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Information Technology Literacy: Implications on Teaching and Learning

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ABSTRACT

This paper aims to discuss the role and impact that information technology (IT) has on the future and existing style of learning and teaching. It highlights the importance of acquiring computer skills and being literate in IT. The focus is put on certain areas related to IT and education which include pedagogy and training to build IT literacy among both educators and learners. Particularly, it covers the current trends in IT development and how it has started to change and will further influence the way learning and teaching will take place in the future. This paper also discusses various theoretical frameworks and methodologies designed to cope with progress in IT. In summary, this paper delivers a message that IT literacy is the key to today's empowerment and that education is the best foundation for it.

Keywords

IT literacy, Computer literacy, Teaching and learning, Workforce development

Introduction

The demand for qualified IT workers rose steadily over the last decade and is likely to become strong again as the global economy recovers from the current recession. Two specific areas where demand for talent has been consistently growing are those of networking/telecommunications and e-commerce (Minch & Tabor, 2003). This demand is a worldwide phenomenon, with technology-based regions such as Southeast Asia banding together from a National Information Infrastructure plan (Bui, 1997). Organizations of all sizes are increasing their dependency on technology and electronic transactions, moving toward what Straub & Watson (2001) call the network-enabled organization (NEO).

The infrastructure that supports this trend requires technical talent to fill positions such as network managers, web administrators, e-commerce developers, and security specialists. Universities, on the other hand, face important challenges in educating the IT workers of tomorrow in these highly technical fields. Even with increasing enrollments, the number of graduates in computer science and information systems has been inadequate to meet worldwide industry demand (West & Bogumil, 2001), and our teaching methods have not evolved to meet the needs of students and employers in these rapidly changing technical fields (Laurillard, 2002). We face additional challenges in curriculum design with the changing student population. Stein and Craig (2000) note that the "dot.com generation" enters university with an intensive education in technology. Stein and Craig's experiences in Australian universities reveal that incoming students exhibit increased computer knowledge, have more confidence in their skills, and use IT applications more extensively than prior generations.

People acquire their technology literacy in two ways: formally through school programs or in the workplace, and informally, whether at home, from friends, or by themselves. Hoffman and Blake (2003) showed that students learn formally how to create and maintain presentation files as part of a course requirement, and participate in a threaded discussion or possibly create and maintain web pages. Informally, however, students use technology to share what interests them. Online computer help sites at many universities (UMD, 2002; QU, 2002) 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.

Instructors are feeling increasing pressure to use IT, but they commonly face several obstacles when attempting to use technological teaching techniques. Institutions of higher education must strategically develop IT integration plans that help overcome these obstacles, addressing the needs of diverse pedagogical agendas and multiple levels of comfort with technology. Barriers can make technology use frustrating for the technologically perceptive, let alone the many teachers who may be somewhat techno-phobic (Whitaker & Coste, 2002).

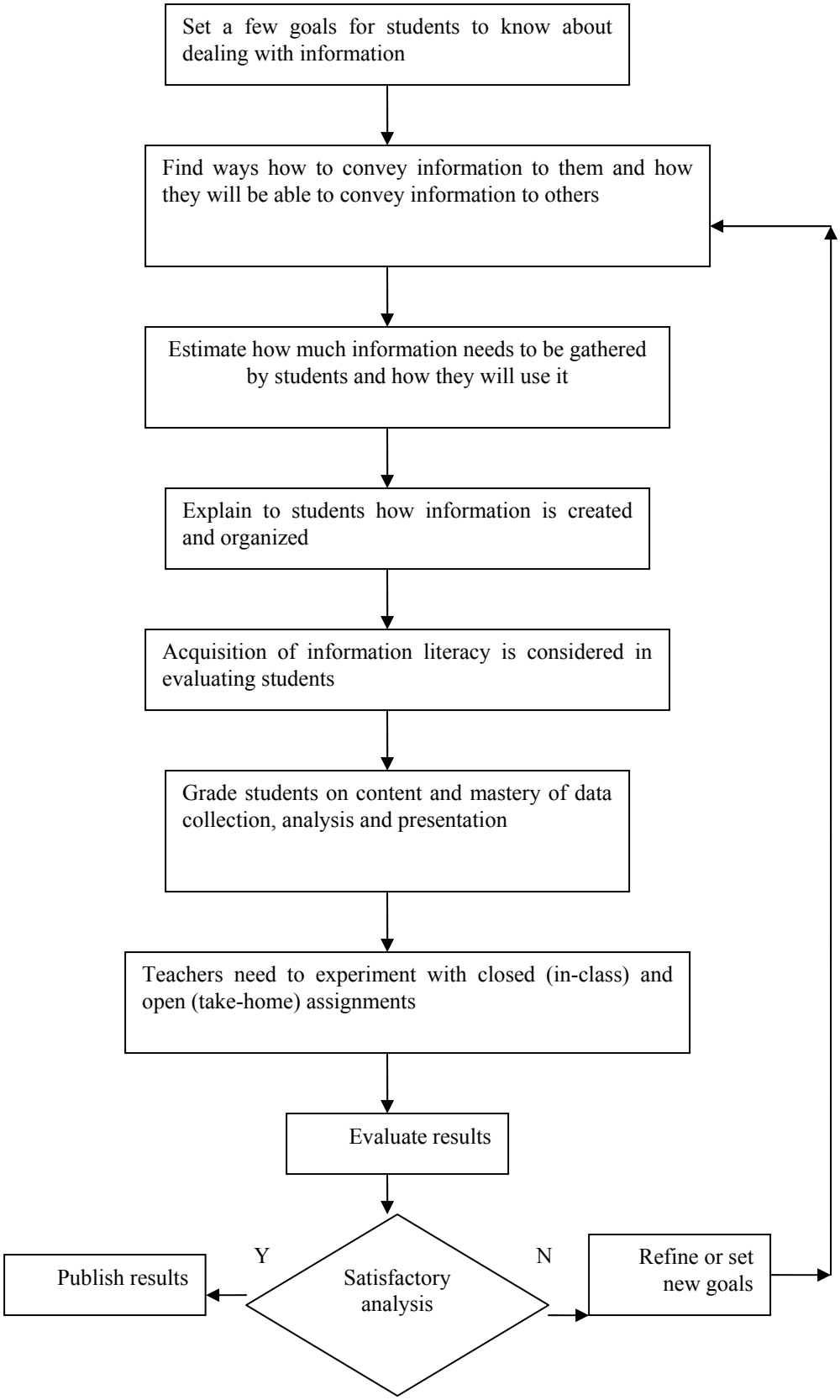

Figure 1. Setting-up and evaluating goals for students' learning

Each instructor uses his or her own approach to teaching and instructing, which he or she believes is the best for the students. Unfortunately, many educators seem unaware of the abundance of the research literature in the teaching and learning sciences to support and question their teaching approaches (Collis, 1998). Key principles for university didactics, as comprehensively reviewed and summarized are:

- Learning arises from the active engagement of the learner; cognitively active roles of both instructor and learner are necessary (Moonen, 1994).
- Communication-oriented pedagogy is turned towards the learner; assessment of competence depends on listening, observing, and responding to learners.
- Good learning is not instructor-transmission oriented but rather process-based and learner-oriented.
- A well-designed instructional environment requires instructor preparation, yet it is aimed at learner self-responsibility (Luft & Tiene, 1997).
- "We must do more with less," students want to move efficiently through their studies, instructors have to move efficiently through their budget (McAvinia & Oliver, 2002).

A common compass reading behind the mentioned principals can be recognized: some sort of strategic orientation in knowledge and skills that the educational system has to provide to a student. Though, not by *pushing,* but rather by preparing the learners to *pull* knowledge and by endowing them with skills that will enable and ease their further education (Trkman & Baloh, 2003). Candy (2004) argues that since organizations are becoming more knowledge based, academics as knowledge workers are ideally equipped to help students become lifelong learners in the information society. Figure 1 depicts a method of how teachers set up goals for students in order to help them learn and acquire knowledge.

Understanding and learning, whether about science or science education, technology integration issues, or teaching in general, requires and follows active involvement. This is true for students learning science, for pre-service teachers learning to teach, or in-service teachers and educators implementing education reform programs in schools (Stevens & Dexter, 2003).

IT Literacy

Over the past 25 years, models and approaches of computer and information literacy have started to merge. This process has been fueled by the rapid growth of technology and its increasing impact on society. Technology is becoming the vehicle for information, and the evaluation of information is becoming one of the main applications of technology.

Looking back chronologically (over the literature), it is obvious that technology paradigm shifts changed not only the way of computing but also how the technology itself is perceived by society. More important, these shifts advance the integration of computing with our environment. 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 then as a means of making people aware of this technology.

Computer Literacy

Computer literacy is finding greater common ground with other literacies. It has been described as literacy with digital texts (William, 2002). 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. Focus is shifting away from the computer toward its integration into a broader understanding of literacy. A brief look at the number of articles indexed under the heading "Computers — Study and Teaching," the subject heading most closely related to computer literacy in the *Reader's Guide to Periodical Literature*, shows a dramatic increase in the mid-1980s, as depicted in figure 2.

There is no agreement among scholars on the definition and measurement of computer literacy (Alshare, Grandon, & Miller, 2004). While some researchers define and measure computer literacy in terms of the number of computer courses completed, the amount of time spent on the computer, and having a computer at home, others consider the

familiarity with computer terms, experiences, and ability. Computer literacy is also defined as understanding computer characteristics, capabilities, and applications as well as the ability to implement this knowledge in the skillful, productive use of computer applications to individual roles in society. Accordingly, one of the important tasks the school system has to fulfill is to train students for effective use of technological tools in their future and present daily work.

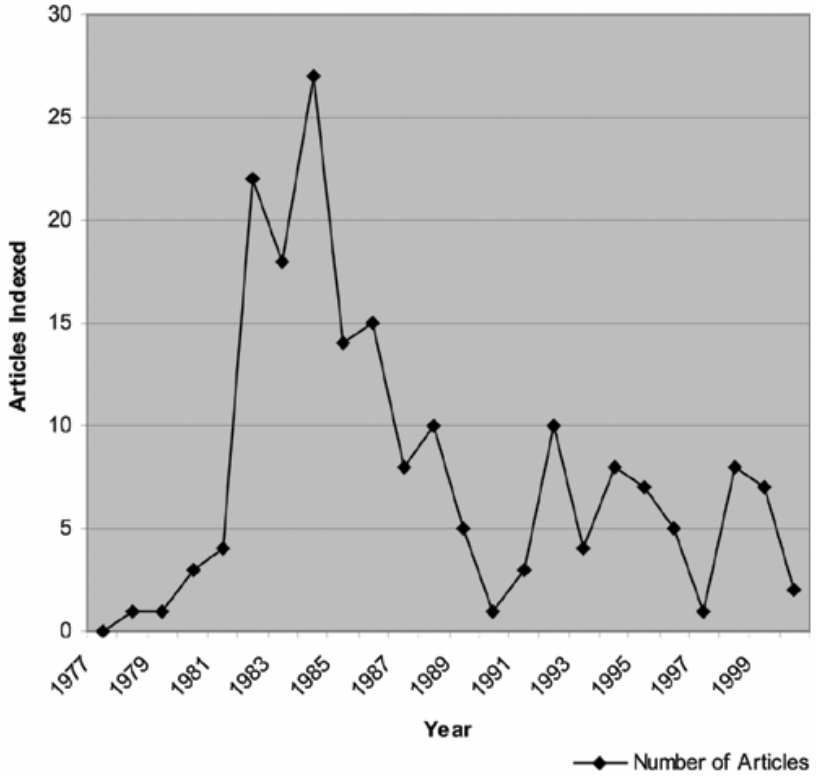

Figure 2. Number of articles indexed under the heading "Computers — Study and Teaching,"

Computer literacy is one of the most important skills a person can have in today's competitive environment. One of the most important changes was the transformation of blue-collar workers into white-collar workers (Hughes, Ginnett, & Curphy, 1999). The pervasive use of IT makes knowledge of and the ability to use IT essential requirements, no matter what kind of work is being done. Whether in a government agency or a multinational corporation, inadequate IT skills of employees are sure to undermine the day-to-day functioning of any organization (Mahapatra & Lai, 2005). Employees today must contribute value by what they know and by the information they can provide. Following that, it is harder and harder to imagine a successful professional career without decent knowledge of (IT) and its effectual use. The degree of computer literacy of new employees is a key element that may dictate the number of resources a company should allocate in training for a successful deployment of computer and IT skills.

IT Skills

It has been noted that high schools play an important role in providing students with computer literacy and preparing them for the global IT workforce (Csapo, 2002). Imparting basic IT skills to students is essential in order for them to function in academia, in the workforce, and in everyday activities. With today's technological society, basic computer literacy is emphasized in every institution's requirements, and is many times offered as a stand-alone core competency, in addition to being integrated into all other core curriculum content areas.

Skills such as managing a personal computer (Radi, 2002; Bartholomew, 2004; Burger & Blignaut, 2004; Hoffman & Vance, 2005), using word processing, network browsers, mail, and spreadsheet software, or understanding an

operating system are what are most usually subsumed under the label of computer literacy. Because IT skills are closely tied to today's applications, the set of necessary skills can be expected to change at about the same rate that commercial IT changes, i.e., quite rapidly. Note, for example, that a list of skills developed 10 years ago would not have mentioned the web or the Internet. Changes in the specific interests and needs of the individual involved also have a significant effect on what skills are essential. Over the course of a lifetime, individuals who use IT must regularly evaluate their skills and determine which new skills they need for their workplace or personal success.

Another hurdle in coping with computer literacy is the constant state of flux of IT today. For example, students with a basic awareness of HTML no longer require any knowledge of any encoding system in order to author web pages. In fact, web-authoring programs nowadays such as Dreamweaver or FrontPage not only facilitate the creation of static web pages, they also enable the creation of interactive web pages using a pull-down menu to insert JavaScript "behaviors" or snippets of code. Even learning about website navigation can become an issue. In many academic institutions, teachers use a web course authoring program such as WebCT or Blackboard to create a course website, where each course website presents a familiar and comfortable user interface to students.

The following list of topics is usually taught in many computer literacy courses. Acquiring these skills includes understanding what similarities and differences to expect between different products for the same task (Committee on Information Technology Literacy, 1999). The set of skills might include the following:

- Setting up a personal computer
- Using basic operating system features
- Using a word processor to create a text document
- Using a graphics and/or artwork package to create illustrations, slides, or other image-based expressions of ideas
- Connecting a computer to a network
- Using the Internet and the web to find information and resources
- Using a computer to communicate with others
- Using a spreadsheet to model simple processes or financial tables
- Using a database system to set up and access useful information
- Using instructional materials to learn how to use new applications or features

Skills, concepts, and capabilities represent the three major IT literacy components, which might be approached differently. Students can learn word processing through the need to prepare and submit essays, spreadsheets or databases through the need to manipulate data in science courses, and so on. Many students will develop some of these skills prior to college, but even those who do not will have considerable motivation to learn them. College students have many non-curricular opportunities to develop current IT skills, such as reading self-instruction books, learning from friends, or taking college or university workshops and non-credit courses taught by non-faculty professionals such as computing center professionals and librarians.

The fundamental concepts are somewhat harder to integrate into standard curricula. However, as instructors develop and structure their courses to use IT for enhanced pedagogical effectiveness, it will be increasingly possible to take advantage of the opportunities provided for discussing the fundamental concepts and the application of these concepts in terms that are relevant to the disciplinary content of those courses. For example, art students study images, and often these images are images on a computer screen. But understanding the fidelity of these images to the originals requires an understanding of how images can be digitally represented. A business course might use computer simulations to demonstrate business processes. But understanding the limitations of a simulation requires understanding how processes can be modeled and the nature and scope of their limitations.

The capabilities also warrant being taught as part of disciplinary or departmental instructional programs. Indeed, these capabilities contribute both to IT literacy and to developing analytical skills that are necessary for success in multiple disciplines. The mode of instruction is primarily through projects that serve the purposes of the domain yet offer students the opportunity to interact effectively with IT and to learn and/or exercise all capabilities.

Effective interaction with IT

Information literacy provides students with the opportunity to explore how information and knowledge shapes their lives, their community, and the world. Students become critical users of information, learning how to situate information and knowledge in a diverse global environment. One of the purposes of IT Literacy course of action is to

provide a framework for the integration of IT to achieve the vision of IT as a foundation skill area. Effective integration of IT into all curricula assists students in developing the abilities necessary to use, manage, and understand IT. The development of these abilities guides students on their journey toward IT literacy.

Careful consideration of the role of IT will lead to new ways of teaching, learning, and assessing (http://www.edu.gov.mb.ca/ks4/docs/support/tfs/developing.html) (Province of Manitoba, 1998). However, the presence of IT alone will not produce this transformation. Effective interaction with IT provides students with opportunities to:

- utilize the rich, interactive capabilities of IT, providing experiences traditionally unavailable within the school (i.e., computers used only for drill and practice or remedial work will not help reshape education)
- ask questions, identify problems, and seek multiple solutions to problems
- progress at their own rate and gain access to necessary learning resources
- work together, where the emphasis is on teamwork and critical and creative thinking
- act as peer tutors, helping classmates work through problems and challenges
- take responsibility for their own learning and strive to reach high expectations

In here, students focus on the role of technology as an integration tool and how it can be utilized to solve real-world problems, such as how to improve the way a company keeps its customers satisfied, the way decisions are made, how raw materials become finished products, or how products are distributed. Sophisticated IT interactions will be handled during specific training programs provided by the employer.

Targeted IT Training

The critical role of end-user training is regularly noted by corporate managers, as evidenced by the fact that U.S. companies planned to spend approximately $57 billion on employee training in 2001 and that more than one-third (37%) of such programs were targeted at improving the computer skills of employees (Galvin, 2001. While the training of technical employees is not a new challenge, measuring that training for effectiveness and efficiency remains a daunting task. Today, the training function must focus on sustainable competitive advantage by strategically aligning itself with overall corporate business goals (Devaraj & Babu, 2004).

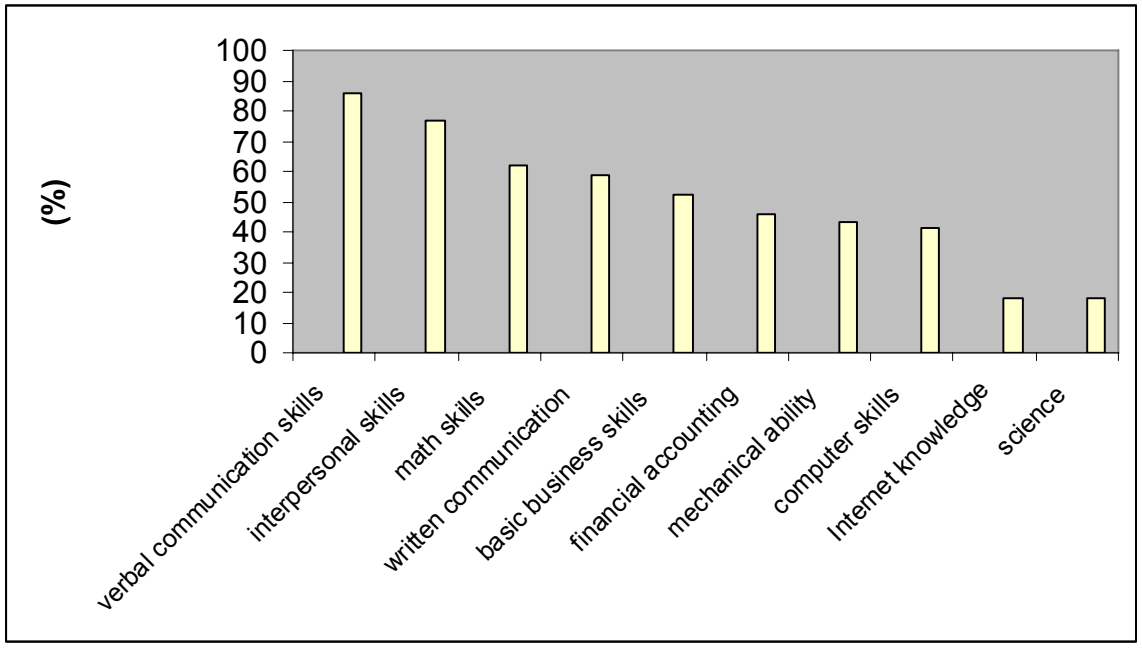

Figure 3. Voices from Main Street: Assessing the state of small business workforce skills

In the U.S., the education and training requirements of the 2000–2010 projected total job openings (Hecker, 2001) due to growth and net replacement are:

- 69.8% of jobs will require work-related training:
- 42.7% short-term on-the-job training
- 15.1% moderate on-the-job training
- 6.5% long-term on-the-job training
- 5.55% work experience in a related occupation.
- 20.9% will require a bachelor's degree or higher
- 9.3% will require an associate's degree or postsecondary vocational award.
-

Voices from Main Street is a program launched by American Express Small Business Services to engage small business owners in a national dialogue about the issues that matter most to them. This report presents the results of the American Express Voices from Main Street Survey, June 2000, which was the second in a series of U.S. small business opinion polls that reached nearly 800 small businesses (American Express, 2000). Computer skills and Internet knowledge represent 42% and 18% respectively. Other skills reported to be important are depicted in figure 3.

Two years later, the National Association of Manufacturers 2001 members' survey found computer skills and specific skills for a particular job were the most important skills representing 54.3% and 64.2% respectively (National Association of Manufacturers, 2002). Table 1 shows the rest of the skills and their corresponding percentages.

Table 1. National Association of Manufacturers 2001 members' survey

7.0%	of employers offered advanced math education opportunities
8.6%	basic reading and writing
9.3%	GED
13.3%	diversity awareness
14.5%	ESL
15.8%	basic math
19.0%	verbal communication
19.7%	formal apprenticeship programs
22.9%	interpersonal skills
25.1%	problem solving
28.7%	customer service
33.5%	teamwork/leadership
37.1%	certification training for various technical degrees/licences
39.6%	continuing education for technical/professional personnel
54.3%	computer skills
60.6%	tuition reimbursement for undergraduate or graduate programs
64.2%	specific skills for a particular job

A strategic business challenge facing all software companies is how to train their employees to keep pace with the software industry's ever-changing knowledge and development requirements. Organizations increasingly recognize that formal training is critical not only for the success of their software professionals but to the organizations' competitive position in the marketplace. One result is growing pressure on training departments to deliver high-quality training and education (Devaraj & Babu, 2004).

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 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 usually acquired by targeted training such as help desks (Hoffman & Blake, 2003).

In principle, educators are not well prepared to use IT effectively (Wright & Marsh, 2000). Proper training requires that faculty gain familiarity with a tool, observe someone experienced in its use implementing it successfully, use the

tool themselves, and then gauge its potential to help them meet their pedagogical goals (Barrette, 2000). The learning outcomes of technology use are the result of the activities in which the technology is used. Technology use in and of itself does not provide results (Ehrmann, 2000). Rather than having technology drive teaching practice, teaching goals should drive how technology is implemented (Frayer, 1999), and the training engaged must be prioritized in support of educational content (Sanford, 2000).

Despite the fact that some faculty members have overcome fears of an environment of depersonalized information delivery, training should not minimize the fact that technological advances present faculty with a lot of challenges, or that higher education as a whole has a lot to learn about how technology can enhance student learning. In fact, IT innovation may be occurring faster than our understanding of its use in practice (Merisotis & Phipps, 1999). To respond to the impact of this phenomenon, IT implementation must be approached more as an ongoing organizational learning process than as a technology-acquisition process (Levinson, 2000). Effective IT use involves a continual process of: 1) identifying pedagogical goals; 2) determining what activities will serve this goal; and 3) selecting the appropriate IT tools to implement the activity (Ehrmann, 2000). The fundamental question driving IT adoption must ask what the best methods to teach our students are at any given point in time.

Theoretical Framework for IT Literacy

Jurema and O'Rourke (1997) identified four theoretical IT constructs: tutorial, machine-as-human, tool kit, and catalyst. Their research claims that pervading these constructs is the understanding that IT can be used as an ideological agent, which is vital if there is a need to connect theoretical foundations with practice. The outcome of this investigation underpinned the importance to address both practical levels and theoretical perspectives of IT literacy in the educative process. The practical includes technical, socio-historical, and political-ideological levels, while theoretical perspectives help us to identify which conceptions emphasize the way IT is used.

A theoretical framework for IT literacy could be drawn from various research approaches: 1) organizational knowledge creation theory (Von Krogh et al., 2000; Nonaka, 2003); 2) relational information literacy theory and practice (Bruce, 1997a; Bundy, 2004); and 3) systems thinking methodology (Checkland, 1999; Checkland, 2000; Somerville et al., 2006).

Bruce (2000) argued that research driven by critical theory is intended to be empowering and participatory, and is likely to be of substantial concern to practitioners. Like other research approaches, critical research is recognizable through the philosophies and views supporting it. Relational research, specifically phenomenography, searches to expose important differences or variations in people's ways of seeing aspects of the world. This is achieved through attending to variation in what is called the "relation" between people and the phenomenon of interest. Systems thinking methodology (Somerville et al., 2006) offers a holistic systems thinking framework comprised of rich pictures, root definitions, and conceptual models. This methodology provides common language and shared tools for discussion and analysis of the complexities and interdependencies of situated issues in order to facilitate participants' efforts to make tacit professional knowledge explicit.

Somerville et al. (2006) employed a theoretical framework for IT literacy that blends Eastern and Western approaches to knowledge creation through making implied information explicit and codifying it, while also enhancing implied knowledge flow through better human interaction to generate new ideas.

Numerous studies use a well expressed theoretical framework and provide the research and practitioner community with new methods of thinking about significant aspects of information literacy. For example: 1) Cheuk (1998) used the sensemaking approach to investigate the experience of IT literacy in the workplace; 2) Limberg (1999) studied the use of phenomenography to determine varying ways of experiencing the information-seeking and -use process; 3) Bruce (1997b) conducted phenomenographic exploration of people's varying experience of information literacy; and 4) Todd (2000) examined a cognitive analysis of adolescent girls' use of heroin information to get a better picture on the impact of the drug and hence increase learning capability.

Colins (1995) investigated a number of theoretical and empirical studies on various aspects of literacies. Recently, various new literacies have been identified and conceptualized, and new categorizations of literacies have been proposed (Leu et al. 2004; Lonsdale & McCurry, 2004). However, as Lonsdale and McCurry (2004) argue, not all

new theories have added much value to existing conceptualizations of literacies. Their research review suggests that the most explicit and comprehensive theoretical framework for the investigation of literacies includes two taxonomies. The first taxonomy separates the motive of the literacy according to who benefits from literacy: the individual or society. The second taxonomy positions various conceptual and practical aspects of literacy enhancement into two models: autonomous and ideological.

Various taxonomies classify theoretical and practical perspectives according to different criteria. For example, Ba et al. (2002) classify the definitions of digital literacy according to their conceptual and operational features. They identify four major groups of definitions: technical, generic, generic with information technology, and problem-based. Corbel and Gruba (2004) classify perspectives of computer literacy according to their conceptual origin. They identify four categories of perspectives: skills, textual practices, sociopolitical, and information.

The basic IT skills perspective has a more empirical, rather than philosophical, conceptual base (Martin 2000) and a strong wide-ranging practical presence in day-to-day IT literacy teaching and assessment practices (ECDL 2004). This perspective focuses on the basic practical skills needed to use computer hardware, software, and networks.

The cognitive perspective focuses on IT literacy outcomes from a generic skills angle. This view integrates IT knowledge and skills with problem-solving and information handling capabilities (Markauskaite, 2006). Therefore, theoretical works and practical implementations emerge in different disciplinary domains such as information literacy (Eisenberg & Johnson, 2002) and interdisciplinary domains (Candy, 2004). Ba et al. (2002) described two structural approaches: problem-based and generic with information technology. The difference between these two approaches is that problem-based approaches structure IT outcomes based on the key steps of the problem-solving, whereas the generic approach does not link knowledge or skills to specific problem-solving.

Challenges in IT Education and Integration Efforts

Generally, students are expected to support and nurture the learning experiences of their classmates as well as their own (Whitaker & Coste, 2002). This sense of responsibility for one's own learning and the learning of others is extremely empowering and not something to be tampered with. However, it has been observed that fears that technology would dilute this culture were largely groundless. In fact, it may be that IT's greatest contribution to education will be that students take more responsibility for their own learning experiences. Although the inhibiting effect of computer phobia/apprehension was an early concern in the classroom adoption of IT, these fears have faded. The most important factor in reducing apprehension appears to be overall experience with technology (Scott & Rockwell, 1997). In addition, the socially and culturally neutral IT environment (Do & Lee, 1997) seems to mediate the effects of power dynamics present in oral communication and may further reduce apprehension in articulating ideas. As students' exposure to technology increases, IT emerges as an excellent venue for all to share in the learning experience.

Throughout the world, information and communication technology (ICT) is changing the face of education. In addition, ICT is changing the nature of work and the workplace. The knowledge revolution combined with economic globalization has created conditions in which countries that have focused on knowledge-based industries have been able to harvest significant rewards. Knowledge-based industries require an educated labor force of computer-literate individuals who themselves understand and can harness the power of ICT. In response to the demands for producing such a labor force, many countries have changed the objectives of their education system and have directed much of their attention to the development of ICT skills in schools.

Furthermore, ICT offers tremendous possibilities in enhancing students' learning, developing teachers' professional capability, and strengthening institutional capacity. Such possibilities include: 1) computer-aided applications which could be used to individualize learning while giving immediate reinforcement and feedback; 2) combination of computers and multimedia tools and then integrating graphic, audio, and video into appealing computer-based instructional units; and 3) computer-mediated communication technologies such as instant messaging, bulletin boards, and computer conferencing to facilitate communication among students and teachers.

The introduction and sustainability of ICT in the education system is also expensive. The capital cost of the entire infrastructure needed to initiate the process is quite obvious. A little less obvious is the high level of recurrent costs

associated with the effective use of ICT. An attempt must therefore be made to optimize the benefits of such large investments and to develop cost-effective maintenance procedures.

Administrative Barriers

Keen vendors, hoping to corner the educational market, provide cut-rate products and services. Legislators pass budgets with large sums for educational technology, because they fear that students will be unprepared for the future unless they use technology every day in school. As a result, well-meaning administrators often seize upon technology as a solution to their budgetary problems. No doubt, some administrators also see technological initiatives as a path to their personal success, a way to make their mark on an institution and advance their own careers (Neal, 1998).

Linked to uncertainty about administrative motives for promoting IT is the necessity for administrative support of the pedagogical rationales for using educational technology tools (Whitaker & Coste, 2002). Administration must acknowledge and address institutional barriers to technology selection and implementation for IT to thrive in the classroom. Usually, administration (or management) provides the original momentum to create an IT committee and will be responsible for charging the group with its mission. Throughout the evolution of the IT environment, administration should monitor how the group is reacting to the challenges encountered during the continual attempts to upgrade and maintain the IT resources.

One of the most popular methods of support for faculty is one in which the complete responsibility for incorporating technology is placed on IT services. The role of the faculty member is to provide the idea. It is then the responsibility of IT services to take the idea and make it work with the technology available on campus. It is also IT services' duty to maintain the tools and technologies and update them when necessary. Accordingly, IT services should design services that are stable and easy to maintain because they know that, in the end, they will be the ones looking after it (Wainwright & Arnold, 2004). High-quality IT literacy teaching requires the administration to provide support for faculty by adequately funding the staffing of IT services personnel to levels that can accommodate the demands placed upon them.

IT Support Structure

IT literacy education focuses on how to effectively enhance teaching and learning, involving all the structures and processes used by an institution to support effective student learning including, for example, support through independent learning, e-learning, and distance learning. It places great importance on the role of "support" services in supporting effective learning, for example, in the provision of libraries and information services and the institution's IT infrastructure. It considers that students are active partners with shared responsibilities for their own learning and achievement, and that one of the defining characteristics of education is the extent to which it relies on this active participation in, and student ownership of, the learning process.

Hampel & Keil-Slawik (2001) argue that mainstream discussions on the role of technology in teaching and learning are based on two basic paradigms. Hypermedia systems aim to support individual learning processes, with special emphasis on new educational qualities, which are attributed to the interactive combination of various media types such as text, graphics, audio, video, etc. The second paradigm embodies the notion of delivering education through networking technology to distribute and access study materials as well as establish communication channels between students and teachers. Students are able to learn individually at their own pace and at their own selected location.

At an institutional level, an area of faculty concern is the support available to them when technology tools fail. Similar to the experiences described by faculty at different institutions, those of us who have used various technologies in our classrooms encountered related problems. Most commonly, problems developed when a new technique was being implemented without sufficient debugging or when software was upgraded without sufficient warning or documentation. Moreover, having faculty and technology staff in constant communication about practices that result in less-than-desirable experiences has greatly improved the likelihood of having adequate lead-time to effectively adapt to new technological tools (Whitaker & Coste, 2002).

Over time, we have learned that the most effective applications of IT tools are those that encourage a more active student involvement in the learning experience, facilitate a greater depth of understanding of course content, and promote richer communication between faculty and students (Whitaker & Coste, 2002). In keeping with our foundational belief in the importance of continually evaluating the pedagogical impact of the methods, this longitudinal process ignores traditional student/faculty boundaries and facilitates the practice of a discipline much like what is achieved with the apprentice system. To the extent that the learning community's members are dependent upon their modes of communication and dissemination of knowledge, a sustained environment is established that determines the tenor of interaction (Brown & Dugid, 2000). However, for this environment to be beneficial for all, a number of critical factors must be attended to: 1) the varying technological opportunities and challenges of different disciplines; 2) the faculty's concerns about the impact of technology on their students' learning, classroom environments, and the make-up of the institution; 3) the training needs of users at a variety of levels of technological expertise; and 4) the unique support demands of each technological tool being adopted.

Future Trends in Computer Literacy and Learning

Computing technology profoundly shapes the definition of computer literacy. Understanding the trends of today will help us make an educated guess about the future. 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. Wireless technology truly frees laptops to be mobile, providing an application from a particular platform at a particular location. In essence, portability and mobility imply access to information and the ability to communicate from any place and at any time.

Pedagogy concerned with critical literacy and new technologies began a long way back. Many teachers, and many teacher educators, are simply not conversant with operational and cultural aspects of new technologies and their associated social practices and literacies. The development of new interactive technologies inevitably has an impact on all aspects of teaching and learning. This is more evident in the case of novel interactive technologies that fascinate the broad public, such as Virtual Reality (VR) and computer and video games.

VR, the three-dimensional, multisensory, immersive, and interactive digital environment, has triggered public imagination as the technology that will dominate the way our work, education, and leisure are delivered in the future. VR is a technology that was traditionally associated mainly with gaming and entertainment. During the last decade VR has gained recognition also for its great educational potential. For educational purposes, VR has been proposed as a technological breakthrough that holds the power to facilitate learning. VR can work for educators as a tool in assisting students to become immersed in a learning environment where they can participate in their own learning in a technology-based environment. Recent research has identified several capabilities of the VR technology that are expected to facilitate learning (Youngblut, 1998; Halvorsrud & Hagen, 2004). The visual nature of VR and the intuitive manner in which users (students) can control and manipulate virtual objects are thought to be the two main ingredients that support learning in virtual environments (Win & Jackson, 1999). Research in VR and education is a relatively young field, but in recent years it has shown considerable growth (Roussou, 2000; Roussou, 2004; Connolly, 2005).

Video games for learning are important and can be used at different academic levels (Aguilera & Mendez, 2003). In addition to simulating motivation, video games are considered very useful in acquiring practical skills, as well as increasing perception and stimulation, and developing skills in problem-solving, strategy assessment, media, and tools organization. Of all the games available, simulators stand out for their enormous educational potential.

Playing games to learn basic life skills has been an important learning strategy from the earliest times and remains so today, especially for early instruction at home. However, when games are mooted as strategies for formal instruction, opinion quickly polarizes around two very different positions: on the one hand, some educators will point out that apart from their undeniable power to motivate, games are capable of fostering the development of valuable skills in areas such as strategic thinking, communication and collaboration, group decision-making and negotiation, and literacy and numeracy. On the other hand, others (perhaps less willing to accept the role of fun in education) see games as wasting valuable time, irrelevant to set curricula, and incapable of helping students to achieve mandated high-stakes outcomes. The advent of digital games has tended to add more fuel to the controversy, being popularly

portrayed as even more time-consuming, motivational to the point of addiction, and fostering a range of antisocial values that may translate into sexist, racist, or criminal behavior.

It is repeatedly pointed out, for example, that young people choose to spend many hours playing complex computer games outside school. Games seem to have a way of engaging and interesting young people. The desire to harness this motivational power to encourage young people to want to learn is the main driver behind an interest in computer games for learning.

Summary

The growth and use of IT and the resulting demand for workers with specialized skills have placed a considerable demand on the traditional educational system to provide a qualified and sustainable IT workforce (Randall & Zirkle, 2005). According to the US Department of Labor statistics (2004), IT is the fastest growing sector in the economy, with a projected 68% increase in growth rate between 2002 and 2012. In response to advances in computer technology, rapidly deprecating skills sets, and the slow response of traditional education, the IT industry uses extensive training programs as a way to accredit its own (Clarke, 2001).

The goal of integrating and implementing IT as a foundation skill area within all curricula is to help students on their journey toward IT literacy through the use, management, and understanding of IT. Curriculum developers, teachers, and administrators play a significant role in working toward achievement of this goal. Strategies for the integration and implementation of IT, developed with an understanding of the use and historical impact of IT, will help facilitate positive change in the classroom and lead to IT-literate students.

Many, if not most, colleges and universities understand that IT will play an increasingly large role on their campuses (Burg & Thomas, 1998). Indeed, some colleges and universities are requiring that all matriculating students have a personal computer for use throughout their college careers. Courses are being restructured and new curricula are being developed to take advantage of new pedagogical opportunities offered by IT.

Students who are successful in these courses must have skills adequate to support their use of the technology. Most institutions and courses provide some opportunities, whether in for-credit courses or not, for students to learn these skills. But the fundamental concepts and intellectual capabilities do not seem to be essential in these courses in any meaningful way. The challenge for colleges and universities is then how to build on the existing infrastructure of hardware, support services, and technology-adapted curricula and courses to support IT literacy.

IT-literate people who are equipped with a set of IT skills, understand the basic concepts on which IT is founded, and those who have engaged in the higher-level thinking embodied in the intellectual capabilities should use IT confidently. They should come to work ready to learn new business systems quickly and use them effectively, and they should be able to apply IT to personally relevant problems. They should be able to adapt to the inevitable change as IT evolves in their lifetime.

In summary, education is a process, and as such can be constantly improved (Funk, 2005). Improving education involves internal and external resources and influences. Just one or more of these factors can cause a learner to drop out. If this happens, then we as educators have failed to help individuals achieve their full potential. However, if we intervene in some manner by creating a sense of community, facilitating financial aid, validating their shared ideas, and being sensitive to problems of adult life; then we are empowering students to learn, live, and serve.

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