

COMPUTER LITERACY: TODAY AND TOMORROW*

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ABSTRACT

Computing and technology departments often offer service courses in Computer Literacy that provide the entire academic community with the opportunity to develop skills in the use of computers. These courses have been around for many years, but all too often they have not been updated to reflect new skills and knowledge that students are now bringing with them. In this paper we chronicle the history of teaching Computer Literacy, and discuss its relationship with the broad topic of Information Literacy. We include the description of a course on the Internet taught at Quinnipiac University that serves as a model for an updated Technology Literacy course incorporating both Computer Literacy and Information Literacy.

INTRODUCTION

As technology educators, we are constantly amazed at the rapidly evolving knowledge base that our students arrive with. Gone are the days where we are forced to concentrate our efforts on basic computer technology. The number of computers in dorm rooms across campus is rapidly approaching the number of students in those rooms, and will likely soon eclipse it! What then do we teach students in Computer Literacy courses? The traditional approach, covering the same litany of office applications might not provide our students with what they need. We are concerned that we are simply covering material that our students have already mastered.

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With that in mind, we have attempted to ascertain student abilities in our technology literacy course. From a survey of skills administered by the authors we know that in rank order students can connect to the World Wide Web (Web), send and receive e-mail, participate in synchronous chat, use a search engine, and create word processing documents. While there might be the occasional student who does not possess some of these basic computing skills, the vast majority does. This knowledge, however, is not based on an understanding of the underlying technology. Our students come to us as simple consumers.

Students acquire their technology literacy two ways: formally through school programs or in the workplace, and informally, whether at home, from friends or by themselves. Our survey shows that formally, students learn how to create and maintain presentation files as part of a course requirement, participate in a threaded discussion or possibly create and maintain Web pages. Informally, however, students use the technology to share what interests them. This represents a much broader, diverse set of skills encompassing everything from synchronous chat with acquaintances around the globe to "sharing" all manner of media files. This leads us to wonder whether informal instruction is more effective. Clearly, students learn about the technology if they can relate it to their lives. We might further consider the balance between formal and informal acquisition of computer skills: as computing becomes more seamlessly integrated with how we live our lives, and thus mediating our interests, informal acquisition of skills may well become the primary mode for learning about technology.

Online computer help sites at many universities [1-3] offer students the ability to informally increase their knowledge about new technology. The presumption appears to be that students already know most of what is considered traditional Computer Literacy, and they are willing to learn what they do not know about the operation of this technology. They confidently use computing technology, they are skilled with fundamental applications, and they navigate the Web with ease.

This leads us to ask what the "new" role of formal Computer Literacy education is. As educators concerned with Computer Literacy, we have begun to assess not only where we are today, but also where we will be tomorrow. Clearly, students acquire most of the skills *they* consider meaningful on their own. Although sophisticated in the use of these skills, they do not understand the underlying technology that makes them possible. These skills are an integral part of their lives, but they do not stop to consider how the technologies are shaping those very lives. From the simple question of how these technologies work to complex sociological discussions about online communities, our goal as technology educators is to help our students to become truly informed.

HISTORY OF COMPUTER LITERACY

The teaching of Computer Literacy has a long and rich history that parallels major advances in computing technology. Four stages in the development of computer technology correspond with stages in the development of Computer Literacy initiatives: the introduction of minicomputers in the 1970s, microcomputers or personal computers (PCs) in the 1980s, the Web as the defining Internet application in the 1990s, and portable and mobile (wireless)

computing today. We can follow Computer Literacy proposals in the literature and clearly see the role technology has played in this process.

In the 1970s the general public did not have access to computers. Their use was limited primarily to data processing workers and programmers. While increasing numbers of universities networked their computers, no central, universal network aimed at fostering community or citizenship existed.

Computer literacy at that time included the need to know about computer technology because of its relative "pervasiveness," the need to make informed decisions on public policy involving computers and their applications, and the need to tell the public about data processing and computing careers. Teaching topics included hardware, software, applications, and implications for society and individuals [4]-but no programming (active participation) was included.

The arrival of PCs in the 1980s made computing technology more widely available to the general public. By 1985, classroom models of Computer Literacy began to resemble today's definition [5], specifying stages: computing awareness, computing literacy, computing fluency, and computer expertise. While easy access to PCs provided the opportunity to teach programming, its inclusion remained a controversial issue. During this time frame, one of the authors developed a Computer Literacy program that combined hands-on experience with computing awareness in PC-based software. An online quiz at the end of each lesson determined whether the student could proceed to the next lesson.

By 1987 computer applications had improved to the point where the ability to use them implied Computer Literacy [6, 7]. Word processing, spreadsheets, business and presentation graphics, and file management became the core Computer Literacy topics. Because PC applications had grown easier to use, companies began to view them as productivity (or even employment) requirements.

Other topics in literacy courses included history, basic computer operation, computer confidence, and the role of computer technology in the business world. Movement occurred away from earlier, more practical and performance-based models. One Computer Literacy proposal included the philosophical issue of whether humans are merely machines themselves [7]. Programming was not considered an essential Computer Literacy skill. Students could pick up important programming concepts while learning applications [6]. Some courses included algorithmic thinking, but at a fairly high level. A Computer Literacy course taught by one of the authors from 1988 to 1992 offered a (relatively) painless approach to introductory programming through the use of HyperCard and its built-in scripting language.

Although the Web debuted in 1993, it did not have an impact on Computer Literacy courses until later in the decade. In 1994 neither the Web nor the Internet was included in Computer Literacy proposals. Social and ethical aspects of computer use, however, became more prominent in course proposals [8]. These proposals, fueled by a diverse student constituency, also included application literacy. Computer literacy encompassed the social and ethical context of computing, hardware and software components of a computing system, and

the computer-user interface embodied in file abstractions. Application literacy covered how to use applications to solve problems in specific knowledge domains.

Discussions about the social and ethical aspects of computers and computing still centered on the effect computers have on society. Although the Web continued to grow exponentially, it had not fully caught on commercially. Additionally, home computer use had not yet reached critical mass, and online content providers had just begun to provide direct consistent connections to the Internet and the Web.

In 1997 the Internet emerged for the first time as a topic in Computer Literacy courses [9]. Social and ethical aspects of computing had also become significant components. The responsibility of computing professionals, particularly academics, to teach these topics was grounded in the ACM Code of Ethics [10] and IEEE Code of Ethics [11]. Topics in literacy courses included computer history and applications, how computers work, and the power and ethical use of information in our technological society.

An influential report by the National Research Council (NRC) published in 1999 [12] offered guidelines for the development of courses that provided "computer fluency" with information technology. (The phrase *computer fluency* was meant to convey a deeper understanding than Computer Literacy.) This report defined three kinds of knowledge required for fluency with information technology: Contemporary skills (the ability to use available information technology applications), foundational concepts (the basic principles of information technology), and intellectual capabilities (the ability to use information technology for organization, reasoning, and problem solving). This represents a first step toward merging Computer Literacy with the idea of Information Literacy, centering on the concept of "information technology."

As this was happening in Computer Literacy courses, portable and mobile technologies were becoming commonplace. A computer with an Internet connection could be found in virtually every library. Although the "digital divide" persisted, many homes had multiple computers, and college freshman in some universities were required to have laptop computers (often with campus-wide wireless capabilities). Computers were becoming as much of a fixture in the modern office as desks or chairs.

By 2000, Computer Literacy courses included entire sections dedicated to the "literate" use of the Web. Because students still came to courses with a wide range of skills and experience, traditional application-based teaching remained. Interestingly, exploration of computer-based (online) teaching had also begun [13]. Literacy topics included exploring how computers work; using applications such as word processing, spreadsheet, file management, database, and presentation graphics; finding useful information on the Web; examining the history and future of computers; and purchasing a computer.

Starting in 2000 we find attempts to update definitions of Computer Literacy. *Literacy in the Cyberage* [14] directly countered the "traditional" techniques of teaching Computer Literacy. Its author advocated teaching literacy from the standpoint of traditional rhetoric-rhetoric being the "ancient art of persuasion." By using the "rhetorical triangle of ethos (author's credibility), logos (message's logic) and pathos (emotional appeal to audience)," the

course could move beyond technical competency toward a critical understanding of what students encounter in cyberspace. This approach used several forms of literacy to accomplish its objective, including media literacy, civil literacy, and discourse literacy.

Cyberliteracy [15] continues this literacy theme. Words such as *speed*, *reach*, *anonymity*, and *interactivity* are used to characterize the unique features of the Internet. Social topics such as gender, online rage, hoaxes, and privacy are explored. Understanding the impact of the Internet in these contexts is proposed as a new model of literacy called "cyber literacy." Clearly, what was considered Computer Literacy has changed dramatically.

Not only must we think about how technology shapes our world, we must also consider how we perceive its impact. New proposed course models incorporate critical *Computer Literacy* as content in a first-year composition course where computers are also the medium of instruction. *Critical Computer Literacy*, defined as the ability to "comprehend our relationship with computer technology and its uses, possibilities, and meanings," [16] expands the scope of Computer Literacy to include critical literacy: "[A]n awareness of the forces that affect the micro- and macro-level conditions within which we acquire literacy and of how we view the uses and meaning of literacy."

Looking back chronologically over the literature we see that technology paradigm shifts change not only the nature of computing but also how the technology itself is perceived by society. More important, these shifts advance the integration of computing with our surroundings. Minicomputers allowed a relatively small number of people direct access with a comparatively small cost over earlier "mainframes." Universities, and even smaller departments within organizations found themselves able to afford dedicated computing power. Computer literacy emerged as a means of making people aware of this technology. Personal computers shifted the frontier of technology access from organizations to individuals. We also began to see a shift in emphasis from computers to the applications that run on them.

From an increased emphasis on applications, we move to an emphasis on the defining application for the Internet today: The World Wide Web. Its facility to store and distribute information (and foster communication) dramatically changed how computing technology was used. Owning a PC is no longer sufficient in and of itself. A connection to the Internet is required. Using computing technology became less an example of time set aside for work, school or even recreation, and more a part of how people lived their lives. Concepts of Computer Literacy changed to include Internet applications and awareness of the social issues these applications raised.

Technology continues to shape our definition of Computer Literacy. Portable computing and mobile devices are becoming ubiquitous and changing our definitions of literacy. In wireless-enabled environments, laptop computers may be used anywhere. Cell phones are now Web-enabled. Computing technology clearly mediates how we perceive our world. Concepts of Computer Literacy must grow with this new technology and encompass this wider use of computing technology and its social prominence.

RECENT HISTORY OF INFORMATION LITERACY

Information Literacy has changed dramatically as well. It is defined as a "set of abilities requiring individuals to recognize when information is needed and have the ability to locate, evaluate, and use effectively needed information" [17]. Specifically, Information Literacy Competency Standards for Higher Education of the Association of College and Research Libraries [17] state that the information literate student has the ability to:

1. Determine the nature and extent of information needed
2. Access the needed information effectively and efficiently
3. Evaluate information and its sources critically, and incorporate selected information into his or her knowledge base and value system
4. Use information effectively to accomplish a specific purpose (individually or as a member of a group)
5. Understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally

Information literacy obviously has wide appeal across all disciplines, learning environments, and levels of education. It is essential for lifelong learning. In addition, we cannot underestimate the role that technology has played in the development of Information Literacy. Competency standards reflect this reality.

By 1994, Information Literacy course proposals had expanded to include "skills in finding, evaluating, and utilizing information in the information age," and prerequisites for such courses included familiarity with computers [18]. Students needed to have proficiency in the use of a word processor, and promotional literature for one course described "laboratory work using computer networks" and "strategies for finding information" with computers and print tools. Finally, the course would "build confidence . . . to identify and evaluate information using the tools of the electronic age." Additionally, this course introduced discussion on ethical issues of computing, with one lecture (out of twenty-six) dedicated to this topic.

A 1997 paper "Information Literacy: The Web Is Not an Encyclopedia" proposed a different approach [19], noting that the Web was "[n]early a mix between all other media, the Web democratizes information ownership, provision and retrieval." As such, the Web had allowed non-experts to publish "non-refereed webpages" that stood with apparent equal credibility alongside expert publications. The ability to carry out a literate evaluation had become a significant issue. The proposed course discussed how to evaluate Internet tools, such as search engines, and Internet sites. It also included information on appropriate uses of the Internet. Subsequent textbooks have come to reflect these changes [20].

Computing technology as it integrates into our world has profoundly shaped courses in Information Literacy. Initially, these courses served as a means of organizing and presenting information with widely available PC applications such as word processing and presentation software. More recently, however, Information Literacy has changed to accommodate Web-based information sources. Although both Computer Literacy and Information Literacy remain distinct, they are clearly converging.

Interestingly, literacy-as is typically taught through English composition-has also been affected. A recent English handbook, typical of many, integrates technology-oriented and information-oriented topics. These topics include HTML, FTP, designing for the Web, writing for the Web, and building community through electronic mail [21]. This confirms recent perspectives on Computer Literacy, noting its relationship to literacy in general [16, 22]; Computer Literacy is simply another form of literacy, mastery of which is becoming necessary to be literate in a world that so heavily relies on computing technology.

CONFLUENCE OF LITERACIES

Over the past 20 years, models of Computer and Information Literacy have started to merge. This process has been fueled by the rapid growth of technology, and its increasing impact in society. Technology is becoming the vehicle for information, and the evaluation of (and ethical use of) information is becoming one of the primary applications of technology. As such, we are developing a single notion of literacy that demands fluency in both technology and information.

Current trends indicate that most computing skills will be learned informally. Skills inventories may be used to identify where student skill and experience is deficient due to a lack of training or because a skill was not included in their informal education. Increasingly, the skills that are of value will be mastered informally. In place of formal education, missing skills will be acquired by targeted training, such as "Frequently Asked Questions" (FAQs) and help desks. Acquisition of skills becomes "just in time" or "on demand."

Computer literacy is finding greater common ground with other literacies. It has been described as literacy with digital texts [22]. As digital texts and their unique characteristics become a significant means of communication and information distribution, literacy with digital texts will be included as a component of literacy. Therefore, courses like first-year composition [16] will include digital texts as a standard, integrated topic. Recent English handbooks already demonstrate the trend [21]. Focus is shifting away from the computer toward its integration into a broader understanding of literacy. Put another way, a literate person uses computing technology.

Interaction between computing technology and society on issues of culture and ethics centers less on technology today. We see this when students include instant-messaging abbreviations in their formal writing [23]. Computing technology as we know it (personal computers) could effectively disappear from the main stage of our attention, much as other commonly used appliances like televisions, telephones, VCRs and microwave ovens. Interesting issues arise: the blurred boundaries of work time and recreational time [24], or the effects of multitasking. These are social issues facilitated by technology best studied from the social science perspective. However, an understanding of the underlying technology that makes them possible goes a long way toward appreciating their effect and anticipating, or possibly even shaping, future developments.

FUTURE TRENDS

Computing technology profoundly shapes the definition of Computer Literacy, understanding the trends of today will help us make an educated guess about the future. We speculate that portable and mobile computing technologies are the defining technologies of this decade. The Internet has connected PCs around the globe, but PCs for the most part have remained stationary appliances. Laptop computers are showing up in larger and larger numbers, but as they are used to access the Internet, they often assume the role of a stationary appliance. Wireless technology truly frees laptops to be mobile, providing the ability to connect to the Internet from anywhere. Portability frees an application from a particular platform at a particular location. In essence, portability and mobility imply access to information and the ability to communicate any place and any time.

This is significant when viewed in the context of other trends. PC-based applications have stagnated, but Internet-based applications are thriving. A PC that is not connected to the Internet is of little value today. Popular Internet applications connect people, facilitate access to information, and support online commerce.

The focus has changed from document production to communications and information. Although we continue to use word processing, spreadsheet, presentation, and database software, these applications have become stable. There are no new features to develop. Their utility has been established. Their availability is expected. Internet-based applications are where new developments are anticipated.

The Internet is a significant part of our world. An increasingly large number of people find it a necessity. Today over half the households in the US have at least one PC with an Internet connection. This is a dramatic increase over 1997 when only one third of the households had a PC, and one sixth had an Internet connection [25]. The effect of the Internet on our world is being studied from several social perspectives. The Internet has been characterized by a taxonomy of psychological spaces, including the Web, e-mail, asynchronous discussion forums, and synchronous chats [26]. The Internet has also been studied with respect to its effect on all manner of issues such as identity, race, gender, governance, and the effect of copyright on innovation [27-29].

A MODEL FOR A COMPUTER LITERACY COURSE

We are developing a course, *Introduction to Internet Studies* that follows the model of merging literacies. This model anticipates future trends in technology. The course includes three components: a technical component that covers Web page creation and maintenance, principles of Internet technology, and Internet history; an information research component that covers search, analysis and evaluation of Web-based information; and a social component that covers current social, cultural and ethical issues resulting from the widespread use of Internet technology. The Internet is an appropriate vehicle to study the current impact of technology since it is a significant force in the development of the same technology. It is one of the primary means for integrating computing technology into society today.

CSC101 - Introduction to Internet Studies is a service course offered by the Department of Computer Science and Interactive Digital Design in the College of Liberal Arts at Quinnipiac University - a small university near New Haven, Connecticut that, in addition to Liberal Arts, offers programs in Health Sciences, Business, and Communications. CSC101 is one of a number of courses that satisfy a general education requirement from which all students must take one course. A course offered by the Department of Computer Information Systems in the School of Business also fulfills this requirement, and provides a more traditional form of computer literacy focusing on the Microsoft Office application suite. The course is popular (we are offering 9 sections for Spring 2003, enrolling about 180 students), and all sections fill quickly. CSC101 is taught in technology classrooms limiting the number of students to available equipment. This semester we are offering sections taught with "laptop carts" that contain 16 wireless laptop computers that are distributed at the beginning of class, and we offer "laptop-only" sections for students who own laptops they can bring to class. Beginning with the Fall 2003 semester all freshmen will be required to have wireless laptop computers at Quinnipiac. This requirement will give us greater classroom flexibility.

Since we are a small department we use part-time faculty to teach the majority of the sections (only one section for Spring 2003 is being taught by a member of the full-time faculty). We have been fortunate to find highly-qualified part-time faculty from off-campus, however, we have recently found that several staff from the Information Technology (IT) and Academic Technology (AT) organizations on campus are well-qualified and eager to teach the course. Through arrangements with IT and AT we have been able to offer more daytime sessions. Our other part-time faculty teach almost exclusively at night.

The course has been developed over the past two years. During the first year, the course focus was primarily technical in nature, reflected by our choice for the sole textbook. *The Internet Book* [30] provides a broad, general-audience overview of the Internet, but considers only the technology: the hardware and software that runs the network. Beginning with the Spring 2002 semester the course took its present form; two textbooks were added to support instruction on Web page generation (*The Web Wizard's Guide to HTML* [31]) and critical analysis of the Internet's impact on society (*cyberliteracy* [15]). Students and faculty alike are quite demanding of the course materials, and with significant input by part-time faculty we are reviewing replacement textbooks for the Fall 2003 semester that better satisfy course objectives. One textbook being seriously considered for the "information research" component is *Internet Research* [20]. Other textbooks being considered include composition features around technology topics. As expected, we are also relying heavily on Web-based resources.

We continue to experiment with how best to integrate the three components (technical, information research, and social) of the course. Course objectives for one of the authors, serving as representative objectives for all sections, are listed below.

- Learn the basic *technology* of the Internet through study of networking, and internetworking, hardware and software, protocols and standards.
- Learn the *history* of the Internet by studying technical and administrative decisions that contributed to its development.

- Learn the types of *applications* that are enabled by the existence Internet, and how they facilitate use of the Internet.
- Learn how the *World Wide Web* works as an Internet service through the study of browsers and HTML. Develop a Web site including text formatting, color, graphics, images, hyperlinks, tables and frames.
- Learn computer and *information literacy* concepts and skills in the context of the Internet.
- Explore the *impact* of Internet-based applications on social, cultural, economic and artistic aspects of human interaction.
- Develop good writing and *communication* skills.

We are working this semester with the instructors to refine these course objectives. We hope to define the core objectives in a way that may be dynamically adapted to the student demographics of each section, the expertise and interest of each instructor, and current developments in the Internet and its use. Evidence indicates that integrated approaches to covering the material work better than attempting to teach each topic as a distinct unit.

We find that the three topics are integrated to a high degree. Teaching a student how to create and post a Web page to the Internet provides tangible, first-hand experience of the ease of publishing information on the Internet. The experience provides depth when analyzing information found on the Internet. This is important because the Internet is the primary source of information for a very large segment of the population. Similarly, the experience facilitates discussion of social issues such as free speech and privacy. Many paths through the course material satisfy the course objectives.

Instructors enthusiastically report many imaginative assignments and activities. Several course sections have published online resumes. In some cases students went on to polish their online resumes and use them to provide new dimensions in their job searches. Other sections have created group Web sites on particular topics, for example health science students might create an information site on a health science topic, or sections have created a course Web site showcasing student work. Most instructors require students to submit written assignments as Web pages that may be assembled as a student portfolio. Web page creation is usually the first topic covered. Instructors also integrate aspects of the *Writing Across the Curriculum* initiative on campus into the course by having students post and revise their papers as Web pages.

Many instructors use Web sites, such as www.dhmo.org, to evaluate authority, objectivity and emotional appeal. In the same vein, instructors use search engines to discuss Internet research. This discussion covers not only how to perform an effective search, but also how to formulate a research question, select the best search tool, determine the appropriateness of the search results, and how to properly cite Internet-based information when it is used.

The social impact of the Internet has been studied by following the development of ongoing issues such as copyright laws and intellectual property rights. Content producers, content users, technology innovators, media distributors, the U.S. Congress, and the U.S.

Supreme Court are working to find an equitable solution to this complex topic. Copyright has been studied using the textbooks, online news articles, activities and discussion. Many Internet-related topics such as this interest students because of the affect these issues have on them.

Beginning with the Fall 2002 semester we established a repository of course material. The repository allows instructors to share information they find useful. The repository contains syllabi, links to useful articles, interesting Web sites such as online art exhibits, projects, and activities. New instructors find it particularly useful when planning their first course; it gives them a general sense of the course and concrete examples of what other instructors have found successful; it gives them a pool of ideas to initiate exploring their own ideas.

CSC101 implements a proposed model of computer literacy for tomorrow. It provides flexibility to accommodate instructor's expertise and interest, and it is easily shaped by current events. Students acquire an understanding not only of computing technology, but how it shapes the society in which they live.

CONCLUSION

Proposals for Computer Literacy courses over the past three decades were shaped by available computing technology and its degree of integration into society. The flow of new technology: Minicomputers to PCs to the Web shaped what was considered standard knowledge. Today, portable and mobile technology continues the integration of computing technology into society that began in earnest with the Web. For Computer Literacy there are three consequences: changing how we learn how to use computing technology, expanding Information Literacy to include Internet-based information, and placing issues raised by the integration of computing technology into society within the scope of non-computing disciplines. Consequently, Computer Literacy has changed: skills are taught on demand, Computer Literacy has taken its place as one of many forms of literacy, and social and ethical issues are viewed from non-computing perspectives. Our *Introduction to Internet Studies* course attempts to implement this new model of Computer Literacy.

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