of Internet CNN Newsroom began with a survey of the students’ interest in current events and social studies, and their attitude and knowledge about computers and the Internet. As detailed in [Rothstein, 1996], these surveys were administered three times over the course of the school year to the students in the study classroom (LEXSTUDY) and in two control classrooms: another section of Global Civilizations also at Lexington High School not using Internet CNN Newsroom (LEXCONTROL) and one classroom of a similar tenth grade social studies course at Belmont High School (BELCONTROL). All three classes had some access to Internet resources for schoolwork through computers in a library on campus. In addition, the study classroom also enjoyed the use of 5 computers with Internet access in the classroom, with a networked printer and one equipped to display video on a large television monitor.²

Survey results indicated that students in the study classroom (LEXSTUDY) were generally more positive about the benefits of technology in the classroom than in the control classrooms. The small sample statistics limit the conclusions which can be drawn about the impact of Internet CNN Newsroom relative to other variables in the study, such as frequency and quality of access to computers, and differences in relative importance of project work.

The survey data suggested that the study classroom, in comparison to the control classrooms, showed greater reliance on technology tools as an information resource in the classroom. Students in the study classroom identified computers as their most important source of information for schoolwork more frequently, reported using computers more frequently, were more likely to assess their knowledge of computers and the Internet as high, and were more likely to agree with the statement that

²The survey included sixteen multiple choice questions and one open ended question. The LEXSTUDY survey also included additional questions in the second and third administration of the survey specifically about Internet CNN Newsroom.
computers are good for learning and work.

In LEXSTUDY, interest and reliance on computers for schoolwork seemed to peak in mid year. (Figure 4-1) The percentage of students ranking computers as their most important source of information rose from 39% to 67% from September 1995 to January 1996, then dropped to 54% by April 1996. In LEXCONTROL, surveys showed a corresponding peak in reliance on books rather than on computers, while there was a dip in their reliance on computers over the same period. In contrast, this figure rose steadily for BELCONTROL from 7% in September to 13% in April.

Figure 4-1: Percentage of students ranking computers as their most important source of information during the first year of the study, 1995-96. Source: [Rothstein, 1996]

For LEXSTUDY, this data may indicate some novelty effect. Other indicators for LEXSTUDY showed similar patterns. It may also reflect changes in students' coursework over the course of the year. The data for both LEXSTUDY and LEXCONTROL are consistent with a mid year peak in project work. In this period of
increased demand for information resources, students turned predominantly to their
dominant information source: LEXSTUDY to the computers, and LEXCONTROL
to books.

Students in both sections at Lexington High School (LEXSTUDY and LEX-
CONTROL) were more likely than BELCONTROL to report working with other
students in social studies class more frequently than in other classes.

As a followup to this survey data, we administered the survey once again in the
following school year in January 1997 to the new students in the study classroom
(LEXSTUDY2). For a variety of technical reasons, in this second year, the students
were unable to use Internet CNN Newsroom until late in mid-December of the school
year, so it is difficult to compare these results directly with those for 1995-96.³

The results for students in LEXSTUDY2 were comparable to those for LEXS-
TUDY in January. In the second year of the study, the schedule of the LEXCON-
TROL classroom was shifted so that they were able to meet in the same technology
rich classroom as LEXSTUDY and also used the computers for project work. We
did not readminister the survey in the second year to the LEXCONTROL or the
BELCONTROL classroom.

Interviews with students showed the importance of the World Wide Web in the
students’ work. Students cited the currency, scope, and ease of access of on-line
resources as reasons for using the Web for their project and school work. As I
detail in the sections below, students recognized that print and on-line resources
had different and complementary strengths.

4.2 Watching the news: Teacher directed study

While only some of the students had used Internet/CNN Newsroom individually
for their research projects, all of them had seen it used to play current news clips
in class. The primary use of Internet CNN Newsroom was as a video-on-demand

³Part of the difficulties involved a transition from the specialized software developed by the
NMIS project to support video streaming (see [Compton and Bosco, 1995]), to the use of off the
shelf software which is a standard part of Windows 95.
system. For this Internet/CNN Newsroom is used in this classroom just as it is used in nearly 30,000 other classrooms. The class used the Internet CNN Newsroom system in this way roughly once a week.

On one day that we visited the classroom, when the class had just concluded a unit on Latin America, the teacher had selected two pieces for her class: the Top Story, a piece on the US Space program on the tenth anniversary of the Challenger disaster, and a piece recounting the life and subsequent legend of Eva Perrone. Before starting the video clip, students received a copy of the daily program guide which included some background on the top story, a list of vocabulary words, and some questions for discussion about the ‘top story’ of the day. After students had read through the background piece on their own, the teacher lead them in a short discussion about the Challenger accident and the space program. Then the student teacher played the Top Story and the piece on Perrone on a large television monitor in the back of the classroom.

On this day, there was another classroom discussion after viewing these video clips. On other days, the pieces were shown at the end of class and the questions were assigned as homework, for the students to prepare for a discussion the following day. On still other days, the class spent little time before or after viewing the stories, and quickly returned to their ongoing work.

4.2.1 News on demand

In this classroom, this video is downloaded from a server at MIT across the Internet instead of being played from a VCR. Superficially, this mode of presentation differs little from its original broadcast counterpart. However, this technology has

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4 source: Turner Educational Services.
6 There are a few important exceptions raised by many students. First, the segmentation methods used to cut the video stream into stories often missed the start or end point of the story by several seconds, so that stories often appeared with a few seconds missing at the beginning or end, or included a few seconds of a preceding or following story. Also network delays sometimes caused pauses in the play of the video, so that speakers would sometimes be frozen mid-word for a second. Students said in focus groups that although these problems were annoying, they did not significantly interfere with their comprehension or enjoyment of the video. Most students accepted such glitches as inevitable limitations of cutting edge technology.
increased the flexibility and utility of CNN Newsroom for the class.

When the teacher used CNN/Newsroom in years past, she would record the broadcast early in the morning and bring it in to school. She describes the difference:

I mean I don’t have to be responsible for taping it. Right. And I know that it’s going to be there in my classroom. You know previously I mean I could have taped it at 3:00 or whatever the hour is in the morning. And then taken my tape into school and used it. This way I know it’s right there.

The benefit to the teacher of simple access to the material is hard to understate. Interruptions to the school schedule are frequent and often unpredictable.7 Taping the video at home in the evening adds nearly a full day to the lead planning time required to incorporate the material into the lesson plan. Furthermore, because the program is news, it is impossible to anticipate the program schedule.8

In the past, getting the daily program guide also required going to another source. Although she initially learned of CNN/Newsroom through a program guide that her husband had downloaded through America Online, she typically did not use the guide with the video, because of the additional difficulty of obtaining the program guide from a separate source. With Internet/CNN Newsroom, the guide and the news clip are readily accessible at the same place.9 As a result, she finds it easier to bring CNN/Newsroom into her class.

I think [the program guide] might have been available but I was not quite aware where I would get it... I don’t know how that worked. I — it was very difficult. I mean, this whole system [now] is absolutely fantastic. I mean at 7:00 in the morning, we have everything there when the system is working. (Laughter) So we have the guide and we have the news report.

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7 For instance, in one of the weeks that I observed the classroom, it was decided that for two days, all tenth grade students would watch the movie “Schindler’s List” during first and second period.
8 Production of CNN Newsroom is completed in the late evening on the day before broadcast. The teachers guide is prepared that night and is released early on the morning of the broadcast.
9 The program guide is now also available directly from CNN on the Web at http://www.cnn.com.
4.2.2 Classroom integration: lesson plans

Even when the schedule is not interrupted, the competing demands of the curriculum make it impossible to use the system every day. In the words of the teacher:

And the students did say that they wished they could go into the archives and use it more. And that they would find that valuable. The problem is the timing and how to do it within the classroom.

The challenge is to integrate ongoing study — of a region or a historical era — with the self-contained episodes provided by CNN Newsroom. One student observed:

We'll talk about something totally different and then okay, [go] the back of the room [to watch CNN Newsroom]. It doesn’t really tie in to what we’re doing all the time.

However, when the days broadcast did include items related to the unit of study, the delivery technology reduced the overhead involved in including it in the day’s lesson.

The existence of CNN Newsroom as a resource on the Internet which is “packaged” with a complete set of teaching materials has also supported the teacher’s efforts to integrate Internet resources into her lesson plans. For instance, she is able to use pieces from Internet CNN Newsroom, with their accompanying study questions, at one of several media stations as we will describe in section 4.3.

4.2.3 Content: video designed for students

While the technology makes it easy for the teacher to bring the materials to her students, it is the content of CNN/Newsroom and its associated guide which makes it useful to her.\(^\text{10}\) Both teachers and students like the immediacy and impact of the

\(^{10}\)While they have been considered by some observers together [Erdman, 1994], I should note the distinction between CNN Newsroom and Whittle Communication’s Channel One, described in [Robinson, 1994]. Channel One was also a commercially produced news program for secondary school students. Whittle provided schools with televisions, VCR’s, and cable television connections for a captive audience: students in these schools were required to watch these news segments daily when they were broadcast, along with several minutes of paid advertising. In constrast, while Mary Gillespie gets only the right to use the broadcast materials, she decides when and how much of the CNN Newsroom material to use in her classroom.
video presentations. Students in the study classroom seemed to respond to the fact that it is created for students:

It’s just interesting, because it’s kind of like a teen’s point of view rather than an adult’s. It’s easy to understand.

Students also found the video presentation of current events compelling:

...when you’re watching it, it makes it seem so much more real. They give us a sheet like this, right? And it says the report on the top of it. It maybe wouldn’t make that big of an impression as seeing the names and the (inaudible). So it makes it seem that much more real.

Some found that the video aided comprehension,

When you’re reading, you’re not really (inaudible) if you’re not concentrating you don’t get it all. When you see it and its visual (inaudible).

And it’s kind of like when someone reads to you, you understand more instead of reading it yourself.

while others did not.

It’s hard to get the detail when it’s so quick.

For the teacher, the preparation provided by the questions and vocabulary words in the program guide is as important as the presentation.

I mean I think it’s been arranged beautifully that the length of the articles or presentations are appropriate and I doubt very much if these students would watch anything like this at home. ...Yet they want to know. But of course I think that it does take a little bit of preparation in preparing them to watch this. I mean I think you just can’t turn it on and say OK kids here’s the news. ...That OK now for the next 20 minutes in class you’re going to watch the news of the world, thank you very much. And then turn it off. No. I mean there has to be a little preparation for this, but if there is, and if you give them guidelines, I think it’s wonderful. And where else would they get that. They’re certainly not going to get that at home.

This guide also reduces the work required by the teacher to achieve this level of preparation.
I print out the news guide or look at the news guide and then that gives me direction for the day ... I'm guided by the guide.

The guides have proven to be useful even without the video. On some days, the class was unable to view the Newsroom clips due to network or server errors, but the teacher was able to print the study guide. Sometimes she assigned the questions on the guide to her students anyway, asking them to look for the answers in the day’s newspapers.

4.2.4 Promotion and diffusion by students

Some students have recognized the value of CNN Newsroom for their academic work outside of Global Studies. The teacher supports this interest by printing the guide for each day and compiling them for interested students.

... when I don’t show it, right, I always bring up and print out one copy of the guidelines. And I have seen the kids go to it and look at the guidelines to see what was in there, if it would relate to their science course. If it would relate to other courses. So they will refer to it. They know it’s there and that I have it in the pile, you know, the weekly pile. And so they can use it and upon occasion I’ve seen them when they you know want to use it for their science course. So then they can go to the archives and say OK on January something or other they had something on this in the science section.

Students have come in outside of class time to look for the Internet CNN Newsroom material. On days when the students were assigned questions from the study guide but were unable to view the segments in class, they sometimes came in later in the afternoon to try retrieving the video again.

Students have been responsible for some diffusion of this innovation to other classrooms in the school.

Yes, I’ve showed it to people within the social studies department, but I am aware of the fact that people in the science department are very much aware of what is going on, only because of what some of the students have brought [to those classes].
4.3 Directed student research: the web as one of many media

Although Internet CNN Newsroom was the primary means of introducing current affairs in the classroom, it was often used in conjunction with other media. One approach used in the study classroom was to assemble a variety of resources, including articles from newspapers and news magazines, video from Internet CNN Newsroom, and pages on the World Wide Web into a series of 'media stations.' Students would rotate through the stations in teams. At each station, they focused on a particular resource, guided by a set of questions assembled by the teaching staff.

In the past, the teacher used media stations with other print and audio-visual material such as film strips and videotape before the introduction of Internet resources in the classroom. She was already making an effort to introduce materials outside the textbook into her lesson plans. With access to the Internet, the web was incorporated as one of these many information resources. Internet CNN Newsroom was also easily integrated as a media station. 11

With the breadth of viewpoints available in these sources, these stations provided the opportunity for the class to deal explicitly with questions of authorship and reliability. During my observation of this exercise, the topic of the six media stations was the impending return of Hong Kong to China. These included stories on video from Internet/CNN Newsroom, web pages created by the United Kingdom, the Hong Kong government, and the U.S. State department, and text stories on the CNN web page. 12 A set of questions for each source elicits both factual information, and information about the sources. For instance:

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11 When I observed students at these media stations in the study classroom, the CNN Newsroom video had been downloaded through the Internet and recorded onto a videotape to simplify playback for the students.  
4.4 Independent student research

As we described in section 3.2, the Global Civilizations course emphasized individual and group project work. Over the course of the year, these projects varied in scope and length. This range is illustrated by two examples: one asked students to collect facts about a country in the Middle East to report on what life is like there; another,

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13 This question was added after I related to Bob Hill my observation that students did not seem to be aware of the sources of the information they were finding on the Internet.
the final project for the class, asked students to create a monument which will “demonstrate, commemorate, or memorialize an aspect of human nature or an issue which is important to the world.” Project topics, within the bounds of a particular unit of study, were chosen by students, and they involved research using both the Internet and traditional print materials.

Over the course of several days in the classroom, I observed students conducting research for one project for their unit on the Middle East. Their assignment was to “conduct some research about life today in a Middle Eastern country,” in preparation for an oral presentation to the class of what they had found. They were encouraged to use visual aids of some sort in support of their presentation. The complete handout which introduced the assignment is reproduced in appendix C.1. The assignment enumerates a set of questions and topics which might guide a student’s research. These range from simply factual, such as the form of the government, to the analytic, “how does religion impact society in your country?”

After the students had chosen working groups of two or three students and selected a country to research, the students set to work. On this day, the class split, and several students received passes to go to the school library, while others moved to the computers in the back of the room. With five computers in the classroom with Internet access,

In Netscape Navigator, their web browser, a button labeled “Internet Search” takes you to one of the major Internet search engines, which allows keyword searches of the entire Internet. It was primarily through this mechanism that they conducted their research on line.

These searches can be characterized by iterative series of steps. First, the searches began with some definition of the topic at hand. Second, these concepts were used in the specification of keywords to be entered in the search engine. Third, the list of returned “hits” were scanned for relevance and one was selected. Fourth, the selection was scanned, and if it was found to be appropriate, it was printed for later reading and note-taking. Then the students either returned to the list of

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“hits,” or entered a new set of keywords for the search engine. An analogous series of steps could be used to describe the students’ research using print materials.

4.4.1 Choosing whether to go on-line

Student research involved both on-line searches of the World Wide Web and traditional library research using paper resources. In part, this was a mandate of the assigned projects: Mary Gillespie initially required that at least two of the sources to come from on-line resources. Beyond that requirement, students were free to choose from the Internet resources available in their classroom, and texts and indices to other print media in the school library. By mid-year, this requirement had become a non-issue. Students needed no explicit reminder to look for on-line resources. Students took responsibility for choosing when to use one or the other.

So if we wanted to, we could go back and search in the computers for information that we couldn’t find in the library. So if we wanted to (inaudible) we could just stay in the library, or we could go to the Internet, see if there was anything and if there wasn’t, then we could go back. It was up to the student what we wanted for research. So we’re not forced to use the Internet, and we’re not forced to use [the library].

By the time we interviewed students at the middle of the school year in January, students had become sophisticated about choosing sources for their projects. One student’s response to the question of whether she preferred to use books or the net for research was this, “If you know what’s good for you, you’ll use both.” In the sections below, we detail some of the factors in the students’ decisions to go on-line.

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15 Resources in the library included several volumes of the CIA World Fact Book, Facts on File, several atlases, the Reader’s guide to periodical literature with archives of the major weekly news magazines, and on-line catalogs of both books held locally and books at the town’s public library, located in the center of town a few miles away.
4.4.2 Ease of learning and ease of use

How did students make this choice? In part, students chose to conduct research online because it was easier.

It’s easier to get and it’s easier to — instead of going through books and picking out little bits of information, it’s all right there.

Students could cycle much more quickly through the iterative steps of selecting, defining, searching, and refining their queries online. In the case of the Middle East research project described above, students beginning with a vague topic were able to discover and focus on specific and timely contemporary subjects.

I watched one group begin by entering ‘Kuwait’ into an Internet search engine. After scanning several of the resulting hits, they came across a timeline of events in Kuwaiti history. Following that link to its end, they returned to the search engine to look for more information about one entry in the timeline, an epidemic in 1377, which lead to the Centers for Disease Control, which included the latest report of the CDC on the Persian Gulf War Syndrome. In the course of five minutes, these students had spanned 600 years of history. With a little prodding from their instructor, they had focused their research onto an extremely timely subject.

Furthermore, traditional research tools are a stumbling block to many students. In one poll, nearly 3/4 of computer using teachers surveyed said that with computers, they could expect their students to do more.[OTA, 1995] On-line searches are easier, and therefore the students can be more productive.

I followed another group to the library during one research session the same week. The most active member of the group decided to focus on Israeli Palestinian conflicts. Having decided that magazines, being current, would be more useful than books, another group member set out to search the index to periodicals. At one point, he looked up from a volume dated March 1995. Perusing the subheadings under “Israel,” he asked me whether the cross reference entry, “Israel Arab War 1967-,” referred to the year of publication or to the year of the event. When he did locate relevant entries, many of the listed serials were not available in the school’s library.
4.4.3 Multimedia

The majority of the content ultimately found by the students online or in print was textual, however, rich visual layouts aided their navigation and sustained their interest. In focus groups, students described video as engaging, but harder to work with.

It’s like trying to talk about something that you haven’t done or you haven’t seen, and then experiencing it. Like the Internet, it’s like, I know what’s really going on. I know about the people, I know, I see videos on what’s happening. If I’m looking in a book, I don’t see any of that.

Another feature of online research which receives a great deal of popular attention is the abundance of non-textual material on the Internet. No longer are students restricted to dry textbook presentations. They can instead choose from graphics, animation, sound, and video. In practice however, the vast majority of the content that these students drew upon was text complemented by still graphics.

Part of the reason for this is that the technology, even in this well equipped classroom, is still immature. While the display of still graphics occurs transparently without any user attention, the technologies for displaying dynamic media are still evolving and there exists multiple encoding standards and playback schemes. At the time of the study, playing video or sound clips required some extensions of the basic web browser to be installed, and require delays of between several seconds and several minutes. As we describe in appendix A, this is becoming less and less true.16

Furthermore, most students seemed to use their class research time to find and quickly scan sources for later study. Typically, students would make a few notes onto paper, or they would print a copy of the page to read later away from the computer. Printouts of still graphics and text are easy to take home with you. Moving images and audio are both time consuming to review, and cumbersome to take away with you. Even with the easier access to video material provided by new

16The Windows 95 operating system is bundled with a Microsoft’s web browser, Internet Explorer, which is integrated with the Microsoft utilities for playing video and audio in a variety of formats without special hardware.
operating systems and software, reviewing a real-time recording takes far more time than scanning text.

Where I did see students did take advantage of the graphical capabilities of the Web, equivalents sometimes seemed to be just as readily available in the school’s library. For instance, several of the groups downloaded and printed maps and scenic images from the Web for their Middle East research. So why use the Web for research? While a map of one of the countries chosen by the students might have as easily been found in the school library along with some basic geographical and political facts, it is likely that that is all that they would find. But through the web, the students could find a wide range of diverse current sources, many originating from the country itself.

4.4.4 Contemporary and diverse on-line content

Students cited the scope and the currency of on-line sources as their primary motivation for searching for material there. Students looked on line for material that was up to date. In several interviews, students described books as good for an introduction, but limited in scope and always far out of date. In contrast, on-line sources were described as current and comprehensive.

Some things you’re just not going to find in the library. So when there are things that are new subjects. Like Hubble — almost all of the books in the library are from the seventies or earlier and you won’t find anything about Hubble in there because it’s not updated. But on the Internet you can find lots of information about Hubble.

We wanted something on women’s rights in Ghana and we couldn’t find it in the school library. But a lot of other people have [found useful information on the Internet].

Where sources in print on a topic were available, students recognized their value.

... I mean, you can learn a lot from computers rather than from books, but I think books go more in depth than computers. Computers are good for visuals and I mean, multimedia kind of activities rather than written activities. If you want to show a video or some pictures, or whatever. That’s what my computer is good for.
Despite this wealth of sources, there are still clearly topics and areas which are not well covered by sources on the net. While there is a wealth of “live” information on contemporary events at hand on the Internet, some historical information is harder to come by. On-line research perfectly suited a study of contemporary events in Africa, which coincided with the execution of prominent writer and activist in Nigeria, and a firestorm of international criticism.

...we can look up things that were in the news recently, just on the Internet. It’s much easiter to do that instead of looking in books.

For another project on ancient civilizations, the students struggled to find anything of relevance on the net. The resources available on the Internet are tools that suit some tasks better than they suit others.

A final distinction between on line and print resources concerns the authorship and reliability of sources on the net. Unlike sources in the library, which undergo several levels of screening before they reach students, anyone is free to post information, opinions, or misinformation on the Web. When I asked students during one search session to name the authors of the information they found during their search, they responded with mostly blank stares.

The teaching staff has not ignored this issue. One of the early units in the school year was a “suitability unit” which examined questions of point of view, and dealt explicitly with questions of authorship and authority. As this most recent project was introduced, Bob Hill called attention to the reliability of sources on the net. What they have not done is to integrate this analysis into the process of conducting research on the Web.17

4.4.5 Adaptations of student work practice

At each of these stages, there is the potential for students to stumble. In that sense, research on the Internet is no different from research using traditional reference materials. For instance, the choice of overly common keywords in Infoseek results

17This discussion was part of the impetus for Bob Hill to introduce the authorship questions explicitly into the media stations assignment (appendix C.2).
in the return of thousands of hits, which it will not display. Some of the students interpreted this as a malfunction of the search system, rather than as a hint that they should narrow their search. At the next step, students were more or less adept at selecting hits to pursue. When a site had been selected, network errors often stopped searchers before they had begun. The final common obstacle was the recalcitrance of the printer. While saving the files is not difficult, printing the files immediately is more rational for students whose only access to the computers is during class time.¹⁸

Furthermore, most students seemed to use their class research time to find and quickly scan sources for later study. Printouts of still graphics and text are easy to take home with you. Moving images are more difficult to browse, store, and view, and are impossible to print.

The configuration/sharing of the computers in the classroom limits some ways of using the system. Since the computers are shared, there is no guarantee that the computer you are working on today is the same one you will be working with tomorrow. Most software, including Netscape, is designed for use by a single user on a dedicated machine. Features such as Bookmarks in Netscape, which record the network address of a site you have visited, have much less utility when you are not assured of returning to the same machine. The alternative, saving and later recalling information from a disk, requires a certain sophistication with the computers that only some of the students had.¹⁹ On the other hand, displaying and printing the material directly requires only that the user click on the appropriate buttons.

The final common obstacle was the recalcitrance of the printer. While saving the files is not difficult, printing the files immediately is more rational for students whose only access to the computers is during class time.²⁰

¹⁸ There are four networked Macintosh computers and one networked PC in the Global Civilizations classroom. Several more public Macintosh computers are available in the library.
¹⁹ For instance, in one case, the student teacher, Bob Hill, walked a student through the steps for copying a segment of text from Netscape into a word processor, so that just part of the source material from the Web could be printed. Furthermore, saving the entirety of a page on the Web which is full of graphical information often requires multiple steps, some knowledge of the Web formatting language HTML and some file manipulation skills. Selecting “save” in a browser only saves the text of the document, with references to each graphic component.
²⁰ There are four networked Macintosh computers and one networked PC in the Global Civiliza-
Use of templates to guide students, fill in the blanks…

4.4.6 Research strategies and information overload

In the literature on user activity in hypermedia presentations, researchers have delineated a range of user search strategies. They describe users who navigate more or less purposefully: browsing haphazardly, gathering facts, or seeking solutions to a larger abstract question. However, these studies have looked only at self-contained hypermedia presentations, which have been *authored*. In contrast to these neat worlds of exploration, the World Wide Web presents the user with no well marked paths to explore, and no carefully edited list of relevant topics. Users are forced to sift through a large quantity of material before finding appropriate sources.

It is this feature of information overload that Mary Gillespie sees as the biggest change that has occurred as a result of using the Internet for on-line research. Whereas students used to print the one relevant entry from the CD-ROM encyclopedia in its entirety, students are now forced to read, consider, and select from the many results to their queries. As one student said,

> Sometimes you find so much information it’s hard to really narrow it down.

However, the teacher has found this to be one of the most effective tools for teaching her students how to do research. Almost immediately, they are forced by the volume of available resources to cull information selectively.

And say that they had a topic related to Latin America, and I would say previously that they might go to the library and they might download something from the encyclopedia and they would run off 9,000 pages and then not read the material, and then put it all together and hand it in. Right. Punchholes in it and hand it in.

> what I have found that has been most useful and I don’t even think they realize it, but they have to select what they are going to download. I mean they’re not going to download the whole thing, so they have to read the document or listen to the document or whatever, and then select what they would like to download and use …for their documentation
in their project. ... I don’t even think they realize how much more they are doing, than going to the library and downloading the whole thing and then just handing it in. They have to be selective. They have to go to CNN or whatever, they have to go to the archives, they have to go use the technology we have available in the room, and then select what they want to include in their project.

So for teaching students to conduct research, a failing of the system — the explosion of material that occurs with unsophisticated full text searches on the Internet — has become its most notable pedagogical feature. 21

4.4.7 Composing reports: creating multimedia documents

As we described earlier, these projects took many forms. Most involved the creation of documents which included text and graphics. In the first year of the study, students used HyperStudio 22 to create hypermedia presentations of their reports.

In the second year of the study, the teaching staff used word processors to create custom “applications” for their students. Using Claris Works, one of the teachers created templates for student reports which provided a framework for the students report, including place holders for an introduction, supporting details, headings, and graphics.

4.4.8 Peer collaboration

When the teachers allocate class time for computer research, each section of approximately 20 students must share the use of the five computers in the classroom. Even after splitting the class so that some students go the library, it is common for two or three students to share a computer. This is encouraged by the assignment of group projects. The student who is not “driving” the system often contributes by suggesting links to follow, offering trouble-shooting advice on how to operate the system, or suggesting which items should be printed. Furthermore, even where

21 Of course, this feature of searching is not unique to on-line research. However, because on-line searches can yield nearly instantaneous retrieval of vast quantities of information, students run into this problem much more quickly.

22 A hypermedia authoring tool similar to HyperCard.
students each have their own computer to work with, searching on the Internet is marked by a great deal of interpersonal exchange. “Look what I found,” “where are you now?” or “how did you get there?”

Discussion in class on May 3, 1996: students argued that their time was spent more productively in the library, one student said that when they were at the computers, “we spend our time talking.”

While these groups have placed the students in the role of “peer collaborators,” they have been less successful in harnessing the skills of the few students who have a great deal of expertise in using the computers. Because it is a mixed ability level class, where differences in track are emphasized by differences in race, there is some tension between the computer savvy students and their less enthusiastic counterparts. It would be a challenge to create a position for these “student experts” which did not create resentment from the other students. However, while their direct help is not actively recruited, it is clear that they have contributed to keeping the computers up and running in the class.

Furthermore, in reflecting on the role of technology in their classroom, students seemed wary of the possibility of computer use as an isolating force.

But if you used it every day for every single class, why even go to school. Just go home and take your classes. There wouldn’t be any point.

If the example of the study classroom can serve as a guide, they need not worry; class time devoted to independent use of the classroom computers fostered more interaction, not less.

4.5 The role of students: active partners in implementation

Some students have recognized the value of Internet CNN Newsroom for their academic work outside of Global Studies. The teacher supports this interest by printing the guide for each day and compiling them for interested students.
... when I don’t show it, right, I always bring up and print out one copy of the guidelines. And I have seen the kids go to it and look at the guidelines to see what was in there, if it would relate to their science course. If it would relate to other courses. So they will refer to it. They know it’s there and that I have it in the pile, you know, the weekly pile. And so they can use it and upon occasion I’ve seen them when they you know want to use it for their science course. So then they can go to the archives and say OK on January something or other they had something on this in the science section.

Students have been responsible for some diffusion of this innovation to other classrooms in the school. Eager to use the technology for other courses, they have promoted the system by using it for other classes.

Yes, I’ve showed it to people within the social studies department, but I am aware of the fact that people in the science department are very much aware of what is going on, only because of what some of the students have brought up.

Students have taken an active role in the introduction and support of computers in the classroom. A few of the students in the first year of the study were also members of the school computer club, and also helped to maintain and administer the school network. The club also offered workshops for teachers on creating documents for the Web. On a day to day basis, students helped each other resolve the usual range of printing, saving, and network difficulties.

4.6 Summary findings

Over the course of several months, we documented multiple uses of network technology in the classroom. Although the class still faces a variety of technical glitches on a daily basis, the technology has achieved a level of transparency in this classroom: as a tool for doing work, it has “disappeared” as one of many available tools.

One instance of this use was teacher directed viewing of news videos using Internet CNN Newsroom. In this case the technology was used to make a familiar use of video material in the classroom easier to plan and manage.

With that experience, teachers were able to extend another familiar use of media in the classroom, directed student research at Media Stations. By searching for
sources on the Internet and in the archives of Internet CNN Newsroom, teachers were able to extend these Media stations to include primary sources from foreign governments and multimedia sources with video material from around the world. Teachers developed lessons specifically aimed at addressing questions of authenticity, bias, and reliability to deal with the challenges of information on the Web.

With the experience of conducting these searches themselves, teachers were able to guide students through independent research projects. With the increased productivity of gathering information on the Web, the course was able to emphasize projects in the coursework. Teachers developed schedules for class time which allowed individual students to work on computers for extended periods of time.

Students grew to be familiar with research on the Web. By mid-year, they recognized the relative advantages and disadvantages of on-line research and were making choices about media based on this knowledge.

Students developed ways of working with the technology which were adapted to the unreliability of the Web and to their limited access to computers. They also drew on each other for support, and provided technical support for the class and teachers.
Chapter 5

Analysis: Incremental Adoption and User Appropriation

In the last chapter, we documented the way Internet CNN Newsroom and the World Wide Web have become integral tools in the work of the study classroom. By expanding the scope and the kinds of resources available to the students and teachers in the study classroom, the deployment of these technologies has been successful. What factors made possible this successful deployment of technology in this classroom? We also observed that some features of the technology had gained only limited use. What factors determined the features which were actively adopted by the classroom? In this chapter, we reconsider our findings with attention to the literature on educational technology and innovation introduced in chapter 2.

It is clear that the success we observed in the study classroom took place in the context of extensive administrative and technical support. In section 5.1, I review the technical and organizational factors which provided the foundation for this deployment. I argue here and in chapter 6 that the successes of the study classroom bodes well for current plans for large scale deployment of networked computing in the schools both locally in Lexington and nationwide.

Beyond these prerequisite conditions for introducing technology into the classroom, we hypothesized the primary importance of three factors:
**Flexibility of the technology** in allowing partial or incremental implementation: *affirmed.* The technologies which were chosen by the teachers for implementation were well suited for the study classroom in this regard. The flexibility of the technology allowed incremental adoption of the technology, and allowed for gradual integration of the technology into the lesson plans and work practices of the class. In section 5.2 we describe how the technology built on the existing expertise of the teachers with other media and technology and enabled them to easily assemble on-line resources for class.

**Active role of students and teachers** in adapting the technology to serve their needs: *affirmed.* We found that the students and teachers did play an active role in creating educational uses for the technology, and adapting it to their own needs. From the outset, the selection, acquisition, deployment, and use of the technology in the classroom was driven by the curricular goals of the teachers. The day to day choice of whether to use on line resources for school work was made by students. In section 5.3 we revisit specific instances where students and teachers adapted their classroom practices to take advantage of the available technology and, conversely, instances where they selected from technology to suit the demands of their work.

**Suitability of the technology** for satisfying an existing curricular requirement of the course work: *inconclusive.* The most common modes of use of the classroom technology, viewing Internet CNN Newsroom as a class and searching the World Wide Web for independent research, were congruent with existing curricular demands. We also observed instances, such as the introduction of a “suitability” unit to look explicitly at the reliability of source material, where the features of the technology drove the expansion of the curriculum. With more extensive professional development and other resources available for the teaching staff, some other features of the system, such as student searches of the news archive, are likely to have received more attention in the study classroom. In section 5.3 we suggest ways that these uses could be expanded.
5.1 Prerequisites for technology integration

Each of the factors that we posit as primary in our hypothesis address a feature of the technology or of the primary users of the technology, the teachers and the students. In this study, unlike much of the policy work on technology in education, we do not focus on the organizational and technical conditions which form the context for the kinds of activities described in our findings. However, we observed a level of technical and administrative support congruent with most of this literature.

In this case study, the educational use of technology in the classroom was driven by the demands of an innovative curriculum and enabled by administrative and technical support within the school. Consistent with prior research (e.g. [Means and others, 1993]), this “successful” deployment \(^1\) included

**clear curricular objectives:** The creation of the Global Studies course at Lexington High School reflected an ongoing effort to reform the Social Studies curriculum, by increasing project based work along with alternative assessments, by increasing the study of non-western cultures, and to introduce current affairs and interdisciplinary study. The World Wide Web in the classroom, along with Internet CNN Newsroom, has broadened the scope of materials available to the students and teachers for research projects and teaching resources, and has increased their productivity.

**administrative and technical support:** The teachers in the study classroom are respected senior members of the teaching staff, and enjoy the support of the school administrators and the district technology coordinator. The class serves as a showcase for visitors to the district. Technical support staff in charge of managing the district-wide network are located on campus. The student teacher and several students have also contributed technical support to the classroom.

\(^1\)Linking the use of educational technology with educational outcomes is beyond the scope of this study. Our metrics of success are student and teachers perceptions of the effectiveness of the system as expressed by their frequent use of the system and by their positive statements about the technology.
flexibility in scheduling: The joint scheduling of the course with an English section allows for double class periods, where students can work on projects uninterrupted. Full time staff oversee the school library, making it possible to split the class by sending students to work in the library.

flexibility in curricular objectives: Being the only high school in the district, and not bound to rigid state requirements, the teaching staff enjoys some freedom in setting the topics and assignments for the course.

time for planning: The senior social studies teacher in the study classroom was also district social studies coordinator for grades K-8. During both study years, she was also assisted by student teachers, who helped to develop lesson plans and to maintain and support the computers.

ready access to computing facilities: Five computers with direct, high speed connections to the Internet are available for the exclusive use of students and teachers in the global studies class.

With this single case, we showed that the conditions which existed at Lexington were sufficient for the uses which we observed. But from this single case, we cannot conclude that these conditions were necessary, or conversely that even more support and resources would not have improved outcomes further. On the other hand, as we argued in chapter 2, the conditions which framed the introduction of technology in this classroom are becoming increasingly common as schools and districts prepare to invest increasing amounts in computers and networks.

While Lexington as a district and this classroom in particular are better equipped than the vast majority of classrooms, this classroom was not simply flooded with technology. Unlike the model schools developed through recent private/public partnerships such as the Christopher Columbus school in New Jersey, or the technol-

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2Massachusetts is scheduled to define “curricular frameworks” for each subject area. At the time of this writing, the curricular frameworks for Social Studies had not yet been released. An explicit task set out in the Lexington Technology plan is to review software requests to ensure that educational technology is used in support of these frameworks once they are available.

3See [Gingold and McKnight, 97,forthcoming] for a current analysis of key issues in deploying
ogy immersed schools of the Apple Classrooms of Tomorrow [Dwyer et al., 1991], the technology in this classroom was acquired piecemeal over several years, without the oversight of a large corporate sponsor.

Planned deployment of network technology in Lexington calls for gradual introduction of networking infrastructure and hardware across the district over five years. The plan is driven by a desire to expand and reform the curriculum. It explicitly sets aside resources for technical support and curricular development.

In Lexington and elsewhere, this strategy is the result of both fiscal constraints and prudence. As we discussed in chapter 1, Lexington’s plan is in many ways typical of plans being made across the country. From the case of this classroom, we argue that these plans are on the right track.

In the study classroom, the incremental growth of resources and capabilities in the technology was accompanied by incremental adoption of the technology by the teachers and students. In the sections which follow, we identify the patterns by which this integration was achieved. We identify what other factors played a role in facilitating this integration.

5.2 Entry strategies: Incremental adoption of a flexible technology

Deployment of Internet CNN Newsroom in this classroom was facilitated by the possibility of incremental integration of the system into classroom practice. In this section we look at three factors which made this possible.

First, the technology built on the existing expertise of teachers with other related technology and with other media. As they gained familiarity with the new technology of Internet CNN Newsroom, they were able to leverage that knowledge in developing uses for the World Wide Web in the classroom.

Second, the technology of the World Wide Web, upon which Internet CNN
Newsroom is built, is a flexible technology which lends itself to “tailoring” and adaptation by its users. While there is little guidance available for teachers about how to structure the wealth of available Internet resources into a lesson plan, there is accordingly little which interferes with a skilled teacher’s assembly of these resources into a package which is perfectly matched to their curricular goals. Furthermore, the use of Web browsers such as Netscape as a common interface to all of these resources reduces the learning curve for new resources.

Third, access to the technology was flexible. With five computers located within the classroom, teachers could decide on a daily basis whether to devote class time to using computer tools. With more computers located in the library, students had the opportunity to decide by the minute whether to use print or on-line resources. For both teachers and students, technology was a choice based on their needs, rather than a mandate.

Note that the sequence of development in the study classroom does not simply follow the modes of use described in chapter 4. That is, the use of Web resources for independent research developed alongside the use of Internet CNN Newsroom as a video on demand system for class presentation. On the other hand, learning to use of one of these components transfers in part to others. For instance, the use of Internet CNN Newsroom footage as a resource for media stations (section 4.3) built on a teacher’s familiarity with Internet CNN Newsroom content as a source for classroom presentation.

5.2.1 Building on teacher expertise

The classroom technology of Internet CNN Newsroom and the World Wide Web allowed the teachers to build on their existing experience with media and technology. In particular the teachers drew on their experience with CNN Newsroom on video, with using computers to create multimedia presentations, with on-line searches of CD-ROM data, and with using print news sources to supplement classroom resources. As we discuss in more detail in section 5.3, they selected from the available technologies to further their educational goals.
In creating the media stations that we described in section 4.3, the teachers collected current news reports and official documents from a variety of sources. This collection included articles and government documents found and accessed through the Web, video clips from Internet CNN Newsroom, and articles from print sources. The adoption of Web sources for these lessons allowed teachers to easily introduce video material and a wider range of news and government sources.

The classroom computers were purchased in 1994 with a grant to introduce multimedia project work into the study classroom. At that point, the tools available included multimedia authoring tools and word processing software. However, without networking in the classroom, source material was limited to a few CD-ROM resources in the library. The sources for images and sounds available on the Web have filled that need in the study classroom. Their experience with on-line searches with CD-ROM and with manipulating multimedia data has made this migration easier.4

CNN Newsroom was also introduced in the study classroom by video tape before the introduction of networked computers. With network access, the teachers have been able to increase their use of CNN Newsroom just as it had been used before, with a decreased cost in terms of planning overhead required. Furthermore, the search facilities of Internet CNN Newsroom provided a known quantity for the teachers as a starting point for exploring full searches of the Web at large.

By making access to resources outside the classroom easier through the Web, classroom network technology has made it easier for the teachers in the study classroom to develop lessons for their class. The technology has leveraged their experience with teaching with print and videotape materials, to create a point of entry for computers in the classroom. Although their tools were new, the tasks of selecting, compiling, and guiding students through a set of source material was largely

4Mary Gillespie, the senior social studies teacher for Global Civilizations in Lexington, has actively campaigned against purchasing more CD-ROM titles for the library. Although they make use of the computers, they suffer from many of the same faults as paper references: they are narrowly focused, limiting their utility in the classroom, and quickly become dated. As we described in chapter 4, working with multimedia source materials for independent research projects was cumbersome.
5.2.2 Tailorable technology

In section 5.2.1, we argued that the technology allowed for uses which were familiar to the teachers and which built upon their prior experience. The technology also allowed teachers to selectively adopt features and capabilities in the classroom. The use of generic "tool" software such as web browsers and word processors rather than domain specific content-rich course-ware, has enabled the teachers to customize their technology resources for the needs of their classroom.

Using the World Wide Web and a variety of web search engines, teachers were able to assemble customized and current sources for their students. In chapter 4 and appendix C.2 we described one example of this for a lesson on the return of Hong Kong to the control of China. A common interface and infrastructure for accessing information on-line, i.e. Web browsers and the World Wide Web, have shortened the learning curve for users, and have made it simpler for teachers to find and gather these materials. Students are not the only ones who benefit from on-line tools for research.

Once teachers had located these resources, "bookmarks" in Netscape\textsuperscript{5} made it easy for teachers to assemble these sources for their students. Using ordinary word processors, the teachers created templates for students to create multimedia documents.

As well as being selective about choosing from the available resources on the Web, teachers were selective about adopting features of the technology tools. With Internet CNN Newsroom, the lead teacher immediately began using the system to play current news segments for her entire class. Several months later, they and their students explored the archive of past news stories. Even without use of the full feature set, there were immediate payoffs for the student and teachers.

\textsuperscript{5}or equivalently, "Internet shortcuts" in Microsoft's Internet Explorer.
5.2.3 Flexible access

The technology in the study classroom was dedicated to the class, available for the students during every class session and available to the teachers during each planning period. The flexibility described above in using the systems followed from dependability in access to the systems.

As we described in section 4.2, easy and dependable access to both the source material and the presentation hardware facilitated more frequent use of CNN Newsroom in the class. It decreased teacher planning time required to include CNN Newsroom in a day’s lesson, and decreased the overhead of class time required to secure and set up video hardware.

Through the study period, the students in the global studies course shared 5 computers with Internet access. With roughly 15-25 students present in class in each section, the ratio of students to computer ranged from 3:1 to 5:1. As a result, two or more students frequently shared a single computer. But as we described in section 4.4.8 and revisit below in section 5.3 there were some benefits to students sharing computers. In particular, they were able to help each other deal with technical glitches and deadend links as they browsed the Web. Furthermore, with the flexibility to divide the class and send students to work independently at the library, there were even fewer students in the room sharing the computers.

This is not to say that there was never a need for more time with the computers. Although access to the computers was dedicated, it was limited to a part of the time that students were in class. Some students also had some opportunities to use the computers during free study periods, or before and after school. Still, unlike most business users of network applications, access to network computing was limited for most students. As we discuss in the next section, this was significant and was reflected in the ways that the students worked with computers.

Less than half of class time was devoted to student use of the computers. With a space for the computers in the back of the room, separated from the usual rows of desks, the computers were available on demand but did not interfere with other kinds of classroom activities. There was enough open space in this back area that
there was room to rearrange furniture to suit the needs of the class. Students could move several chairs around a single computer or stand in a group to look at what was displayed on one screen.

Finally, the use of computers was a choice made by teachers and students. The use of these systems was driven by users, rather than by a strict requirement of a sponsoring organization or by a mandate of the school administration. By winning a grant from a local educational foundation and signing on as a pilot classroom for Internet CNN Newsroom, the teacher acquired the technology tools that she wanted to expand the range of source materials in her classroom. Given the tools, the skills, and the latitude to make this choice, the students chose from the Internet, Internet CNN Newsroom, CD-ROM, and print resources to complete their schoolwork.

5.3 Patterns of use: user appropriation

Students and teachers have played an active role in the adoption of the technology in the classroom. In this section, we revisit specific instances of where they adapted their classroom practices to take advantage of the available technologies and, conversely, instances where they selected from the available technology to suit the demands of their work practices.

From the first introduction of computers in the classroom achieved with the help of a grant from a local foundation, the teachers have played an active role in selecting technologies for the classroom. These choices, to introduce hypermedia authoring tools, email, CNN Newsroom, and web browsers into the classroom were the result of conscious efforts to expand the curricular focus of social studies to include more project work, more current events, and more attention to non-western cultures. (See appendix B) They have taken advantage of these new tools to broaden the scope of student project work, and have used these tools to develop curricular materials for their lesson plans. Lastly, they have begun to develop strategies for dealing with limitations of the source materials.

The students received some training from the teachers on how to use the class-
room technologies. As we detailed in section 5.2.3, the students also enjoyed access to dedicated equipment in the classroom and were empowered to choose whether or not to use on-line resources for their tasks. Given that freedom, students developed a certain sophistication about media choice, recognizing that print and on-line resources offered different and complementary advantages and disadvantages for their work. Furthermore, the students developed work practices which reflected the capabilities and limitations of the technology, their access to the technology, and the context of their work in a community of peers.

Table 5.2 and 5.1 a summary of technology features and work practices of the students and teachers which we observed in the study classroom. In it, we attempt to identify the directions of causality, that is, whether a feature of the technology drove the adaptation of work practice, or whether existing work practice drove the selection and adoption of a technology feature. In the remainder of this section, we discuss each of these points in turn and discuss those features of the technology which were not frequently used in the classroom.

<table>
<thead>
<tr>
<th>Technology feature</th>
<th>Student work practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>flexible scheduling and full time availability of computers in class</td>
<td>student choice of media and technology sources for project work</td>
</tr>
<tr>
<td>limited access to computers outside of class</td>
<td>adaptations of work for &quot;off-line&quot; work</td>
</tr>
<tr>
<td>student:computer ratio of greater than 3:1</td>
<td>adaptation of roles for group work at computers</td>
</tr>
</tbody>
</table>

Table 5.1: Elements of student adoption, adaptation, and appropriation of classroom technologies in the study classroom. The left hand column lists features of the technology and the right hand column lists corresponding action or adaptation of work practice. Arrows indicate direction of causality, i.e. left to right indicates that attributes of the technology drove changes in work practice, right to left indicates that existing practice drove selection or adoption of a particular technology feature.
Table 5.2: Elements of teacher adoption, adaptation, and appropriation of classroom technologies in the study classroom.

<table>
<thead>
<tr>
<th>Technology feature</th>
<th>Teacher work practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>availability of current news</td>
<td>broadened project scope</td>
</tr>
<tr>
<td>unreliability of network source material</td>
<td>development of “suitability” unit</td>
</tr>
<tr>
<td>information overload: flood of available resources</td>
<td>teaching about selection of source materials</td>
</tr>
<tr>
<td>unreliable network access</td>
<td>pre-loading of video material from the network onto local disk storage</td>
</tr>
</tbody>
</table>

5.3.1 Teachers’ local development of materials

As we argued in section 2.1.1, the Global Studies course reflects changes to the social studies curriculum across Lexington, and changes across education nationally. The computers in the classroom were introduced with the explicit intention of enabling students to create hypermedia presentations in addition to traditional written reports. The introduction of the World Wide Web in the classroom supported the increased focus on project work by the students by reducing the time required to locate information. The introduction of CNN Newsroom in the class, first through videotapes and later through the Web with Internet CNN Newsroom, was an effort to increase the students’ awareness of current events.

The teachers have used the Web to compile resources for own lesson plans. Using the search capabilities of the Web at large, through commercial search engines, and the search capabilities of the Internet CNN Newsroom archive, the teachers assembled diverse sources from foreign and U.S. government sites, news reports from CNN and other major news sources, and paper resources such as magazines and books. As they had collected books to place on reserve for units in the Library,
teachers are now able to compile lists of web sites. The teachers have used the
bookmark facility in Netscape Navigator as a simple way of providing access to all
of the sources that they find for their students.

Using word processors, the teachers created templates for the students to work
from. These templates provided structure for the students’ writing, and step by step
instruction on how to follow up. So in addition to compiling curricular materials,
the staff has created their own custom tools for students to create class projects.

In response to unpredictable network performance, the teaching staff would “pre-
load” the day’s video segments, to reduce the effects of jitter and delay in the network
on video quality. In one instance, when the segment was to be played repeatedly
as one station of a series of media stations, the teacher recorded the segment onto
video tape, to eliminate reliance on the computing infrastructure altogether.

In response to the flood of information on the Web, much of which is irrelevant
or unreliable, the teaching staff has responded in two ways. First, they developed
a “suitability unit” to teach students to consider questions of authorship, bias, and
reliability. These lessons were reinforced later in the year in the Hong Kong lessons
(see section 4.3 and appendix C.2). Second, they celebrated the increased demand
on students to be thoughtful about selecting from the available sources. Now that it
is easier for students to find resources, it is harder for them to decide which sources
are worthwhile.

5.3.2 Student work practices and classroom organization

As we described in chapter 4, a few students have played an active role in main-
taining and supporting the technology. They have helped to upgrade software on
the computers, have provided on-site troubleshooting, and have acted as evangelists
for the technology outside the class. In addition, the students have developed ways
of working which take advantage of the capabilities of the system and which work
around its limitations.

First and foremost, students have become sophisticated about the choice of
whether to use print or on-line resources. In focus groups and in classroom ob-
servations, students voiced preferences for one type media over another on the basis of the kind of content they were seeking. As one student remarked, “if you know what’s good for you, you’ll use both [books and computers].”

Their style of work with the web reflected their access to the technology. Although the computers were dedicated to the course, their primary access to the Internet was limited to class time. So instead of bookmarking sites, and reading their content on-line, students printed the pages to read away from the computers, and away from class.

Students were encouraged and sometimes required to work together in groups. With a limited number of computers in the classroom, students often used the computers together in groups of two or three. In those cases, students would assume different roles in their work in front of the computers. One instance of this was that one student would “drive” the mouse and the keyboard, while another took notes, and another would retrieve and review printouts.

5.3.3 Potential expansion

Despite these successes, the class made limited use of some features of the system. In particular, the archive search capabilities of Internet CNN Newsroom were used infrequently by students for independent research. The teaching staff did make use of the Internet CNN Newsroom search to assemble materials for Media Stations.

A few of the students did use the Internet CNN Newsroom search for research projects, but most of the student research that we observed in the first year of the study used Internet-wide search engines. We can identify reasons for this in the form and content of material on CNN Newsroom. For many of the student projects that we observed, what students might have found on Internet CNN Newsroom would probably not have been useful.

Limitations of the content: Like CNN, the stories on CNN Newsroom are predominantly “Headline News.” To fit the time constraints of television news, each story stands alone and goes into little depth on any particular topic. News stories by definition emphasize new events, rather than analysis of the
history or background of events.

**Limited integration:** Unlike other sites on the web (including the CNN site), stories on Internet CNN Newsroom stand alone, i.e. its stories contain no links to other sources on the Web.⁶

**Difficulties of video:** For individual research projects, video material offers few advantages: it is more cumbersome to browse, save, print, and store.⁷

There are a number of ways that this content could better suit the students project work.

**Development of news specific projects:** The Hong Kong Media stations lesson described in the last chapter is one step towards this goal. The course could also include more study of the evolution of news coverage over time. One recent example would be to follow the coverage of the major presidential candidates over 1996, and to correlate that coverage with their relative standings in the polls, which is also available on the web at [http://www.gallup.com](http://www.gallup.com).

**Integration of search facilities:** It would be relatively easy to create a common user interface which initiated searches of several Internet-wide indices and the archive of Internet CNN Newsroom.

**Annotation of CNN Newsroom stories:** As it is done for CNN articles on the Web, CNN Newsroom stories could include links to other sites on the Web, selected by the authors of the program guide.⁸

In the second year of the study, the senior teacher in Global Civilizations reports that students in the classroom have been using Internet CNN Newsroom for their projects more frequently than in the past year. She attributes this primarily to her increased familiarity with the capabilities of the archive. So perhaps a well designed

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⁶Recently, the format of these program guides was revised to include a pointer to more information on the Web with summary for each story in the program guide.

⁷Students might be looking for video material to include in their reports. While we observed students including graphics in their work, we did not observe students including video material.

⁸See appendix D for an example of a recent program guide which includes these sorts of links.
training seminar, would be more useful than any restructuring of the content or curriculum.

This reinforces one of our primary hypotheses: that putting technology to use in the classroom requires the creative adaptation of that technology to the local environment. No one is in a better position to do this than the teachers and students.
Chapter 6

Conclusions and
Recommendations

We found that networked applications, including Internet CNN Newsroom and search engines on the World Wide Web, became integral tools in the work of the teachers and students in the study classroom. In the last chapter we identified two factors which were critical to this integration:

1. The flexibility of the technology in allowing partial or incremental implementation.

2. The active role of teachers and students in adapting the technology to serve their needs, and in adapting their work practice to take advantage of the technology.

In this final chapter, we draw on these conclusions to draft a set of recommendations for both technology designers building networked applications for classrooms and for policy makers and educators who are consider the implications of the deployment of infrastructure to support these applications on a wide scale.
6.1 Conclusions

Technology use in the classroom is not an all or nothing proposition. In chapter 4 we described how one networked technology, access to news through Internet CNN Newsroom, was employed to support three distinct modes of use in the study classroom. In chapter 5 we identified instances where students and teachers had taken advantage of the flexibility of the web to “customize” these applications to their needs.

Below, we summarize our general conclusions from this study.

Adoption of technology by teachers and students requires flexible and dependable access.

In the study classroom, this was achieved with a small number of computers located in the class with continuous connectivity to the Internet. Although each section of the class had roughly five students per computer, the effective ratio of students to computers was lower. With dedicated access to these machines, they were able to share these computers more efficiently than they could have if the computers were located in a cluster outside the classroom.

They were also supported by reliable on-site technical support from district network technical specialists, and by the expertise of students and student-teachers in the classroom.

Integration of technology into the classroom is incremental.

The initial deployment of networked applications was made possible by the availability of capable and suitable hardware and infrastructure, and the support of administration and technical support. The technology supported partial adoption; initial use of the system as a video on demand system mimicked what was already available through other technologies, and other features were adopted gradually as teachers and students learned more about the system.
Classroom integration requires the active participation of students and teachers.

The continuing viability of this technology in the classroom was driven by the active selection and adaptation of technology features to the needs of the classroom by the students and teachers, and by their adaptation of their work practice to the limitations and capabilities of the technology. To support this iterative development of needs and uses, the teachers also took advantage of time for planning and experimentation. Students became increasingly savvy about their choice of media for schoolwork as the year went on.

The Web as a platform for networked multimedia applications supports user learning and adaptation of content on the Internet.

The Web simplified access to network information for students and teachers by providing a common interface to all resources on the web. The use of Web browsers as a common platform also simplified the job of technical support for these technologies.

6.2 Recommendations for technology designers

Build network applications for the Web.

New network applications should build on the growing experience of teachers and students with the World Wide Web. The Web is now the standard platform for network services. Building for the web allows users to make use of their existing familiarity with web browsers and HTML. Development for the web also facilitates customization and repackaging by building collections of links and bookmarks. Designers can increase the utility of their content by also providing links to related information on the web.

Build modular applications, which allow flexible access to content.

Teachers need to tailor the available content to their specific curricular objective. Large monolithic units of study may be more difficult for teachers to integrate
into their work than small, self-contained units such as the daily study guides that accompany Internet CNN Newsroom.

**Recognize the limitations and strengths of video material**

Even with more capable network and computing infrastructure, video material can be difficult to work with for many applications. Compared to text, video and other real time media are cumbersome to scan and search. Also, tools for editing and annotating video material are less widely available and less familiar to teachers and students. On the other hand, well produced video can be a powerful way of engaging the interest of students.

### 6.3 Recommendations for policy planners and educators

**Ensure reliable and flexible access to networked computers.**

This encompasses aspects of the deployment which are not captured by simple ratios of computers to students. This study suggests that given a choice, dedicated access to fewer computers is preferable to intermittent access to a larger number of computers. In the study classroom, computers were located in the classroom, and were dedicated to the course. With the creative use of fewer than one computer for five students, the study classroom was able to make computer use an integral part of classroom work.

**Build network infrastructure with the future in mind.**

Recognize that implementation and use of technology is a gradual process. Build technology which supports immediate use for familiar practices. Build scalable networks which can grow with the growing demands of the classroom.
Support incremental adoption driven by curricular demands.

The applications in the study classroom were driven by the desire to expand the social studies curriculum in specific ways: to increase the class’s project work, to increase the attention of the class to current events, and to broaden the scope of the curriculum to include studies of non-western regions.

Recognize and support the work of technology integration.

A necessary complement to the traditional role of teachers is the work of technology integration. This work includes experimentation with technology, identification of software and networked resources, development of new lesson plans, provision of on-site technical support, and training for students and teachers. In the study classroom, the student teachers ably fulfilled many of these duties, and the lead teacher was able to do some of the rest. For most classroom teachers working alone with a full teaching schedule, such an additional workload is unrealistic.¹

Recognize, foster, and enlist the expertise of students.

Students in Lexington provided training for teachers, provided technical support during class, promoted the technology within the school, and developed new ways of working with technology. Given the opportunity, students can be a powerful force for the success of new technology in the classroom.

¹A full time position for a district Technology Integration Specialist is called for in Lexington’s technology plan. As of September 1996, this position had not been funded by the Lexington school board.
Appendix A

How to get Internet CNN Newsroom

The applications described in this thesis are accessible through the World Wide Web. Internet CNN Newsroom can be reached with any computer with Internet access and a web browser at http://www.nmis.org/NewsInteractive/CNN/Newsroom/contents.html.

At the time of this writing, most web browsers require additional software to view the video segments on Internet CNN Newsroom. The initial deployment in the study classroom used specialized hardware and software to support one of the first applications of streaming MPEG video over the World Wide Web. Now users have several commercial options for playing MPEG files (without streaming) and for streaming video. As the industry converges on a set of standards for streaming real time media over the Web, the NMIS system will migrate its servers to one of the standard systems. In the near future, it is also likely that support for streaming video will be built in as a feature of web browsers and will require no additional software or configuration by the user. In the meantime, there are several options available for viewing video over the World Wide Web.

With Microsoft’s Internet Explorer and Windows 95, the preferences need to simply be set to use Media Player to view MPEG sources\(^1\). In the second year of

\(^1\)MIME types, mpeg and x-mpeg
the study, this is how the study classroom used viewed Internet CNN Newsroom.\textsuperscript{2}

For users of Netscape Navigator, there are a variety of options available as “plug-in” software modules for a variety of hardware platforms. A complete and current list (changing almost daily) of available extension software is available from Netscape, at http://www.netscape.com/. Many of these systems can be downloaded freely over the Web.

Beyond the software support and connectivity required, users must have roughly 1.5 Mbps bandwidth to support real time streaming MPEG video, i.e. to play video as it is being downloaded. The alternative is to save entire segment to a file, wait for this operation to complete, and then play the video from disk file. With most browsers, this is a simple operation, since files which have been downloaded recently for viewing are saved locally to the disk, or “cached”, for faster access on subsequent visits.

In the study classroom, the teachers cached the stories they wanted to view during class by clicking on the stories before class. This loaded the clips locally, which could then be played immediately during class that morning.

\textsuperscript{2}This does not support streaming, but it is simple and robust.
Appendix B

Chronology

B.1 Educational Technology in Lexington High School

a timeline of the local history of technology

1992 Global Studies Course introduced

1993 Macintosh cluster acquired through LEF grant

1994 Global telecom workshop

1994 ELNA conference attendance in Argentina

1994 Introduction of e-mail into the classroom

1994 High speed Internet access at Lexington through BBN grant

1994 Introduction of WWW into the classroom

1995 Internet CNN Newsroom pilot project launched

May 1996 Town Meeting approval of first year of funding for technology plan

Nov 96 Presentation of FY 97 budget to school committee

Dec 96 Presentation of FY 97 budget to town Selectmen
Spring 97  Town Meeting approval of FY 97 school budget, including $1.2 million for educational technology

June 97  Townwide referendum on approval for school budget

June 97  Deadline for submission of Town Educational Technology plan to Massachusetts to qualify for state matching funds.

B.2  Study timeline

September 1995  Survey I: Lexington study classroom, Lexington control classroom, Belmont control classroom

January 1996  Survey II

29 January 1996  Focus Groups: Lexington study classroom

29 January 1996  Site visit: classroom use of Internet CNN Newsroom for class viewing

11 February 1996  Interview: Mary Gillespie

3-5 May 1996  Site visit: Independent research on countries of the Middle East

5-6 June 1996  Site visit: directed student research on Hong Kong

6 June 1996  Interview: John Papadonis (district social studies coordinator)

10 June 1996  Site visit: independent research for Monument projects

April 1996  Survey III

August 1996  Meeting of 1996-97 Global Studies teaching staff

8 August 1996  Interview: David Buchanan
Appendix C

Global Studies

C.1 A Middle East research assignment

1. The purpose of this project is for you to conduct some research about life today in a Middle Eastern country. You will be presenting your findings to the class in a five minute presentation. You can use any visual in your presentation which you feel will be helpful. You will work in groups of three and each choose different countries to research.

2. Some topics that you should include in your research are as follows:
   
   (a) Government
       • form of government
       • political leaders and parties
       • rights of the people
       • current conflicts?

   (b) Culture
       • way of life
       • customs
       • art
       • music
       • food

   (c) Religion
       • how does religion impact society in your country?
• what are the influences of Islam, Judaism, and Christianity?

(d) Geography
• what does the land look like?
• are there special features or landmarks?
• does geography influence the way of life in your country?

(e) Climate
• does the climate affect the economy?

(f) Resources
• what are your countries resources and how do they influence the economy and society?

3. The above list is not a complete list of topics to research. With your research, you want to give us the essence of what life is like in your country.

source: Class handout on May 3, 1996. From Bob Hill
C.2 Media stations: perspectives on Hong Kong

How will life in Hong Kong be affected by the transfer to China on July 1, 1997?

- Consider the political, economic, social, cultural, religious situation
- Beware of bias - identify point of view and try to look at the sources objectively.

Station #1 - CNN - 3 taped stories

1. What were China’s intentions for the Hong Kong government after July 1, 1997?
2. How has corruption affected government in China?
3. How did corruption play a role in the Communist rise to power in 1949?
4. What role does patriotism (love of country) play in Chinese culture?
5. Were there any wrong facts in this report?

Station #2 - “The world’s freest economy — Hong Kong”

1. Who is the author of this site?
2. What are four factors that make Hong Kong’s economy tick?
3. What role does the Hong Kong government play in the economy?
4. What role does Hong Kong play in the financial world?
5. According to this site, what are the features of the Joint Declaration that make Hong Kong’s future secure?

Station #3 — “FCO — Britain and Hong Kong” Examine the categories “Basic Facts” “Britain and Hong Kong after 1997” “Joint Declaration”

1. Who is the author of this site?
2. What role will Britain play in Hong Kong’s affairs after July 1, 1997?
3. Describe the Hong Kong Special Administration Region as described in the Joint Declaration.
4. What will happen to the members of the Legislative Council elected in 1995?

Station #4 — China — Human Rights

1. Who is the author of this site?
2. Examine the various categories in this human rights report. How would you characterize the human rights situation in China? You should specifically address such issues as:
(a) Right to a fair public trial
(b) Right to privacy
(c) Freedom of speech
(d) Religious freedom

Station #5 — CNN World News Examine the following stories about Hong Kong:
“Hong Kong prepares to become Chinese” - 12/25/95, “Hong Kong residents to get British visa after 1997” - 3/4/96.

1. In what ways is the transfer of Hong Kong affecting the culture of Hong Kong?
2. What is meant by the phrase “one country - two systems?”
3. What actions is Britain taking to secure the future of Hong Kong?
4. Who in Hong Kong is fearing prosecution?
5. According to the author is thes “one country - two systems likely to occur? Why?

Station #6 — The Christian Science Monitor

1. Why do American business executives say, “Don’t rock the boat by mentioning democracy?”
2. Describe two examples given by the author as evidence of a “collapse of public order” in China.
3. According to the authro, what is the “secret” that Americans should share with China?
4. Is this a news story or an editorial?

source: Class handout on June 5, 1996. From Bob Hill
Appendix D

A Sample CNN Newsroom Program Guide

This is the program guide for CNN Newsroom from May 19, 1997.

<table>
<thead>
<tr>
<th>Title</th>
<th>Program Rundown</th>
<th>Segment Program</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OPEN</strong></td>
<td><strong>OPEN</strong></td>
<td>1:00 1:00</td>
</tr>
<tr>
<td>TOP STORY</td>
<td>Zaire’s seven-month long civil war ends as rebel forces march into Kinshasa.</td>
<td>5:00 6:00</td>
</tr>
</tbody>
</table>
| HEADLINES         | -AIDS VACCINE PROMISED WITHIN DECADE  
                      -PRES. CLINTON DELIVERS U.S. APOLOGY  
                      -ATLANTIS, MIR CREWS REPAIR SPACE STATION | 1:15 7:15       |
| ENVIRONMENT DESK  | Whales "talk" in squeaks and moans and recent findings suggest they may even speak in a dialect. | 2:35 9:50       |
| LOOK AHEAD        | Upcoming ENVIRONMENT DESKS...                                                    | :45 10:35       |
| LIVING CLASSICS   | Eighth grade students at Columbus Academy created their own opera in 9 weeks. Now, it's showtime! | 4:15 14:50      |
The Ivory coast is trying to convince farmers and loggers to preserve the land.

International concern about Burma’s government is hurting her businesses.

A religious and artistic revival is getting underway in Russia.

Thailand wants to save its wild turtles.

Los Charros reminds one of Mexico’s past.

----------------------

The Ivory coast is trying to convince farmers and loggers to preserve the land.

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A religious and artistic revival is getting underway in Russia.

Thailand wants to save its wild turtles.

Los Charros reminds one of Mexico’s past.

----------------------

TOSS TO CNN NEWSROOM WORLDVIEW ---------------------- 1:45 16:35

TOP OF THE WORLD

TAKING CARE OF BUSINESS

INSIDE RUSSIA

WILD KINGDOM

CULTURE

CNN NEWSROOM WORLDVIEW CLOSE

:50 30:00

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May be reproduced for class-room use with CNN NEWSROOM Teachable Tech, Inc.

ANCHOR DESK

May 19, 1997 (2)

**********************************************************************

* NOTE: All of this week’s DESKs, including the ENVIRONMENT DESK, *
* can be found at the end of the NEWSROOM Guide for May 9, 1997. *
**********************************************************************

TOP STORY: ZAIRE
1. Ask students to assess the mood of the people of Zaire, based on what the students viewed in the segment. Is there more than one reason why the people appear to be celebrating? Explain.
2. What action touched off the ensuing seven month civil war? Why would the Banyamulenege resist a return to Rwanda? Group
students and have each group use media and other resources to:

a. Discover why the Banyamulenege migrated to Zaire "over 200 years ago" and why, after all that time, Zaire attempted to send them back to Rwanda.

b. Create a profile of the Tutsi and Hutu peoples and discover the historical and recent conflicts between them.

c. Determine the ethnic breakdown in Zaire and Rwanda and, particularly, where Tutsi and Hutu communities reside and their relative political strength.

Share findings. Ask: Historically, what has been the relationship between the Tutsi and Hutu? Discuss the factors that have contributed to their long-standing conflicts and have each group contribute to a Tutsi-Hutu connection timeline.

EXTENSION: Using a map of Africa, have students note other countries in the proximity of Zaire and Rwanda where Tutsi and Hutu populations may have migrated. What has been the relationship between these two cultures in other countries?

LIVING CLASSICS: OPERA

3. What process did the students at Columbus Academy follow to create their own opera? What did they gain from the experience? Ask students to recall and share with the class efforts in which they collaborated that approximated the feelings expressed by the students in the video segment.

4. Challenge student groups to write a brief outline for an opera, play or motion picture script. Share and critique these in class, then have each group express what they found to be most difficult and most rewarding in working on a group product.

---------------------EDITOR'S NOTE: TODAY'S NEWS TERMS---------------------

Mobutu Sese Seko Laurent Kabila Democratic Republic of Congo
Banyamulenege Kinshasa Tutsi Hutu audience development

* The producers of CNN NEWSROOM & WorldView recommend downloading *
* the Daily Classroom Guide directly from cnn.com/newsroom or *
* learning.turner.com. If you are using another carrier for *
* retrieval of the Guide, your copy may be subject to delays. *

***********************************************************************
BURNING FORESTS: IVORY COAST--NATURAL RESOURCES--FORESTS
1. BEFORE VIEWING: Instruct students to divide a piece of paper into two columns. WHILE VIEWING: Write the causes of the deforestation in Column 1 and the effects of the deforestation in Column 2. AFTER VIEWING: Lead a discussion of the patterns perceived in students' data. Then, divide the class into groups. Assign to each a different topic concerning the Ivory Coast, in particular its geography and economy and including its natural resources and land use, as well as who owns the land and what alternatives exist to the traditional slash and burn farming and logging. Share findings then, as a class, use this data and other relevant information to suggest alternatives to the country's current economic practices and what it might take to make the needed changes.
INTERNET: http://www.execulink.com/~bruinewo/ivory.htm

SANCTIONS: BURMA--ECONOMIC CONDITIONS; BURMA--FOREIGN INVESTMENT
2. WHILE VIEWING: List the effects of the unilateral sanctions on Burma. AFTER VIEWING: Have students examine each effect on their list and determine who in Burma is hurt and what effect sanctions will have on the government. Have students list other countries on whom the U.S. has placed unilateral sanctions over the past four years. Group students and divide these countries among the groups. Instruct groups to a. use media and other sources to find out why the sanctions were imposed and the impact they had. b. share their findings and work together to evaluate the effectiveness of the sanctions imposed. Ask each group to identify on a map each country assigned to them, relate information about the sanctions, and discuss the group's evaluation of their impact. As a class, discuss the overall effectiveness of sanctions as a foreign policy tool. Then, based on the positions taken and arguments used, have each group write a letter to the President or the Secretary of State supporting/criticizing this type of action.
INTERNET: http://www-uvi.eunet.fr/Keywords/7/my/ar/myanmar.html

RUSSIA EASTER ART: RUSSIA--RELIGION; SOCIAL LIFE AND CUSTOMS
3. What is the significance of the decorations painted on the
eggs? Distribute art supplies and allow students to paint or make drawings of eggs using their own themes. Ask: Why are artistic traditions important to preserve?

INTERNET: http://www.isisnet.com/amorash/ukregg.htm

------------------- WORLDVIEW: TODAY’S NEWS TERMS -------------------
deforestation  fertility  ecological balance  boardrooms  sanctions
joint venture  policy of engagement  economic clout  charreada
Bibliography


