The ETS iSkills\textsuperscript{TM} Assessment: a digital age tool

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Abstract

**Purpose** – The purpose of this paper is to show how information and communications technology (ICT) literacy skills reflect twenty-first century requirements for researching and communicating information in digital environments. An interactive problem-based, scenario-based, web-based assessment tool, iSkills\textsuperscript{TM}, has been developed through a broad-based effort to establish standards for performance and certification of ICT literacy proficiencies. This paper aims to discuss the assessment’s potential in determining the effectiveness of instruction programs.

**Design/methodology/approach** – Since January 2001, a consortium of experts in ICT literacy served as advisors to the Educational Testing Service (ETS) test developers as they designed an internet-delivered assessment that measures students’ abilities to research, organize, and communicate information using technology. This paper reviews that R&D process, concluding with an example of its application to information literacy program planning and evaluation. A mixed methods approach collected and analyzed qualitative sources and iSkills\textsuperscript{TM} pre-test/post-test data for first-year Purdue University students.

**Findings** – Findings informed curricular decisions for instituting an integrated problem-based learning (PBL) information literacy program. Secondary goals included developing an understanding of how information-processing skills are acquired, identifying best practices for integrating information literacy into the curriculum, and assessing the impact of skill acquisition on overall academic achievement. ICT literate students are generally better problem-solvers, more self-directed, and communicate ideas more efficiently.

**Practical implications** – Universities are beginning to require ICT literacy as competencies for graduation. This paper presents a new strategy for assessing the effectiveness of instructional programs which aim to matriculate proficient students.

**Originality/value** – This paper reports on the efficacy of a problem-based learning (PBL) approach involving three convergent principles of design: the organization and dissemination of information, the creation and communication of information, and problem solving within the context of research projects and assignments. As such, it provides important insights into pairing an innovative instructional approach and the iSkills\textsuperscript{TM} ICT literacy assessment.

**Keywords** Communication technologies, Literacy, Problem solving, Assessment

**Paper type** Research paper

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Introduction
The first years of the new millennium have seen dramatic changes in knowledge production and global exchange, reshaping not only the flow of commerce but also the means by which information and culture are created and shared among individuals, groups, and societies. At the heart of these changes lies a fundamental transformation of knowledge production and global exchange, prompting new opportunities for social, political, and economic development.

As a result of these changes, advancement of information and communication technologies (ICT) is increasingly central to national and international development strategies (e.g., Paul, 2002; Jain, 2006). The term “information and communication technology (ICT) literacy” refers to knowledge of technology applied to information problem solving (Markauskaite, 2006). It recognizes that full participation in the digital knowledge age requires “taking students from ICT access to knowledge sharing” (Fourie and Bothma, 2006). The phrase also acknowledges the significant ICT literacy proficiencies required of information professionals and knowledge workers worldwide (e.g., Rosenberg, 2006; Anwar and Al-Ansari, 2002; Genoni et al., 2006).

Global ICT literacy context
The growing importance of ICT literacy proficiencies is well documented in national and international documents. Termed “digital literacy” in the eEurope 2005 action plan (European Commission, 2002), information and communication technology capabilities were viewed by European heads of state and governments at the Lisbon Summit in March 2000 as essential for enabling the European Union (EU) to become the most competitive knowledge-based society in the world by 2010. The Organisation for Economic Coordination and Development (OECD) issues reports on both ICT skills and education (e.g., OECD, 2001) and the United Nations Educational, Scientific, and Cultural Organization (UNESCO) web site highlights ICT literacy evaluation standards for students and educators around the globe (UNESCO, n.d.). And in the USA, corporate and academic leaders express growing recognition that learning in the twenty-first century must prepare graduates for the technology-enabled communication that has transformed the world into a global community, with business colleagues and competitors as likely to live in India as Indianapolis (Partnership for 21st Century Skills, 2003). Contributors to the Australian and New Zealand Information Literacy Framework: Principles, Standards, and Practices (Bundy, 2004a) have also underscored the importance of ICT literacy. Their conception recognizes information needs followed by understanding, finding, evaluating, and using information through enabling use of appropriate information and communication technologies.

Amidst widespread global recognition about the importance of digital age capabilities, a variety of approaches have emerged for assessing information, technology, and communication proficiencies. For instance, questionnaires supplemented by focus groups have investigated ICT usage among school children and teachers in a secondary school in Glasgow, Scotland (McLelland and Crawford, 2004). A paper-and-pencil self-assessment survey evaluated employees’ ICT literacy proficiencies at Nigerian university libraries (Adeyoyin, 2005) and West African university libraries (Adeyoyin, 2006). Public employees’ perceptions of information and communications technology (ICT) training conducted under the United Kingdom’s
People’s Network program were collected through a web-based survey (King et al., 2006). And, in Finland, a national survey gathered self reports on skills and practices among school children (Hakkarainen et al., 2000).

While certainly of research value, these approaches do not offer a “standardized outcomes assessment” (Educational Testing Service, 2005) instrument capable of large-scale assessment of a “transferable set of capacities related to ICT use” (Markauskaite, 2006). In response, test developers, cognitive scientists, and research statisticians have collaborated with assessment directors, university administrators, faculty members, academic librarians, and workforce specialists on the design and testing of questions for an assessment tool which requires the demonstration of knowledge necessary for information literacy and technology fluency in the digital age (Rockman and Smith, 2005).

A response to studies which show that students can use email and download music but cannot effectively and efficiently find, use, and evaluate content to solve problems and make decisions, the web-based assessment tool crosses disciplines and class levels to assess cognitive abilities and technical skills along with the ethical and legal use of information (Smith and Kirsch, 2004). This instrument recognizes the conclusions about workforce ICT literacy presented in Learning for the 21st Century, which states:

Technology and advanced communication have transformed the world into a global community…. 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 (Partnership for 21st Century Skills, 2003).

Furthermore, the assessment responds to the predicted continuance of pervasive growth in e-business, e-society, e-commerce, e-marketing, e-learning, e-government, e-literacy, e-research, and e-university initiatives worldwide (Battelle, 2005) amidst increasing recognition that e-literacy proficiencies are core competencies in democratic societies (Joint, 2005). The tool also acknowledges that “even far beyond the workplace, the ways in which we access and manage information and communicate with one another in daily life – in the community, in schools, and at home – have become increasingly technology-reliant” (Smith and Kirsch, 2004). However, “technological competence alone does not equal ICT literacy” (Katz, 2005, p. 44).

**ICT literacy assessment development**

Since 2001, the non-profit Educational Testing Service (ETS) in Princeton, New Jersey has led the development of an information and communication technology (ICT) literacy assessment – now named the iSkills™ Assessment. This interactive simulation-based testing program measures postsecondary students’ capabilities to define, access, manage, integrate, evaluate, create, and communicate information in a technological environment. In line with the priorities established by the seven colleges and universities comprising the National Higher Education ICT Initiative, ETS test developers, cognitive scientists, and research statisticians evolved the design, critique, and testing of questions. ETS personnel and subject-matter specialists spent more than 1,000 hours developing and norming the two-hour, performance-based, problem-based, Web-based, interactive ICT literacy assessment tool (Brasley, 2006). Throughout, the work was informed by established standards such as those published by the Association of College
and Research Libraries (ACRL), International Society for Technology in Education (ISTE), New Zealand Institute for Information Literacy, and Council of Australian University Librarians. These bodies share a common information-centric framework which values “activities which may be supported in part by fluency with information technology, in part by sound investigative methods, but most importantly, through critical discernment and reasoning” (Lupton et al., 2004, p. 4).

Beginning in 2003, early versions of the large scale assessment instrument were field tested. This massive effort culminated in spring 2005 with more than 4,580 examinees tested across 31 US campuses (Rockman and Smith, 2005). Participating campuses gained valuable implementation experiences (Somerville et al., 2007; McMannus, 2005). In addition, ETS used results to produce group-level scores by institution, permitting participating campuses to compare their students’ proficiencies against those at peer institutions. The beta phase of the large-scale assessment initiative also informed the finalization of simulation tasks and scoring models, suitable for releasing a new version of the ICT literacy assessment permitting individual score reporting in 2006 (ETS, 2004). The new instrument offers two versions of iSkills™ Assessment – a core assessment for high school seniors and an advanced assessment for upper-level college students (Kennedy, 2006).

The large-scale assessment tool is ground-breaking for several reasons. First, it is scenario, performance, and problem based, not multiple choice. Students must demonstrate their knowledge. Second, it is interactive and delivered over the world wide web – students must engage in the content to solve real-world academic or workplace problems. Third, it recognizes that workers and students need to integrate cognitive skills, technology skills, and the ethical use of information to effectively solve problems and make decisions in today’s information-rich, globally-connected, multicultural society (Rockman, 2005, p. 141).

Throughout, the development of this comprehensive diagnostic instrument was guided by the International ICT Literacy Panel’s report, titled Digital Transformation: A Framework for ICT Literacy (Educational Testing Service, 2002). The report advances the following definition of information and communication technology literacy: “ICT literacy is the ability to use digital technology, communication tools, and/or networks appropriately to solve information problems in order to function in a knowledge society” (Educational Testing Service, 2002, p. 2). This includes the ability to use technology as a tool to research, organize, evaluate, and communicate information as well as the possession of a fundamental understanding of the ethical/legal issues surrounding the access and use of information.

ETS iSkills™ Assessment highlights

Unlike traditional tests which use discrete, artificial tasks to evaluate performance, the iSkills™ test simulates real-life demands of computer users in the information age. Sample questions that convey the nature of ICT tasks (but are not identical to current assessment tasks) include the following:

Task description: Seven supervisors have sent information about training courses to the human resources director, and she has forwarded them to you. Use this information verbatim (copy and paste) to create a memo summarizing training course attendance. Test takers are presented with a simulated e-mail tool and word processor (Copyright © 2007 by Educational Testing Service. All rights reserved).
The task emphasizes the cognitive decision-making regarding what information is relevant to the task at hand, how to find this information, and how best to summarize it. Obviously, technical skills such as sorting, and copy and paste, facilitate completion of the task, and the student is evaluated on both process and outcome. Some might choose to open all of the e-mails and then select the relevant information; others might open one e-mail, select the critical information, and then move on to the next. Regardless of the sequence, to complete the task correctly, test takers are expected to open each of the e-mail messages and paste all of the relevant information into a file.

Task description: You’ve volunteered to create a flier for a community-clean up day to be held in your neighborhood. Include the map below along with the following information and create an attractive one-page flier for the event. The event will take place on Saturday, May 6th from 1-4 p.m. at Lincoln Square Park. Event organizers want a tear-off sheet to print names, addresses, and phone numbers (Copyright © 2007 by Educational Testing Service. All rights reserved).

To complete the task, test takers need to use a word processing program to create a flier. The final product is scored for accuracy and completeness of the information it contains. Additional scoring points might include evaluating the layout and inclusion of graphic design elements such as borders and lines. The task emphasizes the ability to recognize relevant information and effectively communicate this information to a particular target audience. Again, basic technical skills are a prerequisite for achieving this goal.

Task description: After falling awkwardly during a tennis match, your sister has been diagnosed with a rupture of the anterior cruciate ligament, or a tear of her connective tissue, in her right knee. While her condition is not an emergency, her doctor has recommended arthroscopic surgery to repair the injury and to restore her strength and mobility. You would like to find several reliable sources on the Web that recommend treatment and rehabilitation options for this condition (Copyright © 2007 by Educational Testing Service. All rights reserved).

This task requires test takers to use the search engine to locate sites that have articles about connective-tissue injuries, anterior cruciate ligament tears, arthroscopic surgery, and rehabilitation programs. The task emphasizes the ability to effectively and efficiently locate information, evaluate its sufficiency for the purpose, and to evaluate the degree to which the source is trustworthy. Again, technical skill with search engines is a requirement to succeed in this task (Educational Testing Service, 2004).

Throughout, the iSkillsTM assessment measures test takers’ proficiencies in seven skill areas: define, access, evaluate, manage, integrate, create, and communicate. For instance, the category “define” refers to understanding the scope of an information problem in order to facilitate the electronic search for information, such as by:

- Distinguishing a clear, concise, and topical research question from poorly framed questions, such as ones that are overly broad or do not otherwise fulfill the information need.
- Asking questions of a professor, librarian, or other research expert that help disambiguate a vague research assignment.
- Conducting effective preliminary information searches to help frame the research statement.
“Access” proficiencies refer to collecting and/or retrieving information in digital environments. Information sources might be web pages, databases, discussion groups, email, or online descriptions of print media. Tasks include:

- Generating and combining search terms (keywords) to satisfy the requirements of a particular research task.
- Efficiently browsing one or more resources to locate pertinent information.
- Deciding what types of resources might yield the most useful information for a particular need.

The iSkills™ assessment is the only tool to date that not only evaluates knowledge of technology, but also the ability to use critical thinking skills to solve everyday problems within a technological environment. A more detailed list of proficiencies in the seven skill areas can be seen below (Copyright © 2007 by Educational Testing Service. All rights reserved):

1. **Define.** Understand the scope of an information problem in order to facilitate the electronic search for information, such as by:
   - Distinguishing a clear, concise, and topical research question from poorly framed questions, such as ones that are overly broad or do not otherwise fulfill the information need.
   - Asking questions of a “professor” that help disambiguate a vague research assignment.
   - Conducting effective preliminary information searches to help frame a research statement.

2. **Access.** Collect and/or retrieve information in digital environments. Information sources might be web pages, databases, discussion groups, e-mail, or on-line descriptions of print media. Tasks include:
   - Generating and combining search terms (keywords) to satisfy the requirements of a particular research task.
   - Efficiently browsing one or more resources to locate pertinent information.
   - Deciding what types of resources might yield the most useful information for a particular need.

3. **Evaluate.** Judge whether information satisfies an information problem by determining authority, bias, timeliness, relevance, and other aspects of materials. Tasks include:
   - Judging the relative usefulness of provided Web pages and on-line journal articles.
   - Evaluating whether a database contains appropriately current and pertinent information.
   - Deciding the extent to which a collection of resources sufficiently covers a research area.

4. **Manage.** Organize information to help you or others find it later, such as by:
   - Categorizing e-mails into appropriate folders based on a critical view of the e-mails’ contents.
Arranging personnel information into an organizational chart
Sorting files, e-mails, or database returns to clarify clusters of related information.

(5) Integrate. Interpret and represent information, such as by using digital tools to synthesize, summarize, compare, and contrast information from multiple sources while:
- Comparing advertisements, e-mails, or web sites from competing vendors by summarizing information into a table.
- Summarizing and synthesizing information from a variety of types of sources according to specific criteria in order to compare information and make a decision.
- Re-representing results from an academic or sports tournament into a spreadsheet to clarify standings and decide the need for playoffs.

(6) Create. Adapt, apply, design, or construct information in digital environments, such as by:
- Editing and formatting a document according to a set of editorial specifications.
- Creating a presentation slide to support a position on a controversial topic.
- Creating a data display to clarify the relationship between academic and economic variables.

(7) Communicate. Disseminate information tailored to a particular audience in an effective digital format, such as by:
- Formatting a document to make it more useful to a particular group.
- Transforming an e-mail into a succinct presentation to meet an audience’s needs.
- Selecting and organizing slides for distinct presentations to different audiences.
- Designing a flyer to advertise to a distinct group of users.

**Practical iSkills™ applications**
iSkills™ simulates real-life demands of computer users, targeting specific skills of someone who is ICT literate. The results of this type of assessment can be used to establish a baseline understanding of existing ICT literacy skills, a benchmark for anticipated ICT skill proficiency, and support for integrating ICT into the curriculum. These data are much more valuable to administrators than anecdotal reports, suggesting that students’ perceived confidence with technology are not the same skill sets that determine aptitude in finding, selecting, and evaluating the most relevant information to meet their immediate needs (Macklin, 2002). For a test demo, sample score reports, and other test details, go to: www.ets.org/ictliteracy.

Taking this into consideration, field trials of the iSkills™ Assessment also evaluated three types of self-reported measures to confirm the need for ICT instruction in higher education:
(1) Self assessment measures rated students’ confidence levels and abilities with activities and skills related to ICT literacy.

(2) Self sufficiency measures provided insights into students’ capabilities for self-directed learning, including their perceived familiarity with information technologies.

(3) Academic ability measures reflected both the students’ general academic performance (GPA) and overall quality of the institution (mean SAT scores for incoming students) (Katz and Macklin, 2006, p. 6).

Except for frequency of ICT literacy activities, all of the measures correlate significantly with performance, supporting the validity of the assessment. In addition, results confirm that many students believe they have good ICT skills because of their frequent interactions with the Internet. Indeed, there was a strong correlation between the frequency of use and perceived confidence; however, only the students’ confidence in their skills aligned with their performance on the ICT literacy assessment. This finding substantiates librarians’ claims that familiarity with freely accessible search tools (e.g. Google) does not translate to good ICT literacy skills.

At Purdue University, the iSkills™ Assessment was used to establish a baseline understanding of first year students’ ICT proficiency levels. Demographic data taken from the iSkills™ Assessment indicated that 90 per cent of students (n = 262) rated themselves highly skilled users of information technologies. Of that group, 82 per cent stated that they had some prior training in high school, 18 per cent said that they learned what they knew on their own or from peers, and 5 per cent reported that ICT skills were entirely new. Individual score reports showed that 52 per cent of participants scored lower than 50 per cent of the population who took the test. That means that more than half of this group of students who believed they were competent users of information technology could not demonstrate those skills proficiently.

Low-level performers, those scoring below the thirtieth percentile on iSkills™, demonstrated difficulty with foundational skills, such as understanding information needs. They either could not establish a goal, or they were too vague in their interpretation of the problem statements. Average performers, those scoring between the sixtieth and fortieth percentiles, mimicked some of the search behaviors of low performers, including difficulty identifying an information need. Other skills showed promise of ability, but inconsistent performance. For example, students in this group were generally able to identify reasonable search terms, but did not always execute them adequately in a search.

These data were instrumental in demonstrating the need for ICT education, and guided the development of a program to promote skill acquisition. Students were clearly lacking in the ability to define information needs, find and use appropriate resources, and select relevant information. Observations of students’ search behaviors indicated these problems prior, but using a valid and reliable assessment tool made the difference in how the information was collected and disseminated to educational stakeholders.

In addition to providing overall proficiency scores, individual score reports were useful in identifying two areas in need of instruction: defining an information need and accessing appropriate resources. These results were consistent with findings from previous research (Lenox and Walker, 1992; Lippincott, 2005) stating that students do
not generate reasonable research questions or statements regarding information needs. For example, individual score reports showed that 88 per cent of the students did not understand the information need. As a result, students used vague search strategies, employed broad search terms, and did not use operators to limit or expand searches. Students who performed poorly in these areas were not able to refine their thinking on subsequent attempts, and continued to formulate searches that produced poor results.

After the data revealed the deficiencies of first year students’ abilities to use expensive scholarly resources, an action plan was developed to create and implement an integrated ICT program across disciplines. Combinations of students’ individual performances, overall learning outcomes, and assessment strategies provided the best collective understanding of how to construct the curriculum. These included designing activities that would:

- build on relevant conceptual schemes;
- elicit thinking, where students can test, revise, and refine or adapt their current understandings and use of information and communication technologies; and
- convey thinking in multiple representations - text/language, diagrams, charts (Lesh and Harel, 2003).

The Purdue approach recognizes that activities which externalize thinking are critical for assessment in the ICT literacy curriculum. For students, they allow greater opportunities to examine and question the selection and evaluation of information in various formats. For teachers, they provide a means by which to measure a learner’s understanding of the nature of the information used. These tangible representations of the information retrieval process reveal:

- the perception of information needs;
- the conceptual understanding of the organization of information;
- the technical ability to use information technologies; and
- the cognitive ability to plan a search strategy, choose relevant information, and communicate ideas to others.

This type of instruction requires time and collaboration with subject matter experts to integrate information skills and resources into the course content (Webber and Johnston, 2000). For example, a professor of earth and atmospheric sciences might want his students to know how to predict weather patterns. They may look for various weather prediction models using a search engine, test them to decide which provides the best data, collect data, organize it in a spreadsheet, and finally graph the results. In this situation, the librarian might guide the students, using advanced search strategies, to locate weather prediction models on the Internet. In addition, she might also work with the class to test various models and evaluate the data. These activities make learning meaningful, with the end result being a product from which to measure understanding of content and ICT skill development (Edwards and Bruce, 2002).

The Purdue University instructional design strategy was selected to simulate the evidence-centered process of iSkills™ Assessment, which emphasizes an evidentiary chain of reasoning for assessment (Almond et al., 2002) based on the connection between proficiencies and tasks (Messick, 1989; Mislevy, 1994). This connection specifies how observable behaviors are weighted and combined with other
observations to inform estimates of ability. A numeric value is then applied via a two-component process:

1. Evidence identification – determines what elements of the task performance constitute evidence and summarizes their values. This process parses the work products into observable elements of performance that can be automatically scored.

2. Evidence accumulation – aggregates evidence to update estimates of ability in the proficiency model. This process takes observable variables generated during evidence identification and specifies how they constitute evidence of abilities in the proficiency model (Katz et al., 2004).

The chain of evidential reasoning from behaviors (as elicited by tasks) to inferences about test takers’ skills results in a more complete representation of the design rationale for an assessment, better targeting of the assessment for its intended purpose, and a more substantial basis for a construct-representation validity argument supporting use of the assessment (Williamson et al., 2005).

To replicate this process for teaching ICT skills, students need to be able to communicate – through descriptions, explanations, and constructions – how they interpreted a task or problem solving situation. Through testing, revealing, modifying, and refining their thinking, students develop models for making sense of their experiences. An important characteristic of these kinds of activities is that students generate meaningful solutions (descriptions, explanations, and constructions) to integrate into their own knowledge bases and to share with others (Wenger, 2000). These products perform a similar role of documenting and assessing information retrieval and use as do tasks on the iSkills™ assessment, thus providing a way of measuring transfer of skill from classroom activities to a valid and reliable test.

ICT literacy education and assessment implications

Of the responses to the many challenges facing the world, none is more important than growing the global community of informed and questioning as rapidly as possible (Bundy, 2004b). Whether these challenges are democratic, economic, geopolitical, environmental, health or sustainability, what they have in common is that their solution can only be advanced in the digital age by people who are ICT literate. In the words of the New Commission on the Skills of the American Workforce – a high-powered, bipartisan assembly of US education, business, and government leaders who recently released a blueprint for better preparing students to thrive in the global economy, “social inclusion by knowledge equity” (Bundy, 2004b, p. 7) can only occur when we have “the right assessments, and they are connected to the right syllabi” (National Center on Education and the Economy, 2006, p. 15).

With the intention to move in that direction, the large-scale iSkills™ assessment provides aggregated results describing the performance of particular groups and certifying the ICT proficiency of a potential student or employee. ICT assessments can 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 college for the workforce, and displaced workers seeking to gain the ICT skills required to rejoin the workforce. With adequate
cohort numbers, 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, gender, race/ethnicity, class year, academic major, or
other characteristics. This information can be used in a variety of ways, including
designing courses to close the gap between the current state and basic proficiencies,
informing resource allocation decisions, planning curricula, providing accreditation
evidence, evaluating students’ workforce readiness or need for training, and shaping
policy.

Additionally, certification of basic ICT proficiencies would make it possible to
determine, for instance, if 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 enter the workforce. A National ICT Literacy Policy Council has been recently
formed to define what basic or “foundational” proficiency means, and to oversee the
work of expert panels of educators that will translate the Council’s definitions into cut
scores for both the Core and Advanced versions of the assessment. The ICT Literacy
Policy Council is broadly representative of colleges and universities, national education
associations, and other stakeholders including the US Chamber of Commerce.

Individual data will support uses that are quite different from the aggregated
information. Students, for instance, 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.

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
information-intensive world, and to anticipate what additional steps are needed to
reach this goal (Educational Testing Service, 2003).

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