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AN INFORMATION TECHNOLOGY LITERACY SELF-ASSESSMENT INSTRUMENT: DEVELOPMENT AND PILOT RESULTS

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Abstract

The information technology quotient is on the rise in every field imaginable – computers and the Internet are everywhere. Essential information technology (IT) competencies are often taken for granted, to the detriment of students who lack computing and Internet skills. A standard set of computer skills that clearly define the IT competent individual has yet to be determined. However, an upsurge of interest in online learning has prompted many institutions of higher education to implement an assessment measure that aims to ascertain student readiness for distance education via the Internet. This paper summarizes commonly employed IT assessment instruments and introduces a new self-assessment instrument that focuses on three areas: computer hardware and system software; software applications; and networking, the Internet and information literacy. A preliminary administration of the instrument is described.

KEYWORDS: assessment, curriculum, education, computer skills, information systems, computer science, Internet, computer literacy, digital literacy, IT literacy, IT competency.

Introduction

No industry is untouched by the information technology (IT) revolution. The IT quotient – work that is dependent upon computing technology and the Internet – is on the rise in every imaginable field. Commerce, education, communication and socialization in particular have undergone radical transformations. Nonetheless, fundamental IT skills are not necessarily treated as equal to the other must-have competencies: math and English. Critical IT competencies are often taken for granted, to the detriment of students who lack computing and Internet skills.

Attention to IT competencies has taken a few twists and turns in higher education. Not too many years ago, students on many college campuses were required to demonstrate a basic level of computer competency. Several institutions developed computer literacy courses that all students were required to take. The primary focus of these courses was developing basic skills in the use of applications such as word processing, spreadsheet and presentation software. Eventually, these computer skill-based courses began to disappear as many educators believed that students were entering the university well-versed in basic computer usage.

While most students today have exposure to computers and experience using the Internet, a gap is emerging between functional and analytical uses of computing technologies. That is, exposure does not equate with understanding. Students may be able to use a word processor and surf the Internet, but they often do not understand the fundamentals of how and why these technologies work. An analogy is often put forth that relates using a computer to driving a car. Certainly, one does not need to know the engineering principles or mechanical processes behind an automobile to be a successful driver. But the comparison of the automobile to the computer is incomplete. Whereas the results of driving a car are distinct and finite, the outcomes of using the resources and information that emanate from computer technologies are infinite and complex. Cars get us from point A to point B; information technology allows us to reinterpret the journey.

We are in the age of ubiquitous and pervasive computing. Universities are again pondering what defines computer literacy and what specific skills are needed to effectively utilize computer technologies. Computer literacy has traditionally been defined as the ability to use computers to perform a variety of tasks, but that definition is no longer adequate. Computer literacy no longer simply means viewing a computer as a collection of applications; it also means using the computer as a means of communication and a source of information [Hoffman, Blake, McKeon, Leone, and Schorr, 2005]. These same authors provide an expanded definition of computer literacy. Specifically, they state that computer literacy includes both "information literacy, the ability to evaluate information found online, and critical computer literacy, the ability to incorporate computing technology in support of critical thinking" [p. 164]. Moreover, computer literacy must now be extended to digital literacy, as students are increasingly expected to interact with information and content made omnipresent by the fact that it is digitized and available on a variety of devices.

The challenge for institutions of higher education is to operationalize the expanded definition of computer literacy. This is a major undertaking, as the functional definition of computer literacy is expansive. One of the first steps for many universities is to assess the IT skills and competencies possessed by all incoming freshmen and then to provide remediation vectors for students who do not demonstrate adequate mastery of those competencies. The approaches taken differ greatly among institutions. This paper introduces a self-assessment instrument and describes results from a pilot administration of the instrument.

Assessment of IT Competencies

For quite some time, institutions of higher education have espoused the need to create graduates who demonstrate a set of IT competencies. While there is no standard set of computer skills that clearly define the IT competent individual, many institutions have implemented assessment measures that attempt to ascertain the specific computer skills students possess. For the most part, these assessments focus on basic computer operations, use of functional software such as word processors and basic skills in searching the Internet and using e-mail. A typical computer literacy assessment instrument evaluates student skill levels in such tasks as creating a document in a word processor, naming the parts of a computer, sending an e-mail, participating in a chat session and using a search engine on the WWW. Some instruments even include sections related to creating a Web page and setting up a small network.

A broad array of assessment initiatives has been undertaken at the university level. Most of these are focused at evaluating the IT competencies of incoming freshmen with the goal to address and remediate gaps in individual student skill levels. These assessment instruments can be categorized into two general areas: assessment via a published skills-based proficiency test, or in-house developed assessment instrument.

Published Skills-Based Proficiency Assessments

Several skills-based assessment instruments are available which test IT proficiency. Many of these assessments lead to some type of formal certification These tests generally include evaluation of skills or knowledge in general computing concepts, Internet use and application software (word processing, spreadsheets, presentations and databases). The most widely known of these assessments is Certiport's Internet and Computing Core Certification (IC^3). The certification is divided into three exams covering the areas of "computing fundamentals, key applications and living online" [Certiport, 2006]. The "Computing fundamentals" component tests for basic understanding of computer hardware, purchasing and maintenance decisions, identifying different types of software and what they are best suited for, fundamental concepts about the use of databases and understanding of basic operating system and file manipulation operations. The "Key applications" component tests basic skill in using word processing, spreadsheets and presentation software. The "Living online" component tests basic concepts in networking, skill in using electronic mail and searching the Internet, understanding the different types of information sources found on the Internet and understanding risks and responsible use of computers and the Internet.

Another example of a widely available computer literacy assessment instrument for undergraduate students is known as the Tek.Xam. Tek.Xam is a partnership between the Virginia Foundation for Independent Colleges, and ACT, Inc, an internationally known educational assessment corporation. Tek.Xam has 12 different online tests that evaluate student proficiency in seven areas, including general computing, knowledge and use of the internet, word processing, spreadsheets, presentations, databases and web authorship. Separate tests are administered for each area and immediately upon completion students are provided a report of their test results outlining their strengths and weaknesses.

Another widely available assessment instrument is sponsored by the International Computer Driving License (ICDL), an international essential IT skills certification in use by over 140 countries. The ICDL has been noted as providing a standard for assessing computer literacy world-wide with the main intent of providing individuals with a way to demonstrate their IT proficiency to potential employers. The assessment instruments are built upon a standard syllabus of IT competencies as identified by the European Computer Driver License (ECDL) Foundation. The ICDL assesses skills in seven basic areas including IT concepts, operating environments, word processing, spreadsheets, databases, presentation graphics and the Internet and e-mail. Obtaining certification or the ICDL 'license' requires passing tests in all seven areas.

Finally, textbook publishers have entered the IT competency assessment arena by offering series of skill-based assessments coupled with computer-based learning systems for end user applications. In late 2004, Course Technologies launched a program termed the "SAM Challenge" [Course Technology, 2004] built from their computer-based training series. SAM, short for Skills Assessment Manager, is designed as a series of IT assessment instruments that coincide with Course Technologies' computer-based training programs. The assessments employ the use of simulated software environments. Tests cover areas such as basic computer skills using the Windows XP operating system, application software skills using Microsoft Office and Internet skills using Microsoft IE. Colleges and universities can build their own exams from the Course Technology 60,000 item test bank. Provisions are also available for customizing the test by including in-house designed questions.

Prentice Hall offers a similar program using the title "Train and Assess IT" [Prentice Hall, 2006]. The program is heavily weighted towards Microsoft Office applications but also includes topics such as basic computer and Internet use. Like SAM Challenge, this program uses performance-based testing utilizing simulations of software applications. If desired, Train and Assess IT will provide immediate student feedback and map students to appropriate 'Train and Assess IT' computer-based learning modules or Prentice Hall texts from their 'Go!' series.

A summary of the skills and competencies evaluated by published skills-based proficiency assessments is presented in Table 1. Competencies were divided into 11 different domain categories. As noted, these instruments, for the most part, are task and skill oriented. While, each of these instruments assesses needed and worthwhile IT skills, they represent only one aspect of computer literacy. Further, these certification based evaluations, tend to assess IT skills in isolation. They focus on the functional use of computers; they do not attempt to evaluate the analytical skills students need to be able to use computing technologies to support critical thinking activities.

Table 1. Competency Area Represented in Published IT Assessment Instruments

	Assessment Instrument				
Competency/Skill Area	**IC^3**	**Tex.Xam**	**ICDL**	**SAM Challenge**	**Train & Assess IT**
Basic concepts of IT	X	X	X		
Hardware and hardware components	X	X	X		
Operating System basics including file management	X	X	X	X	X
Word processing	X	X	X	X	X
Spreadsheets	X	X	X	X	X
Presentation Software	X	X	X	X	X
Database fundamentals	X	X	X	X	X
Use of the Internet (Web browsing and search engine)	X	X	X	X	
Web Page Authorship		X			
E-mail	X		X		
Societal Impact of Computing Technologies [including legal aspects, ethics]	X	X			

In-House Developed Assessment Surveys

A number of colleges and universities assess IT competencies among incoming freshmen using in-house developed instruments. These instruments represent two basic forms: self-reported student evaluations or objective-based tests. In general, self-reported assessments are optional and provide a guide for students to evaluate areas in which they need remediation. Objective tests, on the other hand, are usually required.

A review of 10 publicly available in-house developed assessment instruments was undertaken to identify commonly cited IT competencies. Competencies were categorized into 13 different domains, 11 identical to those outlined in the published assessment instruments and 2 additional areas not previously reported. These included attitudes and computer security. This data is presented in Table 2.

Table 2. Competency Area Represented in In-House Developed Assessment Instrument

Competency/Skill Area	Number of Instruments Covering this Topic
Basic concepts of IT	5
Hardware and hardware components	5
Operating System basics including file management	10
Word processing	10
Spreadsheets	10
Presentation Software	7
Database fundamentals	1
Use of the Internet (Web browsing and search engine)	9
Web Page Authorship	1
E-mail	9
Societal Impact of Computing Technologies [including legal aspects, ethics]	3
Computer Security (primarily related to virus protection)	5
Attitudes towards computing technologies	1

An analysis of these self-assessment instruments shows that they are primarily competency or skill-based. In other words, these instruments attempt to identify 'what' a student can do. While this has merit, it is also short-sighted. Having a level of technical competence in using computer technologies does not necessarily translate into being computer literate.

The Educational Testing Service (ETS) has developed a standardized instrument that attempts to assess IT proficiency. The Information and Communication Technology (ICT) test is focused on information literacy and uses a novel approach based on interactive scenarios. A description of each of these proficiencies and task descriptions may be found at the ETS web site (www.ets.org under the ICT Literacy Assessment link).

Use of Assessment Instruments

The primary objective of these assessment instruments is to provide students with information for the purpose of remediation. Based on results, students are often advised on how to gain a level of IT competency deemed appropriate for a beginning college student. For instance, students who do poorly on an assessment might be advised to take a particular entry level computer literacy course. Students who perform poorly on particular sections of the assessment might be advised to take a workshop or engage in a computer-based training program. The assessment serves as a guide for the student in terms of the IT competencies they are expected to have mastered and a warning as to what proficiencies they are expected to acquire.

The IT Competency Self-Assessment

After reviewing existing instruments, a decision was made to blend the best of published surveys with more contemporary IT issues, especially those we see lacking in our own students. Students entering universities today have had more exposure to IT than ever before. And technology itself is fundamentally different today than in previous iterations of computer literacy. So we identified a need for a more flexible instrument, one that could be quickly adapted to rapid changes in the technology landscape and to the needs of our students.

Our instrument contains items that address three broad areas of IT competency: computer hardware and systems software, application software, and networking, the Internet and information literacy (Table 3). The competencies and skills were divided into these categories to parallel the modules in the IT literacy course developed by the authors. A five point Likert scale was used for all items in the instrument.

At our university, students may elect to enroll in a first year class titled "Computers and Your World." Organized around the three areas described above, the course includes varied topics such as updating an operating system, designing a database, conducting research on the web, securing a home network, and creating a web site. Other topics include privacy, globalization, diversity and ethics.

Table 3. Competency Area Represented in IT Competency Self-Assessment

Competency/Skill Area	Items That Address This Area
Computer Hardware and Systems Software	4, 5, 6, 10, 18, 19, 23, 26, 27, 28, 31, 37, 38, 42, 43, 46, 47, 49
Application Software	2, 3, 9, 11, 16, 21, 22, 28, 35, 36, 39, 40, 44, 46
Networking, the Internet and information literacy	7, 12, 13, 14, 15, 16, 20, 24, 25, 28, 29, 32, 33, 34, 41, 45, 48, 50

Results

The instrument was administered to 95 students in five sections of our course. All five sections of the course were taught by the three authors, two of whom had two sections each. The instrument was administered on the first day of class and again at the end of the term. Most of the students were freshmen because all five sections were coupled with other required first year courses. That is, students met a first-year requirement by enrolling in a "learning community" which bundles 2 or more required first-year courses for registration purposes.

Table 4 shows the average across all sections on a sample of items that address attitudes toward computers, use of specific Internet applications, and the degree to which respondents considered themselves computer savvy. Table 5 shows the average across all sections on a sample of items that address specific competencies. Because this is an exploratory examination of the instrument, no strong quantitative analysis has been conducted yet. Tables 4 and 5 show primitive descriptive reports of our results.

Table 4. Sample of Attitude and Use Items Before and After Taking IT Literacy Course

Question	Before	After	Difference
I surf the web every day.	4.5	4.8	0.3
I check my e-mail at least once a day.	4.3	4.4	0.1
I frequently use IM to chat with friends.	3.7	3.9	0.2
I enjoy learning about new technologies.	4.1	4.2	0.1
I enjoy using computers.	4.5	4.5	0.0

Table 5. Sample Competency Items Before and After Taking IT Literacy Course

Question	Before	After	Difference
I know how to determine how much RAM is installed on a computer.	2.8	4.2	1.4
I know how to change BIOS settings.	1.9	3.1	1.2
I know how to use an FTP or SSH program to transfer files.	1.9	3.4	1.5
I know how to receive information via an RSS feed.	1.8	3.0	1.2
I know how to disable and enable cookies in a Web browser.	2.9	4.0	1.1
I consider myself computer savvy.	3.4	4.0	0.6

Conclusion

This paper reports on a preliminary examination of a new instrument to assess IT literacy in first-year university students. Results are largely description and so there are limits on our ability to interpret and generate conclusions. Rather the results can guide a qualitative, reflective discussion of the current state of literacy in our first year students. For example, the greatest changes were observed in items that referred to file transfer and hardware configurations. The students perceived that their knowledge of these two areas has increased. It is unclear whether or not their knowledge has actually increased, but increased awareness is a step in the right direction. An important goal of the IT literacy course is to manage student perceptions and expectations about what they need to know in order to succeed as college students.

Next steps for this research include the following: First a larger number of students are needed to participate in the study. Ideally students from multiple institutions will participate in the future, allowing not only for more rigorous statistical analysis, including tests for significance and possibly refinements to the three clusters we have identified so far.

IT literacy is a moving target and instruments used to assess IT literacy must be fluid in design. Many of the competencies encompassed by what has variously been referred to as IT literacy, computer literacy, information literacy, and computer fluency change at the same rate as the underlying technologies themselves. IT is indeed the third literacy on par with English and mathematics.

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Meg Murray is an Associate Professor in the Department of Computer Science and Information Systems at Kennesaw State University, part of the higher education system of the state of Georgia. She holds a Ph.D. in Information Systems, an MBA in Finance and a MS in Computer Science. She has been in the field of computing for more than twenty years and has served both in higher education and industry. Dr. Murray specializes in the area of emerging technologies and the development and implementation of those technologies to meet business and organizational needs with a special interest in technology infusion in healthcare. Her focus in teaching is to inspire students to create and devise new and innovative ways to implement information technologies to solve real-world problems. Her most recent work is in the area of devising strategies to assess and remediate IT skills needed by an educated workforce to ensure they are able to use the power of technology as a means for innovation, the driver necessary to sustain economic growth.

Martha Myers is Professor of Computer Science and Information Systems (CSIS) at Kennesaw State University (KSU), where she has taught since 1990. Dr. Myers holds three degrees from UT Austin: BA mathematics, MA mathematics and computer science education, and PhD information systems. She served as CSIS Department Chair from 1993-2000. From 1985-1988, she was Vice President of Systems for Continental Insurance Company. She has also taught high school mathematics and computer science. Teaching interests include database systems, systems analysis and design, project and team management. Research subjects include diversity in the IT work place, real-time writing, and database pedagogy. Dr. Myers is faculty principal for KSU's Women In Technology student organization and chair of OWLS (Outfitting Women Leaders in the Sciences), a faculty organization at KSU.

Appendix A

Information Technology Self-Assessment

Name:	Section:	
Major:	Age:	Gender:

Instructions: Circle one number to indicate the extent to which you agree or disagree with each statement.

Question	Scale of Agreement				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I surf the Web every day.	1	2	3	4	5
2. I am skilled in using a word processing program such as Microsoft Word.	1	2	3	4	5
3. I know when it is more appropriate to save an image as a GIF rather than a JPG.	1	2	3	4	5
4. I know how to save files to different locations (e.g., desktop, hard drive, USB drive).	1	2	3	4	5
5. I consider myself computer savvy.	1	2	3	4	5
6. I know how to use compression software such as Winzip to compress and decompress files.	1	2	3	4	5
7. I know how to use an FTP or SSH program to transfer files from a local system to a remote system, and vice-versa.	1	2	3	4	5
8. I enjoy learning about new technologies.	1	2	3	4	5
9. I know how to burn a music CD.	1	2	3	4	5
10. I know how to change the device boot order.	1	2	3	4	5
11. I know what the intersection of a row and a column is called in a spreadsheet.	1	2	3	4	5
12. I check my e-mail at least once a day.	1	2	3	4	5
13. I know how to enable and disable a pop-up blocker in a web browser.	1	2	3	4	5
14. I know how to secure a wireless router.	1	2	3	4	5
15. I know how to create a web page in a text editor.	1	2	3	4	5
16. I know how to download and install a software application.	1	2	3	4	5
17. I enjoy using computers.	1	2	3	4	5
18. I know how to install and reinstall an operating system on a PC.	1	2	3	4	5
19. I know the difference between a cold boot and a warm boot.	1	2	3	4	5
20. I know how to empty the disk and memory cache in the browser to free up space on the hard drive.	1	2	3	4	5
21. I know how to rip a music CD.	1	2	3	4	5
22. I know how to update the virus definitions of an antivirus application.	1	2	3	4	5
23. I know how to change BIOS settings.	1	2	3	4	5

Continued on back.

Question	Scale of Agreement				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
24. I have an account on MySpace, FaceBook or another social networking web site.	1	2	3	4	5
25. I know how to receive information via an RSS feed.	1	2	3	4	5
26. I know what causes hard drive fragmentation.	1	2	3	4	5
27. I know how to change the settings on a computer using the Control Panel.	1	2	3	4	5
28. I know the difference between a search engine, a subject directory, and a meta-search tool.	1	2	3	4	5
29. I know how to use a Boolean search to find information on the Web.	1	2	3	4	5
30. I know how to back up files to a CD or DVD.	1	2	3	4	5
31. I know how to determine how much RAM is installed in a computer.	1	2	3	4	5
32. I know how to use a WYSIWYG editor to create a Web page.	1	2	3	4	5
33. I know how to disable cookies in a Web browser.	1	2	3	4	5
34. I know the difference between a relative and absolute file address in a hyperlink.	1	2	3	4	5
35. I know how to create a PowerPoint presentation.	1	2	3	4	5
36. I know what a file extension such as .pdf, .doc, or .zip implies about that file.	1	2	3	4	5
37. I know how to identify what operating system version is installed on a computer.	1	2	3	4	5
38. I know how to identify the speed and type of microprocessor in a computer.	1	2	3	4	5
39. I know what the keyboard shortcuts Ctrl-V and Ctrl-C do.	1	2	3	4	5
40. I know the result a spreadsheet would return when an equation such as =2+2*6/3 is entered.	1	2	3	4	5
41. I can distinguish reputable from non-reputable sources of information on the Web.	1	2	3	4	5
42. I know how to install an internal hard drive.	1	2	3	4	5
43. I know the difference between RAM and ROM.	1	2	3	4	5
44. I know how to crop a photographic image.	1	2	3	4	5
45. I frequently use a search engine to find out about new computer technologies on the Web.	1	2	3	4	5
46. I know how to transfer photographic images from a digital camera to a computer.	1	2	3	4	5
47. I know how to find and install security patches for a computer's operating system.	1	2	3	4	5
48. I know how to delete the history of sites visited in a web browser.	1	2	3	4	5
49. I know how to defragment a computer's hard drive.	1	2	3	4	5
50. I frequently use instant messaging to chat with my friends.	1	2	3	4	5