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## Chapter V

# Integrating Technology Literacy and Information Literacy

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## Abstract

*Information technology literacy can be seen as an integration of what are commonly two separate literacies—technology literacy and information literacy. This chapter defines them, reviews issues related to both, and argues that both must be acquired and functionally utilized for students and workers to achieve success in our heavily technology-oriented society and workplace. The authors address learning outcomes and design components that should be considered in training and instructional settings, and give examples of instructional strategies for achieving them.*

# Introduction

To succeed in today's higher education and workforce environments, one cannot rely solely on either technological or information literacy skills. The two are complementary, and they must be interlocked to provide a complete inventory of needed skills and knowledge. In some places the phrase "information technology literacy" is used to address both; here they are addressed separately before describing why they are complementary. Integrating and utilizing standards and competencies for both through an instructional systems design (ISD) approach strengthens curriculum and program development in the digital age. Building skills upon skills allows for continued proficiency acquisition and adaptation to changing environments, and infuses the concept of continued lifelong learning.

The need for technology skills and knowledge in schools, the workforce, and society is an obvious extension and consequence of living in the digital environment of what Alvin Toffler coined as "the Information Age." Computers and computing have become a way of life and the primary means for doing work in today's world. Governments, schools, and business have attempted to address issues in acquiring specific technical skills for some time. Often missing from discussions about technology literacy is technology's interdependent relationship with information. There is a reason, after all, why it is not called the Technology Age—technology is tools or the use of tools, but it is the result of using them that is important. Computers have not only made creating, acquiring, tracking, storing, retrieving, and analyzing data and information easier; they have made it more accessible than their original creators could have ever imagined. The skill sets needed at the very center of this vortex where technology interfaces with information are both technology literacy and information literacy.

# Background

Traditionally, technology skills have been thought to be the responsibility of employers. Duemestre (1999) argues that while arts and technology should be balanced in education, the latter is more likely best addressed by employers in a work setting. However, the Deputy Director of the National Science Foundation noted in his October 24, 2002, address to participants of the Advanced Technology Education program that this was a challenge—the skills students need for the workplace is an issue that should be reviewed in the context of the traditional college curriculum. Bordogna (2002) avers that technical skills are increasingly the purview of community colleges. Others have suggested that in particular, information technology skills should be incorporated into a minor as part of college programs (Bailey & Stefaniak, 1999).

Early on, information literacy was taught primarily in undergraduate environments, where the need for honing research skills was seen to be the greatest. Information literacy, as it is now known, began in the '70s when computers were first used in publishing, and the amount of information began to grow. In the '80s, computers began to be used as tools to organize and retrieve published information, and accessing information became even more complicated for end users. The '90s, of course, saw the proliferation of both published and unpublished information via ubiquitous networked computers and the World Wide Web (Murray, 2003). A recent review of trends in librarianship noted that information literacy research has progressed from codifying a doctrine for librarians, to proving its effect in supporting both general education and lifelong learning for students, to integration into specific curricula through collaboration (Arp & Woodard, 2002).

The two literacies have taken parallel, if not mutual paths. Each was once considered the responsibility of a specific constituency—employers or librarians. Each became more complex as computers became a driving force in both the workplace and education. And each has begun to be seen as set of skills and knowledges which underlies larger needs and outcomes in both areas. The two paths have, at this point, crossed.

## Defining the Literacies

What comprises technology literacy, knowledge, and skills? Often it depends who you ask. People in a higher education setting tend to view technology literacy as either the ability to work with technology within a given discipline, such as biology, or as a generalized set of IT skills necessary to perform perfunctory work in a computer-rich environment (Kock, Aiken, & Sandas, 2002). Educators in K-12 settings view more narrowly the skills of "computer literacy" as being able to use the computer for keyboarding, basic programming, and so forth (Murray, 2003). Government and industry view things in very applied and outcome-oriented terms; technology literacy can be described as mastery over technological tools, usually specific to a company and the products it produces (Bailey & Stefaniak, 1999).

The National Academy of Engineering's (NAE) (2001) Council on Technological Literacy notes that in addition to specific skills (including, for instance, the ability to change a fuse), people who are technically literate also have "a sense of the risks, benefits, and trade-offs" in using technology in various situations. Many technology inventories of competencies are available on the Internet and show a wide range of skill sets. The CPSI Technical Skills Inventory (1999) identifies hundreds of specific industry skills by categories, such as software and hardware engineering, operating systems, data bases, Web/Internet, desktop publishing, and so forth. For schools, the Carl D. Perkins Vocational and Applied Technology Education Act of 1990 has had a major impact. Many schools now address a variety of technology competencies at both K-6 and 7-12 levels, including such specifics as demonstrating "knowledge and use of appropriate connectivity methods, basic networking, and communication hardware and software" (Conroe Independent School District, 1999, Section 1, Paragraph 2).

Information literacy encompasses a different domain of skills and knowledge, those involved in finding, retrieving, and using information. The context has been computer-based information, even as noted in the American Libraries Association (ALA) report of 1989 which predates the World Wide Web. Like the NAE, university librarians believe information literacy must include knowledge and understanding of the context of information in today's society, its composition and organization, as well as its use in lifelong learning (Dupuis, 1997). K-12 educators take a simple, though related view: information literacy includes skills for locating and using information, as well as knowledge for interpreting and evaluating it (Murray, 2003).

Specific information literacy approaches include identifying standards, goals, objectives, or outcomes. For instance, from the ALA, information standards include accessing, using, and evaluating information "critically and competently" (American Association of School Librarians, 2004). Examples of K-12 goals include abilities to define information problems, determine range of possible sources, and extract relevant information from a source (Eisenberg, 2003). University objectives tend to be more specific, such as: "Given an industry-related task, the user can identify and obtain critical information to support the decision-making process" (Purdue University Libraries Faculty, 1995, Goal 1, Paragraph 5).

Increasingly, the skills and knowledge used in information seeking and retrieval require sophistication using computers as tools of access, analysis, and formatting. The Association of College & Research Libraries' (ACRL) (2000) Information Literacy Competency Standards for Higher Education is an updated framework for information literacy in an academic setting. It notes: "Information technology skills enable an individual to use computers, software applications, databases, and other technologies to achieve a wide variety of academic, work-related, and personal goals" (Association of College & Research Libraries, 2000). Basic skills that support information literacy may include using e-mail, managing personal databases, and troubleshooting operating system problems. In many ways, it is impossible for anyone to work and survive in the Information Age without information technology skills (Latham, 2000). And at this point in time, it could go without saying that these skills and knowledge extend to networks, the Internet, and the World Wide Web.

Overall standards for literacies vary. As noted, the nomenclature used to describe them can be expressed as objectives, skills, expectations, competencies, or standards, depending on the context. Generally, standards are the highest conceptual level of expression, and objectives are concrete and detailed expression of outcomes designed for an instructional session, course, or program. A sampling here indicates the variability in scope and specificity of skills.

University Setting (Instructional Technology Committee of the Campus Computing and Communication Policy Board, 1998):

- Handle e-mail attachments (send, find, open, read, and store).
- Open a browser and find various sites.
- Download/save images and files.
- Find help and search university's Web page.

Public School Setting (North Carolina Department of Public Instruction, 2003):

- Select and use technological tools for class assignments, projects, and presentations.
- Practice and refine knowledge and skills in keyboarding/word processing/desktop publishing, spreadsheets, databases, multimedia, and telecommunications in preparing classroom assignments and projects.
- Use word processing and/or desktop publishing for a variety of writing assignments/projects.
- Select and use appropriate technology tools to efficiently collect, analyze, and display data.
- Use electronic resources for research.

Statewide Setting (Linberg, 2000):

- Manage large hierarchical file system, organize tools, re-order scattered files.
- Find, install, and use plug-ins; use secure space, manage advanced browser features.
- Import/export to/from text, tab, or other delimited formats.
- Devise solutions/workarounds when no help is available.

*Figure 1. ABCD model applied to an objective*

| | |
|---|---|
| Audience | Students |
| Behavior | will present to the class |
| Condition | a critical analysis of fresh-water ecosystems literature |
| Degree | through an electronic presentation |

## Designing Literacy Components

A closer look at designing literacy objectives gives further insight into how outcomes and skills can be facilitated. When developing any instructional sessions or courses, basic instructional systems design (ISD) principles can go a long way in helping develop effect activities and solid learning outcomes. One main benefit of using basic ISD principles is that learning outcomes can be tied directly to the types of activities and projects assigned to students. To use these principles, an appropriate model should first be identified to create the effective integration of skills. Gagné, Briggs, and Wager (1988) state that developers of instruction must pay close attention to internal and external influences on the learning environment and how this affects the learning process. A common instructional systems design model used is the ADDIE model. This model focuses on key components of the instructional design process, which can be easily applied by an individual or design group. The ADDIE model is an acronym for Analysis, Design, Development, Implementation, and Evaluation.

The model used isn't as important as keeping in mind what is to be accomplished by the instruction. "All stages in any instructional systems model can be categorized into one of three functions: (1) identifying the outcomes of the instruction, (2) developing the instruction, and (3) evaluating the effectiveness of the instruction" (Gagné et al., 1988, p. 14). Prior to instruction the first three steps of the ADDIE model help with the creation of the instruction. The *Analysis* step determines the need for instruction and what learners should gain overall from the instruction. *Design* and *Development* is the process of creating the structure of the instruction. This includes determining outcomes and objectives, developing assignments and activities, and creating methods of assessment. How the structure is built directly influences the level of success when conducting or implementing your instruction. Morrison, Ross, and Kemp (2001) recommend using the following questions to address the components of designing instruction.

- For whom is the program developed? (characteristics of learners or trainees)
- What do you want the learners or trainees to learn or demonstrate? (objectives)

- How is the subject content or skill best learned? (instructional strategies)
- How do you determine the extent to which learning is achieved? (evaluation procedures) (p. 5)

As with Gagné, Briggs, and Wager's recommendations for instructional design, these points focus on key components of the overall process of developing instruction.

When incorporating technology, it should not overwhelm or supplant content to be taught or substitute class time that is typically spent on content. Just using technology will not bring benefit to the overall outcomes of the instruction or the students. Using an ISD model can help one avoid this trap. A design model, called eTIPS (educational technology integration and implementation principles), was developed specifically to help teachers design instruction with effective incorporation of technology. This model helps anyone using technology to avoid the trap of using technology for technology's sake. Specifically, this model encourages "a teacher-designer to consider what they are teaching, what added value the technology might bring to the learning environment, and how technology can help to assess student learning" (Dexter, 2002, p. 57).

Writing quality objectives will help determine the rest of the instruction's structure. In the context of most classes, creating objectives that just focus on the use of a particular technology can take time away from the content of the class and the overall learning outcome. When writing objectives, focus on the use of a technology as it supports the established learning objectives and desired behavior of the student either in assignments or assessment (Dexter, 2002). Examples of these types of objectives can be as follows: 'Students will conduct a half-hour interview of a local historian using a digital camcorder.' or 'Students will present to the class a critical analysis of fresh-water ecosystems literature through an electronic presentation.' These objectives demonstrate that the focus of the assignment is on the content of the class, but use technology to support the achievement of the objective and therefore the overall learning outcomes.

Developing concrete outcomes can be a challenge if someone is not used to creating curriculum from an ISD standpoint. Using the ABCD model to create solid objectives can make the development of them much easier. The acronym stands for Audience, Behavior, Condition(s), Degree (of success). Each component of the model has a specific function in the creation of an objective. Essentially, this type of objective guides the learner (Audience) to perform (Behavior) in a certain situation (Condition) to a specified level of success (Degree) (Schuman & Ritchie, 1996). See Figure 1 for an example of this model and its application to a learning objective.

Projects or assignments developed for instruction need to be in direct support of the objectives of the course. When developing a project, some basic questions should be asked: How does this project support the overall goal of the course? What main objectives are directly supported by this project? Is the project focused on the course content and not directly on the tool? One pitfall professors and instructors tend to fall into is creating an assignment for using a tool which does not support the curriculum. If it is important for students to know how to develop a Web site, a Web development assignment should not arbitrarily be created; the Web development assignment should be put into the context of the course. Students can create a Web site that demonstrates their knowledge of main concepts of the course or shows their research and critical thinking skills through an examination of the course content.

When integrating technology and information literacy, students can acquire skills in multiple ways. While there are many studies and models discussing how these skills should be gained, more recent discussions show that the point-and-click demos in particular are no longer the best way for skills to be transferred. A report produced by the Panel on Educational Technology (1997) recommends that projects, assignments, and instruction overall should not just focus on the technology or hardware, but use these as a complement to support the instruction. A research project, for instance, contains the traditional aspects of information literacy such as using scholarly journal articles and providing critical analysis. However, the container in which the project is handed in to the professor can vary in format. Some examples of containers can be a Web site, video presentation, documentary short, or e-portfolio. The appropriateness of the container greatly depends on the course content as well as overall learning outcomes.

> *Another key to the successful use of technology for learning is to encourage the interactivity of learners with curricular material and one another. Multimedia learning materials are well designed if they encourage learners to be active, engaged, and purposeful about their learning. Computer conferencing tools and applications are well designed if they also foster constructive dialogue among learners around critical concepts.* (Abrami, 2001, p. 118)

## Specific Literacy Outcomes

Information and technology literacy skills can be acquired in several ways, as well as on multiple levels. The basic research paper requires fundamental technology skills such as word processing to write the paper and a Web browser to access online sources. The same research paper may require higher-level information literacy skills such as finding multiple types of sources, evaluating the validity of the sources, and critically analyzing the content of the sources as they support or refute the student's hypothesis or thesis statement. These higher-level information literacy skills don't need to be compromised for the technology component of the project to go to a higher level. If the traditional research paper is just one type of container for the research project, then other, more technology-based containers can be produced.

Some examples have been mentioned above on how to incorporate technology into instruction. Specific examples of instruction that can be used in academic courses are given below. All three examples have been used at Purdue University in association with the Digital Learning Collaboratory. These examples were used in English literature classes, a communications class for PR majors, and a Botany class.

Electronic presentations have become quite standard as a requirement for student projects. Many people use PowerPoint because of easy access and familiarity. However, people typically don't move beyond the basic functionality of PowerPoint, often creating dull and unimpressive presentations (Abram, 2004). PowerPoint's capability to apply custom animations, embed video and audio, and create voice-over narration can allow a student to create a presentation that pushes his or her creative envelope.

Since literature classes often require the critical analysis of text, a group presentation was created as a final project in three English literature courses. Each group of four to five students was to develop a 20- to 25-minute presentation that examined, developed, and expanded an idea, theme, or metaphor in literature, which embodied personal as well as cultural aspects. Students were required to include both personal views and scholarly documentation. Students could use photos (personal or commercial), newspapers, magazines, journals, books, music, DVDs, videos, personal narrative, and so forth to support their views and critical analysis. This assignment was created by Dr. Binnie Martin while a PhD student in the English department.

As students advance through their major, it is not uncommon for higher-level classes to require a semester-long project. The subject area greatly influences the container type of the final project, but it is not unusual for the project to be in the form of a 25-plus-page research paper. As universities focus on alternative learning experiences such as service learning, opportunities are provided to incorporate exploration of scholarly communication, various types of technology, and applied experience into semester-long projects.

Developing campaigns is a standard component of the Public Relations industry. To help students gain practical experience, a service learning assignment was created by Dr. Mohan Dutta-Bergman, Assistant Professor of Communication. Students working in groups of nine to ten were to create an advertising campaign for a local non-profit agency to help promote awareness, address an issue, or solve a problem in the contingency served by that agency. This project required the development of a campaign plan and materials in physical or electronic format. The campaign plan needed to be a strategic document that presented the different elements of communication strategy proposed by the students to help address the agency's need.

The materials could be created using various hardware and software such as digital cameras, scanners, graphic editors, video editors, Web development, and so forth. The development of the plan and materials needed to be supported by scholarly research and published statistical data.

E-portfolios are becoming a more common way for students to showcase their skills, expertise, and accomplishments during their college career. The e-portfolio format provides a way for projects and products to be shown in a way paper cannot. A quality e-portfolio also demonstrates a student's skill and knowledge of technology. An e-portfolio is typically considered a tool for presenting specific work when seeking employment. However, it can be used in the classroom environment to effectively support learning and provide an assessment tool (Cole, Ryan, & Kick, 1995). In the classroom setting, the e-portfolio is often the container in which the final project is enveloped; the content of the final project greatly depends on the assignment and course subject. An effective research project utilizes the components of information literacy, which are then evident in the products included in the e-portfolio. Because the e-portfolio can easily incorporate multimedia, components of the e-portfolio can include audio files, video files, animations, digital images, 3D graphics, and electronic documentation.

In a class focusing on Plants and the Environment, students were required to examine how plants influence and are influenced by the environment. The students' research and findings of this semester-long project were to be encapsulated into an e-portfolio. The project required students to find scholarly research relating to plants and the environment, grow actual plants and capture this growth as digital images, interview a local scholar using a digital camcorder, and develop a field study report tying together their work over the course of the semester. The e-portfolio could be in the form of a Web site, DVD, or CD-ROM, but needed to include effective navigation to the various portions of the project requirements. This project was created by Dr. Carole Lambi, Associate Professor of Plant Pathology.

## Conclusion

Technology and information will continue to influence academic, work, and personal environments. To function effectively in these environments, individuals will need to be both technology and information literate. It is no longer a viable option for employers or universities to expect the other to handle the development of these skill sets. It is argued here that a university setting affords a great opportunity to combine and integrate these literacies in a variety of learning situations. Inclusion of technology into curriculum, while it should not be arbitrary, does not have to be an overwhelming or complicated process. Utilization of an instructional systems design model can guide the development of instruction, creation of objectives, and application of technology. To be successful, instruction must be designed to balance the two literacies, and integrate them with course content and goals to create meaningful results for students' immediate outcomes, to prepare them for the workplace, and to position them for lifelong learning.

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