

# Role of ICT Literacy in Cognitive Skills Assessment.

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In recent years we have seen tremendous advancements in computer technology which has been changing how we live, learn and work today. It is also changing our future by shifting the very nature and value of knowledge and information. Information Communication Technology (ICT) competencies have beneficial influences over outcomes and are growing and gaining in its speed. How we access and manage information and communicate with one another in the workplace, in schools, at home, and in our communities are increasingly more reliant on technology. Developing greater ICT proficiency is not sufficient to be the goal of learning since ICT literacy is a tool that enables one to gain access to whatever one may need to know or learn, similar to the case where learning to read is one of the intermediary goals of learning and knowing.

As we start a new day every morning we encounter and rely on up to date information to arrange our daily lives, we check up on the local weather forecast with satellite maps with Doppler radar images, catch up on e-mail, reserve a book at the library, and download video and music clips to watch or listen to in

the car on the way to work. Often our work involves using the computer for merchandising, learning, and communicating. In the evening, family members may gather together to read messages from school. Frequently, a student's homework is posted on the school web site and the teacher has commented on work a student submitted earlier. Many new options of learning have developed as E-learning institutions began to certify proficiency in areas such as computer networking skills, or even in subject domains historically dominated by traditional colleges and universities. E-learning often gets conducted exclusively through Internet communications including instruction, testing, and certification. Students progress through classes in ones own pace and schedule. Students often use a search engine through the Internet to conduct initial research. Reports are analyzed and written using the computer at home as well as at school. The examples are too numerous to show how much our lives rely on digital technologies as we seek information suited for our individual needs or preferences and expect to be able to obtain the information immediately.

A newspaper, although a great medium for communicating information of various sorts and interests, because of its limited space and form it is restricted in the breadth of coverage of the news and depth of analysis which can be presented. While a majority of readers may be satisfied with the content in a newspaper, it does not quite meet the unique interests and needs of all readers all the time. Certainly it is very difficult to search information written a while ago without having the paper physically and this process would require great effort to maintain such storage.

The changes brought about regarding what, when, where and how one can acquire knowledge and skills through the widely available ICT is leading us to enter a historically significant phase of cognitive skills acquisition and assessment.

### **Defining ICT Literacy**

In response to the growing importance of information and communication technologies in all aspects of people's lives, in 2001 Educational Testing Service (ETS) convened an international panel of experts from education, government, nongovernmental organizations, labor and private sector to study the importance of ICT and its relationship to literacy. The panel defined what it means to be ICT literate and determined that there is a dire need for an assessment of a person's ability to think critically and communicate effectively in a technological environment. The group released *Digital Transformation: a Framework for ICT Literacy* (ETS, 2002), and analysis of what was known and not known about ICT literacy, including recommendations

for research and policy.

### **ICT is changing the very nature and value of knowledge and information.**

The growth of information and digital communication technologies, including capabilities for networking and shared environments, is changing the nature of social interactions and collaborative endeavors. Digital technology, in all its forms, allows information to be continuously available and adapted for different uses. Computers, handheld personal digital assistants (PDAs), on-line resources, networks and mobile telephone systems allow us to extend the reach of our cognitive capabilities and communication. Participating in this digital world is fast becoming a necessary condition for successful participation in society.

### **ICT literacy, in its highest form, has the potential to change the way we live, learn and work.**

Higher levels of ICT literacy have the potential to transform the lives of individuals who develop these requisite skills and knowledge. Just as researchers have shown that compulsory schooling and literacy lead to changes in how individuals learn and think, future research might show similar advantages resulting from the development and application of ICT literacy skills. For example, researchers studying reading and writing have noted that different cultures and groups may engage in different kinds of literacy practices (Heath, 1980; Scribner & Cole, 1981; Szwed, 1981). The cognitive behaviors connected with these various practices have been associated with the acquisition of different types

of knowledge and skills. The transformative nature of information and communication technologies might similarly influence and change not only the kinds of activities we perform at school, at home and in our communities but also how we engage in those activities. As with reading and writing, ICT has the potential to change how we think and learn, advantaging not just the individuals who acquire these skills and knowledge but societies as a whole.

**ICT literacy cannot be defined primarily as the mastery of technical skills.** The concept of ICT literacy should be broadened to include critical cognitive skills such as reading, numeracy, critical thinking and problem solving and the integration of those skills with technical skills and knowledge. Because of the importance of these underlying cognitive skills, current levels of literacy, critical thinking and problem solving might present a barrier to the attainment of ICT literacy. There are strikingly low levels of general literacy around the world. Even within many OECD countries, there are many young people who fail to develop adequate levels of literacy (Kirsch, deJong, Lafontaine, McQueen, Mendelovits & Monseur, 2002). Without such skills, it seems doubtful that comprehensive ICT literacy can be attained.

The negative implications of lack of ICT skills are potentially numerous, not just for individuals but for societies as a whole. Gary Becker, a Nobel Prize winner in economics recently noted “human capital is by far the most important form of capital in modern

societies” (Becker, 2002). In the emerging global economy, individuals and nations with these skills will most likely prosper while those lacking them will struggle to compete.

As stated in a recent report titled *The Well-Being of Nations* (OECD, 2001), human capital is made up of the knowledge, skills and attitudes that facilitate the creation of personal, social and economic well-being. Recent data from national and international surveys show that, in addition to obtaining and succeeding in a job, literacy and numeracy skills are also associated with the likelihood that individuals will participate in lifelong learning, keep abreast of social and political events, and vote in state and national elections. These data also suggest that literacy is likely to be one of the major pathways linking education and health and may be a contributing factor to the disparities that have been observed in the quality of health care in developed countries. Thus, the non-economic returns to literacy and schooling in the form of enhanced personal well-being and greater social cohesion have been viewed by some as being as important as the economic and labor-market returns. According to some, ICT is becoming an essential literacy for the 21st Century (The North American Council for Online Learning & Partnership 21st Century, 2006).

ICT literacy focuses on information processing competence as demonstrated through technology that is beyond technical competence- just being technologically savvy does not automatically lead to skillful use of information. For example, using a

modern search engine makes information gathering very easy with a few cleverly chosen key words. However, the information obtained then needs to be evaluated in terms of relevance, whether the information is appropriate, authoritative and/or timely.

The panel defined ICT literacy which combines both information literacy and technical competence as: ICT literacy is the interest, attitude and ability of individuals to appropriately use digital technology and communication tools to access, manage, integrate and evaluate information, construct new knowledge, and communicate with others in order to participate effectively in society.

The following table presents a set of processes of ICT literacy to further clarify this continuum of skills and knowledge. These processes take place in many contexts in varying degrees such as personal, public, educational, or occupational. It is important to note that being proficient in ICT is to have proficiencies in foundational skills at school, at home, and at work as well as technical proficiencies in hardware, software applications, networks, and other elements of digital technology.

The following examples of these 6 processes represent a small portion of what would be involved in activities using any combination of the 6 processes. Obviously many activities involved with using ICT skills can be much more complex.

An *Example of Access* may involve opening a document file, e-mail message, or locating and opening an application. It also include navigating various Web sites using a browser within an Internet environment and successfully accessing information needed, as well as using a search function within an application.

An *Example of Manage* may involve entering information, creating a list, organizing information into a table or chart, and organizing multiple files according to a structure designed for future usage.

An *Example of Integrate* may involve comparing multiple information of the same type or different types such as video clips and graphs, and looking through several Web sites to identify, compare, and summarize information on a particular topic.

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.
Construct	Generating new information and knowledge by adapting, applying, designing, inventing, representing or authoring information.
Communicate	Conveying information and knowledge to various individuals and/or groups

An *Example of Evaluate* may involve selecting Web sites that best meet specific criteria, evaluating authenticity and reliability of information sources.

An *Example of Construct* may involve writing a brief e-mail message, writing a paper using a word processor, developing a report using presentation software, creating a Web page, and transforming one presentation to another.

An *Example of Communicate* may involve sending an e-mail message, contributing to an on-line discussion, and purchasing an item using e-commerce.

ICT literacy as defined above represents the proficiency necessary to seek and gain in a digital information environment not only the traditional skills and knowledge conventional tests have been assessing, but also new kinds of knowledge and individualized learning processes.

Traditional assessments at schools have been testing the presence or absence of knowledge and skills transmitted from the teachers to the students. Commonly administered achievement tests are good example of measuring such knowledge. In these tests, the primary objectives are to verify the efficiency and completeness of the knowledge duplication from a teacher to students. Items are designed to display how accurately an examinee can recall the facts, or execute the procedures that he or she learned in the classroom. To perform well on such tests, you need to rely heavily on memory for the facts to be recalled or procedures to be replicated. The more a student

accumulates such knowledge, the better the student will perform since the quantity of knowledge and procedural options in the domain is the measuring objective. The function of these test questions is to elicit what is stored in ones mind.

Of course memory has been and will continue to be a very important aspect of human cognitive skills and is a necessary component of learning. Without foundational knowledge and memory, the development of critical thinking skills may not take place. However, traditional testing assumes the common experiences of learning in terms of the knowledge being presented, the method of teaching, the sequences of components of learning, and probably of most consequence how well a teacher can present the material to students. Teachers have been doing this through standardizing teaching objectives, textbooks, and controlled practices, exercises and drills. If learning experiences are common among students, measuring duplicated knowledge in the students is meaningful to evaluate the efficacy of teaching and the degree of knowledge and skills duplication.

We started seeing changes in what, where and how learning is taking place recently. Subject domains traditionally taught in classrooms in academic institutions are often taught through computer delivery. E-learning environments and programs from Cisco Systems, Microsoft, and Plato Learning are gaining ground and on-line university classes are growing in number. In United States 11% of all students in colleges and universities are enrolled in at least one class online in 2004. Some

universities exist almost exclusively in an Internet environment.

E-learning can benefit management and organizations as well as learners. Learners can concentrate only on the particular subject which they need to learn without going over material already learned elsewhere. The pace of a learner's progress can be adapted to their needs and circumstances. Instructional materials can be placed on the Web and can be accessed from anywhere and at any time. It may be a lot safer to handle virtual experiments and lab works before handling real objects that might cause bodily harm. Progress can be assessed, recorded and monitored readily for learners and for administrators. Administrators can benefit by being able to address problems or issues that may arise, update the instructional materials at the server only once, and monitoring progress in real time. With available digital tools, learning of skills and knowledge can be accurately evaluated and appropriate feedback can be made.

These digital classes provide flexibility in the sequence of learning by smaller package of learning sets, with the time utilized for learning based on the preference and convenience of individual students, as well as the physical place of learning. While it is appropriate to use a common instrument to assess learning of students who received classroom instruction in brick and mortar schools following a fixed curriculum sequence, it is inappropriate to assess learning of students who use a different pace of learning and sequence of learning within ICT environment. Assessment of cognitive skills needs to come closer to

where learning takes place.

Type of knowledge is not limited to the printed media, now the knowledge can include various forms of sound and images in addition to text. Because entire lectures can be stored and accessed any time, any archived lectures carry similar permanence to the written information in a book. This may be a great benefit to anyone who may have dyslexia but with a desire to learn. Some of the obstacles of learning can be overcome by providing alternate modes of learning in the ICT environment.

Location of knowledge is no longer limited by educational organization, nor country. Many institutions make learning materials available to anyone who may wish to learn and great community of expertise sharing exists. Numerous information in various degrees of quality and accuracy on any subject matter are available. Each learner needs to evaluate the authenticity and accuracy of information.

With ICT, the new knowledge we can assess may involve hierarchical structure of domain knowledge that is often described as meta-cognition. Having such knowledge would enable us to decide what is lacking, which method of search is most efficient, and to evaluate the information obtained. With ICT we can do faster and modify the path of search and test ideas as we gain more information. Assessing this type of interactive knowledge acquisition and information seeking was not possible without ICT.

Individualization of learning in an ICT

environment poses a new problem. Because of not having a teacher in a classroom acting as a coach, a guardian, motivator, or disciplinarian, learning in an ICT environment rests on the self motivation of the learner. Democratization of knowledge acquisition characterized by greater opportunity and choice of E-learning modes comes with added responsibilities of learners. Successful learning largely rests on a learner's initiative and discipline. It is also becoming clear that more important decisions are being asked and made at individual levels. Health insurance can be customized to meet the unique health care needs of an individual. Airlines provide a method to develop a travel plan on the Web with numerous options that can be customized to meet the preferences of individual customers. Some airlines have eliminated counters altogether and have only Web-based ticketing in order to reduce ticket prices.

In society in the past, we relied heavily on the printed text, and literacy skills were necessary for learning ideas, full participation in society, and to allow an individual to understand and take advantage of the opportunities life provided. Literacy research found that our societies are largely organized to reward those with higher literacy skills. With the increased emphasis to drive public and private investment and planning toward knowledge-based economies and information-age societies, a shift now toward ICT literacy is becoming more significant for learning, working, recreating, financial planning, and in every aspect of our daily lives.

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Kirsch, I., Braun, H., Yamamoto, K., & Sum, A. (2007) *America's Perfect Storm: Three Forces Changing Our Nation's Future*, Policy Information Center, Center for Global Assessment, Educational Testing Service, Princeton, NJ.

von Davier, M., & Yamamoto, K. (2006) Mixture-Distribution and HYBRID Rasch Models, in vonDavier, M., & Cartensen, C. (Eds.) *Statistics for Social and Behavioral Sciences* (pp. 99-118). New York: Springer.

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## 【機関紹介】

**Educational Testing Service (ETS)****概要**

Educational Testing Service(ETS)は、1947年、テスト開発を行っている3つの団体——米国教育協会 (the American Council on Education)、カーネギー財団 (the Carnegie Foundation for the Advancement of Teaching)、そしてカレッジボード (the College Entrance Examination Board) ——の一部が ETS として独立した。主導者は、ヘンリー・チョーンシー (Henry Chauncey) であった。

組織を立ち上げるに当たっては、ETS 創立の10年前に、ハーバード大学学長ジェームス・コナント (Harvard University President James Conant) の信念「一組織が教育的研究と測定に集中して取り組むことが、アメリカの教育の成長にとって基本的な貢献になる」という考えが背景にあった。主な事業は各種アメリカ国内外のテスト開発、コンサルティング教育評価ツール開発である。

2500人以上のスタッフが、米国 ETS および世界中のオフィスで働いている。2500人のうち、1100人が教育、心理、統計、教育測定、コンピュータサイエンス、社会学、人類学などの専門家である。600人が学位をもち、250人が博士号を取得している。

南米、ヨーロッパ、カナダに拠点をもち、アジアにも拠点を拡大中である。

**主な研究領域**

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研究テーマの詳細については、下記 URL 参照。

<http://www.ets.org/portal/site/ets/menuitem.22f30af61d34e9c39a77b13bc3921509/?vgnextoid=73b2be3a864f4010VgnVCM10000022f95190RCRD>

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- ・ Test of English for International Communication (TOEIC®) : 英語を第二外国語とする生徒向け英語能力試験。社会人対象。