Succeeding in the 21st Century: What Higher Education Must Do to Address the Gap in Information and Communication Technology Proficiencies

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ABSTRACT*: Technology has fundamentally altered how we live and work, as well as how we learn. In the world of higher education, virtually every aspect of scholarship-from conducting research to communicating ideas-has been influenced by technology. Not only has the nature of classroom learning been changed, but also the very concept of the classroom itself has been redefined by the proliferation of distance education and e-learning. As a result, higher education's reach now extends far beyond what was once possible or even imaginable. Despite the widespread impact of technology on our institutions of higher education and beyond, little is known about students' Information and Communication Technology (ICT) literacy. There is anecdotal evidence that students are coming into the university unprepared to learn in a high-tech environment, but the dimensions of the need are unknown. To address this critical need, Educational Testing Service (ETS) has joined forces with seven leading college and university systems in the United States to create the new National Higher Education Information and Communication Technology (ICT) Initiative. The central goal of the National Higher Education ICT Initiative is to provide colleges and universities with the measurement basis they need to evaluate their existing approaches to ICT education and to develop new strategies for closing the gap between those who possess essential ICT skills and those who do not. Only through such research-based efforts will it be possible to prepare all students to be fully involved and productive members of a world that has been, and will continue to be, transformed by technology.*

1 PREFACE

This document is written for all those in higher education who are concerned with preparing students for success in today's world—success as individuals, as members of society, as workers, as lifelong learners. Given the remarkable extent to which technology has transformed our lives, bringing a vast new world of information resources into our homes, classrooms, libraries, and offices, it seems clear that among the most essential ingredients of success today is the ability to learn, communicate, evaluate, and manage all forms of information.

As Anthony Comper, president of the Bank of Montreal, told the 1999 graduating class at the University of Toronto, "however great your technical skills, and however attractive your attitude, and however deep your commitment to excellence, the bottom line is that to be successful [in the new millennium], you need to acquire a high level of information literacy. What we need in the knowledge industries are people who know how to absorb and analyze and integrate and create and effectively convey information—and who know how to use information to bring real value to everything they undertake."[i]

In recent years, much attention has been given to the so-called "digital divide" between those who have access to various technologies and those who do not. Yet far less attention has been given to what we might call the "proficiency divide"—the gap between those who have the blend of cognitive and technical capabilities required to negotiate information demands in the academy, or the workplace, or society, and those who lack them.

There is an urgent need for higher education to focus on this proficiency divide and to do all we can to close it. As a recent report put it, "Today's education system faces irrelevance unless we bridge the gap between how students live and how they learn… Students will spend their adult lives in a multitasking, multifaceted, technology-driven, diverse, vibrant world—and they must arrive equipped to do so."[ii]

The difficulty in shaping an effective response is that we lack even the most basic data on the dimensions of the problem. What is the current status of information and communication technology literacy among various populations in higher education? We simply do not know.

In response to this need, seven leading college and university systems in the United States joined with Educational Testing Service (ETS) in 2003 to form the National Higher Education Information and Communication Technology (ICT) Initiative. This effort is focused on developing a highly innovative, simulation-based assessment to measure the breadth and depth of ICT proficiency among those who are either seeking to continue their higher education or transitioning into the workplace.

The Initiative's efforts are guided by the work of the International ICT Literacy Panel, a multinational group of experts from education, government, non-governmental organizations, labor, and the private sector that was convened in 2001 by Educational Testing Service. The Panel's 2002 report entitled *Digital Transformation: A Framework for ICT Literacy*[iii] provided a comprehensive analysis of what we do and do not know about ICT literacy, and offered valuable recommendations for research and policy.

Building on this foundational work, the central goal of the National Higher Education ICT Initiative is to provide colleges and universities with the measurement basis they need to evaluate their existing approaches to ICT education and to develop new strategies for closing the gap between those who possess essential ICT skills and those who do not. Only through such research-based efforts will it be possible to prepare all students to be fully involved and productive members of a world that has been, and will continue to be, transformed by technology.

2 INTRODUCTION

Preparing young adults to meet the challenges of the future is a vital part of higher education's mission. For many (if not most) of them, that future will include a wide-ranging assortment of information and communication technologies, including those that are familiar today as well as those not yet imagined.

Technology has fundamentally altered how we live and work as well as how we learn. In the world of higher education, for example, virtually every aspect of scholarship—from conducting research to communicating ideas—has been influenced by technology. Not only has the nature of classroom learning been changed, but also the very concept of the classroom itself has been redefined by the proliferation of distance education and e-learning. As a result, higher education's reach now extends far beyond what was once possible or even imaginable. This transformative process will undoubtedly continue as broader bandwidth gives faculty and students, as well as administrators, access to new opportunities.

Students moving from higher education into the world of employment, and individuals re-entering the workforce, are also discovering a workplace that is vastly different from the one they might have entered as recently as a half-decade ago. While it used to be the case that only certain specialized occupations required skills in technology use, this is no longer so. In fact, U.S. Department of Labor projections indicate that eight of the ten fastest growing occupations in this country require "technological fluency."[iv]

In its 2003 report entitled *Learning for the 21st Century,* The Partnership for 21st Century Skills expanded on the importance of ICT skills in today's workplace:

> Technology and advanced communication have transformed the world into a global community, with business colleagues and competitors as likely to live in India as in Indianapolis. Moreover, flattened hierarchies in competitive businesses require employees to make business decisions, work productively in teams, and communicate directly with customers. In this environment, *employers value job candidates who can acquire new knowledge, learn new technologies, rapidly process information, make decisions, and communicate…* (emphasis added).[v]

Even far beyond the workplace, the ways in which we access and manage information and communicate with one another in everyday life—in the community, in schools, and at home—have become increasingly technology-reliant. Whether one is gathering information about a political candidate using the Internet, communicating with a friend via e-mail, managing personal finances, or looking up a book on a computerized catalogue at the library, the evidence of this surrounds us.

If information and communication technologies are changing the nature of higher education, the workplace, and everyday life, then what are the consequences of *lacking* skills in this domain? The negative implications are potentially numerous, not just for individuals but for society as a whole.

For individuals, the theme is one of diminished opportunities. In the higher education context, students who lack information and communication technology literacy cannot benefit fully from learning opportunities either in the classroom or beyond it. No matter what field one is studying, success depends on "the ability to organize the information once it has been amassed, to assimilate it, to find meaning in it," in Vartan Gregorian's words. Thus, for example, students who lack basic ICT skills are likely to be ineffective or inefficient in their attempts to conduct research using the Internet because they lack an understanding of effective search strategies; they may also have difficulty analyzing and interpreting the information they do gather (e.g., judging the credibility of a source, or comparing various sources of information). Further, they may be unable to communicate their ideas effectively using technology, such as organizing data in a graph or composing their findings in a research paper with graphic enhancements and exhibits.

Beyond the campus, those who lack ICT literacy may encounter obstacles to full civic participation. While technology makes an abundance of resources available to help citizens be informed and involved--for example, information about political candidates, community resources, or policy issues--this abundance is of little use if one cannot manage and evaluate these resources effectively. It is for this

reason that one observer has compared individuals lacking ICT literacy to King Midas: "they know the 'gold' (the information) is there, they can even 'see' it (on the computer screen), they may be able to touch it in a library or a book store, but they have never learned how to use that 'gold' for their personal, family, or business goals."[vi]

In the context of the workplace, the negative consequences of lacking ICT skills are well documented.[vii] Although it was once true that workers with limited skills could depend on finding jobs in factories and offices performing routine tasks, technology's rapid infiltration of the workplace (e.g., the growing use of computers to automate simple operations that were once performed by people) has made such jobs largely obsolete. New openings exist in today's economy for highly skilled, technologically proficient workers, but many businesses report having difficulty finding qualified individuals to fill them.

Collectively, these lost opportunities for individuals add up to a weakened society, one with fewer informed voters and citizens, fewer productive workers, fewer lifelong learners. As one researcher has warned, "While our society will not collapse today or even tomorrow from the uneven distribution of skills we currently see in America, our nation risks falling behind in international competitiveness and becoming more divided along social and economic lines."[viii] The failure to address these disparities in a comprehensive way will almost certainly result in a further erosion of opportunities for many in our society, with consequences for all.

Who will shoulder the burden of preparing students for success in the 21st century? Clearly, the responsibility is shared among K-12 schools, higher education, and other institutions. Each will play a vital role in devising and implementing solutions. While other publications have presented performance standards and offered important policy recommendations to address the growing need for ICT literacy, this document focuses specifically on what higher education can do—indeed, what it must do—to close the gap between those who possess essential proficiencies in this domain and those who do not.

3 THE NEED FOR INFORMATION

Despite widespread consensus about the need for ICT literacy among college students, there is little information available to tell us the dimensions of the need or what might be done to address it. This can be attributed to the almost exclusive concentration of research on access to technology. In this country and abroad, countless studies have sought to measure (and thereby close) the "digital divide" between those who have access to computer hardware, software, and networks, and those who do not.[ix] Access is obviously important, but increased exposure to technology does not automatically lead to increased ability to use it. Access is not the same as understanding. More to the point, the narrow focus on access has diverted attention away from the cognitive skills needed to manage, integrate, evaluate, and create information using technology.

This is not to say that the larger issue of ICT literacy has been ignored. In fact, many industry groups, associations, and others have examined information and technology competency and fluency.[x] Some higher education institutions, as well as several influential accrediting agencies (including the Middle States Commission on Higher Education, Western Association of Schools and Colleges, and Southern Association of Colleges and Schools), have identified "information literacy" or "technology literacy" as a critical outcome of higher education.[xi] These initiatives have provided helpful models and specified many technology competencies required for the labor force and in K-12 education. Yet, none of these efforts has directly addressed the need to evaluate whether individuals have attained the core cognitive skills related to technology use that are required to function successfully in today's world.

What is urgently needed, then, is an assessment program that will make it possible to determine whether (or to what extent) college students have obtained the combination of technical and cognitive skills needed to be productive members of an information-rich, technology-based society.

4 THE NATIONAL HIGHER EDUCATION ICT INITIATIVE

To address the critical need for diagnostic information about ICT proficiency in higher education, in 2003 Educational Testing Service (ETS) joined forces with seven leading college and university systems in the United States to create the National Higher Education Information and Communication Technology (ICT) Initiative.

This Initiative marks the first time that a comprehensive assessment of ICT proficiencies has been developed in partnership with higher education. Because the assessment program described here is being developed *by* and *for* the higher education community, the charter institutions are centrally involved in every step of the process, making critical decisions that will affect what is to be measured and how this will be accomplished.

The Initiative's work is being informed by diverse research and industry efforts that provide a starting point for examining the skills and knowledge required for the 21st century workforce, as well as for education and life-long learning. A key influence on the Initiative's program is the International ICT Literacy Panel's 2002 report, entitled *Digital Transformation: A Framework for ICT Literacy,* which presented a detailed list of research and policy priorities related to ICT literacy. Specifically, the International ICT Literacy Panel argued that large-scale assessments, policy research, and diagnostic tests designed to measure ICT proficiencies and skills of individuals are "sorely needed" and will be crucial in understanding the breadth and gaps in ICT literacy.[xii] Higher education faculty and administrators, in particular, need such data in order to gauge the effectiveness of current teaching strategies and curricula, to identify best practices, and to initiate better approaches.

Building on these recommendations, and directing them to the unique priorities and circumstances of higher education, the mission of the National Higher Education ICT Initiative is to conceive, design, and build a series of innovative, simulation-based assessments that will make it possible for colleges and universities to measure the extent to which their students (traditional as well as non-traditional) possess the ability to use digital technology, communication tools, and networks appropriately to address a wide range of information needs. The detailed proficiency data provided by these assessments will enable higher education leaders to evaluate and improve their efforts to ensure that all students acquire the ICT proficiencies they need in order to be successful long after they receive their diplomas.

5 A 21ST CENTURY DEFINITION OF LITERACY

The National Higher Education ICT Initiative is distinguished not only by the central role of higher education institutions in all aspects of the project, but even more importantly by the way in which ICT literacy is defined and operationalized. Unlike other tests that have been developed to evaluate knowledge *of* technology (in terms of general knowledge of hardware or the ability to use specific software applications), this Initiative is focused on what it means to be *literate in a technology-driven world*.

Stated differently, our assessment program is based on a 21st century definition of literacy. The Initiative participants believe that just as the ways in which information is stored, organized, and disseminated have changed dramatically in recent years, so too must our definition of literacy be revised to include the knowledge and skills required in today's globally connected, information-rich world. As literacy researcher Irwin Kirsch has observed, "While traditional (reading and writing) literacy and numeracy skills have become a currency for full participation in our society, the future will increasingly require each of us to demonstrate these traditional competencies through the use of technology."[xiii]

The idea of rewriting the definition of literacy is neither radical nor new. In fact, our view of what it means to be literate has changed continuously over time in response to changes in the nature of our society and its demands. While the term "literacy" was once quite narrow in meaning, its definition has gradually evolved, encompassing not only reading for various purposes but also writing and mathematical proficiency (or numeracy).

Accordingly, the Initiative participants believe that a 21st century definition of literacy must include not only the ability to read and write, but also knowledge and skills related to the use and application of information and communication technologies—ICT proficiencies that will enable individuals to function successfully in today's (and tomorrow's) world.

In developing a 21st century definition of literacy, representatives from the charter institutions and ETS drew on the work of the International ICT Literacy Panel as well as the Association of College & Research Libraries' Information Literacy Competency Standards for Higher Education. The following definition of ICT proficiency in the higher education context represents the informed consensus of the charter group's deliberations:

ICT proficiency is the ability to use digital technology, communication tools, and /or networks appropriately to solve information problems in order to function in an information society. This includes the ability to use technology as a tool to research, organize, evaluate, and communicate information and the possession of a fundamental understanding of the ethical / legal issues surrounding the access and use of information.

This definition's three-dimensional focus on cognitive and technical proficiency, in combination within social and ethical understanding, clearly distinguishes the ICT Higher Education Initiative from testing programs that measure technical knowledge and skills in isolation. While the ability to use particular digital devices, software, and infrastructure is important, technical know-how by itself is inadequate; individuals must possess the cognitive skills needed to identify and address various information needs and problems. Just as eight-track tapes and the Sony BetaMax have become a faded memory, many of the technologies we depend on today will soon become obsolete, and new ones will replace them. It is therefore imperative that our students develop the skills that will allow them to reap the benefits of *any* technology.

In other words, the participants in this Initiative are motivated by the belief that a person's *cognitive* skills—how they think, solve problems, and learn—have a bigger impact on that person's ability to function in our technology-rich society than knowledge of any specific software package or hardware platform. Society needs citizens who not only know how to obtain information, whether through technology or other means, but who can analyze and evaluate what they learn in order to develop an informed opinion. Employers want to hire people who are able to solve problems using technology tools, not just those who can type on a keyboard or use a mouse.

Furthermore, people manipulating information in any technological context need to be aware of the constraints—ethical considerations, legal restrictions, institutional policies, and the like—that govern and limit what we can access, use, and communicate in given situations.

This 21st century definition of literacy crafted by the charter institutions is guiding the design and development of the Initiative's higher education ICT assessments, determining not only the types of tasks that will be used to evaluate students' proficiencies but also the ways in which the resulting information will be analyzed and reported.

6 ASSESSMENT INFORMATION AND ITS USES

There are potentially many different purposes for conducting an assessment of ICT proficiency. Two purposes that are most salient are to provide aggregated results describing the performance of particular groups, and to provide individual results that can be used, for example, to certify the basic ICT proficiency of a student or potential employee. The following sections consider these two different assessment purposes and compare the different types of information they may yield.

6.1 Purpose 1: Provide Aggregated Results

A primary purpose for the higher education ICT assessments is to provide aggregated information about the performance of various groups, including entry-level students at two- and four-year schools, rising juniors, students seeking to enter majors that require ICT proficiency, students transferring from community colleges to four-year schools, students leaving community college for the workforce, and displaced workers seeking to gain the ICT skills required to rejoin the workforce. The results will enable higher education administrators and faculty to determine and describe the ICT strengths and weaknesses of the entire student body or subgroups defined by language, race/ethnicity, class year, major, or other characteristics.

Among the questions that may be answered by group ICT assessments are the following:

- What percentage of individuals in this group (e.g., entering freshmen, rising juniors, continuing education students) exhibit basic ICT proficiencies?
- What percentage of individuals in this group are able to perform certain types of ICT tasks?
- How many students will need basic ICT instruction next year?
- What is the distribution of basic ICT proficiency scores in this group, as a whole and by subgroup?

- How does the distribution of basic ICT proficiency scores in this group compare to that of our nearest competitor?
- How does the distribution of basic ICT proficiency scores in this group compare to that of the previous class?

This information could be used in a variety of ways, including designing courses to close the gap between the current state and basic proficiency, informing resource allocation decisions, planning curricula, providing accreditation evidence, evaluating students' workforce readiness or need for training, and shaping policy.

Aggregated data of this nature will enable policy makers to understand the status of ICT proficiency in colleges and universities and to target the needs that are identified. As the assessments continue to be administered over time, it will also be possible for higher education institutions and policy makers to study the effectiveness of their strategies to improve ICT proficiencies and to refine their approaches as needed.

Academic deans are likely to find the aggregated assessment data useful for management and planning purposes. For example, knowing the distribution of ICT scores in a particular group or class, along with comparative information from previous classes or competing institutions, would enable deans to identify specific areas in which freshmen lack basic ICT proficiency and thus determine the need for intervention. Similarly, department chairs could use the assessment data for course planning—for example, to estimate the numbers of students who will need ICT instruction at a particular level the following year.

Student advisors, on the other hand, might use the assessment data quite differently. The results may help them, for example, to identify the specific attributes of tasks that their advisees found most difficult in the assessment (e.g., defining information needs or integrating data from different sources). They might then use the results to tailor instruction (e.g., by adding tutorials to a course) or to provide advisees with remedial assistance focused on the particular problem areas identified.

6.2 Purpose 2: Provide Individual Results

Another purpose for assessment is to certify individuals' basic ICT proficiencies. Individual assessments would make it possible to determine, for example, whether a particular person is adequately prepared to begin undergraduate education, be accepted into a major program, enter upper division instruction, earn teacher certification, transfer from a community college to a four-year institution, enroll in certain courses (e.g., web-based, ICT-dependent courses), graduate, or take on a new job.

Among the questions that could be answered by individual assessments are the following:

- Does this individual have basic (or advanced) ICT proficiency? What types of tasks can he or she perform successfully?
- Does this individual need basic ICT instruction?
- Does this potential teacher candidate have the ICT proficiencies needed to become licensed?
- Should this entry-level teacher improve her/his ICT proficiencies in order to be more effective in the classroom?
- Does this student have the ICT proficiencies needed to take a technology-rich course?

Individual data will support uses that are quite different from the aggregated information. Students, for example, could use their performance results to help them decide which courses to take or to determine how best to prepare themselves to enter a particular major. Graduating students may use the data to identify which careers they are well equipped to pursue, or to certify their skills to potential employers. Displaced workers will be able to determine what areas of ICT proficiency they most need to strengthen in order to be eligible for the particular jobs that interest them.

Prospective employers may use the assessment data for hiring or training purposes. For example, if the assessment results indicate that a particular student has mastered basic ICT technology operations and concepts, or has a sound understanding of how to access, manage, and communicate information using technology, then the employer is able to make informed decisions about particular jobs or responsibilities

that the individual should be capable of performing successfully. Conversely, if a potential employee is shown to be deficient in certain areas of ICT proficiency, then the employer can use this information to make intelligent decisions about training needs.

In summary, the assessments will provide meaningful aggregated and individual data that will give higher education administrators and faculty, as well as employers, a firm basis for analyzing the outcomes and effectiveness of current policies and educational programs, as well as for devising more effective strategies. The results will offer a way to gauge the extent to which a college or university has succeeded in preparing students for the escalating technology demands of today's world, and to anticipate what additional steps are needed to reach this goal.

7 MEASURING ICT PROFICIENCY

Unlike traditional assessments—which use discrete, artificial tasks to evaluate performance—the Initiative's assessments will evaluate ICT proficiency using complex tasks that simulate real-life demands and that focus on aspects of performance identified as critical for someone to be ICT literate. Also unlike traditional assessments, which typically provide single scores based on isolated skills, our assessments will use innovative statistical procedures to produce detailed aggregated information about individuals' proficiencies in various contexts. The authentic nature of the assessments, and the involvement of higher education throughout the development process, ensures both the quality and validity of the assessment as well as the utility of the results.

Although it is not the intent or purpose of this document to describe the assessment development procedures in depth, it may be helpful for readers to have an overview of the process being undertaken. The construction of the ICT higher education assessment is being guided by an innovative approach known as "evidence-centered design"[xiv] which is grounded in the belief that a complex assessment must be designed from the very beginning "around the inferences one wants to make, the observations one needs to ground them, the situations that will evoke those observations, and the chain of reasoning that connects them."[xv]

Accordingly, initial specifications for tasks, scoring, and interpretation are all developed as part of the assessment planning process. These specifications take the form of *proficiency, evidence,* and *task* models, which together constitute the conceptual framework underlying the assessment. Each of these three models is designed to address a specific question, as follows:

- ***The Proficiency Model*** -- What complex of knowledge, skills, and abilities possessed by the individual do we wish to make claims about? *The answer to this question reflects experts' view of how the components of proficiency are organized in the ICT domain.*
- ***The Evidence Model*** -- What can we observe about the individual that would provide evidence for those claims? *The answer to this question specifies the kinds of behaviors or performances that provide evidence of the ICT knowledge and skills identified in the Proficiency Model, and the kinds of tasks or situations that should be used to elicit them.*
- ***The Task Model*** -- How can we structure tasks for the individual to perform that will give us the opportunity to make those observations? *The answer to this question guides the creation of valid tasks as well as the development of construct-based scoring criteria and rubrics that relate students' responses to the specific proficiencies we wish to know about.*

While these questions are implicitly answered in all educational assessments, a key benefit of evidence-centered design is that the answers are explicitly documented. The end result of this process will be the creation of an assessment that uses cutting-edge technologies to collect highly detailed, valid information about the status of ICT literacy in higher education.

8 THE PROFICIENCY MODEL: AN OVERVIEW

The first step in developing the proficiency model for the Higher Education ICT Initiative was articulating a definition of ICT literacy, the domain being assessed. The definition developed by the charter institutions in collaboration with Educational Testing Service, presented earlier in this document, encompasses three areas: cognitive and technical proficiency, and social or ethical understanding.

Cognitive proficiency is the ability to identify and address information needs and problems, think critically about information, and communicate findings or solutions. *Technical proficiency* is the ability to use digital devices, software, and infrastructure that facilitate the creation, storage, manipulation, and transfer of information. *Social or ethical understanding* includes knowledge and understanding of legal and ethical issues attending the access and use of sources and the communication of "sensitive" or confidential information.

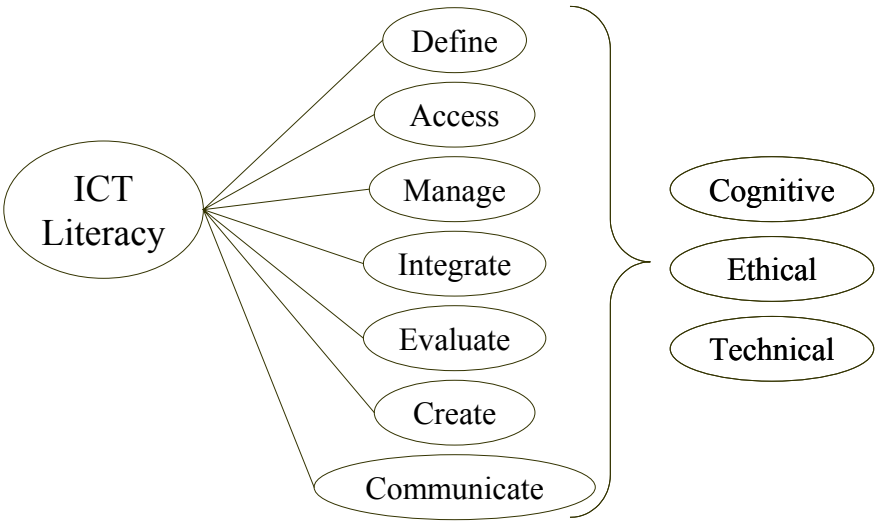
While this definition of ICT proficiency is an important starting point, it lacks the specificity needed to serve as a road map for developing assessment tasks. Accordingly, the next step in developing the proficiency model is to identify precisely which aspects of proficiency are to be measured. Seven processes, listed in Table 1, were identified by the charter institutions as critical components of ICT literacy in higher education: the ability to define, access, manage, integrate, evaluate, create, and communicate information. These processes reflect the wide range of uses for information and communication technologies.

Table 1:
Components of ICT Proficiency

PROCESS	DEFINITION
Define	Using ICT tools to identify and appropriately represent an information need
Access	Knowing about and knowing how to collect and/or retrieve information
Manage	Organizing information into existing classification schemes
Integrate	Interpreting, summarizing, comparing and contrasting information using similar or different forms of representation
Evaluate	Reflecting to make judgments about the quality, relevance, usefulness, or efficiency of information
Create	Generating new information and knowledge by adapting, applying, designing, inventing, or representing information
Communicate	Conveying information and knowledge to various individuals and/or groups

Thus, the proficiency model encompasses key components of ICT proficiency within the context of cognitive and technical skills and social/ethical considerations. These interactions are shown in Figure 1.

FIGURE 1: ICT PROFICIENCY MODEL



In the coming months, ETS and the charter institutions will lead briefings and disseminate this proficiency model underlying the National Higher Education ICT Initiative assessments to educators, business, and government leaders, and others invested in ICT proficiency. This expansion phase of the project is expected to include additional college and university systems with similar ICT measurement needs.

9 DEVELOPING THE ASSESSMENT TASKS

Using the model of ICT proficiency described above, assessment tasks are being designed to measure an array of ICT understandings and abilities in context—for example, the cognitive skills required to evaluate information (e.g., comparing and contrasting two data sources), or the technical skills needed to communicate information in various social contexts (e.g., composing an e-mail summarizing certain research findings).

To simulate real-life situations in which a person might need to use ICT skills, the assessment tasks will use innovative measurement techniques—such as simulations and virtual worlds—that are technology-delivered, scenario-based, and interactive in nature. The assessment will be delivered via the Internet, and the process of creating a secure delivery architecture is underway.

The tasks will encompass a wide spectrum of digital technologies, including computers, word processing software, spreadsheet and database packages, simulation tools, and multimedia and Internet applications. Communication tools will include hardware (e.g., computers and networks) and software (e.g., e-mail and virtual marketplaces) that allow two or more people to interact electronically. The use of natural language processing and other cutting-edge technology to score the test will make it possible to capture information about (and score) the processes that an examinee uses to perform a task as well as the end result.

As the assessment development process continues, pilot testing will be conducted at the charter colleges and universities and at additional colleges and universities to ensure that each task is conceptually and statistically valid. In addition, once the assessment administrations begin, ongoing research will be conducted to examine the performance data. This exacting development process will ensure that the assessment instruments meet the highest standards for validity, quality, and utility.

10 CONCLUSIONS

If higher education institutions are to accomplish their mission of preparing students for success in today's world, then clearly they must address the growing demand for ICT literacy. Few would disagree

that the ability to understand and use a variety of technologies and the information resources they make available to us is becoming increasingly crucial.

In our technology-infused world, those who are ICT literate have power—"power of autonomy, power of enlightenment, power of self-improvement and self-assertion, power over their lives and their families' future," as Vartan Gregorian has put it.[xvi] Conversely, those who do not are left with diminished power and limited opportunities. Their ability to succeed in higher education, in the workplace, and in their communities is likely to be severely restricted, and this rift between the "haves" and "have nots" has critically important consequences not just for the individuals themselves, but for the very fabric and future of our society.

To bridge these disparities, and to ensure that all students acquire the 21st century literacy skills that modern society demands, we must have valid and reliable information about the current state of ICT proficiency, particularly in higher education. While countless studies have sought to measure and improve access to technology resources, these efforts have diverted our attention from the other part of the picture: improving proficiency. Access to various technologies is of little use if one lacks the ability to use these technologies, and the information resources they provide, effectively.

The National ICT Higher Education Initiative is premised on this expanded view of ICT proficiency. Accordingly, the assessments growing out of the Initiative are designed to provide valid and highly useful diagnostic information about college students' ICT knowledge, skills, and understandings, showing what they know and can do, how they compare with other students, and what types of tasks give them difficulty. These data will provide colleges and universities with the research basis they need to evaluate and improve their strategies for closing the proficiency gap and preparing all students to succeed in today's world.

Secretary of Labor Alexis Herman, speaking at the National Labor Summit in 2000, put it this way:

> To say there is a worker shortage is to say the people we need don't exist. But they *do* exist. They are people who have bills to pay, children to raise, and dreams to pursue. What they lack are the skills demanded by today's economy. Some of them are young people who left school without a skill. Some are workers whose factory has closed, or whose company has switched to a new technology. Some are coming off welfare, or are Americans with disabilities. All of them must be brought into the mainstream of our information-based economy, where *what you know* determines *how far you go.* [xvii]

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