Equipped for the Future
Use Information and Communications Technology Performance Continuum

PERFORMANCE LEVEL 1

Use Information and Communications Technology

How adults at Level 1 **Use Information and Communications Technology:**
- Determine the purpose for using information and communications technology
- Select the technology tools(s) and resources appropriate for the purpose
- Apply technological knowledge, skills, and strategies to use technology tool(s) and resources to locate, process, or communicate information
- Monitor own ability to use the tool(s) and resources and their effectiveness in achieving the purpose, and, if needed, adjust strategies to overcome barriers to achieving goals

Level 1 Indicators

Use Key Knowledge, Skills, and Strategies
Adults performing at Level 1 can:
- Orally understand a simple vocabulary of technology terms (such as software, memory, disk drive, mouse, keyboard, CD-ROM)
- Understand that software and hardware are both needed for the computer to work
- Use input devices (such as a mouse, keyboard, remote control, or buttons/switches) with inconsistent levels of control
- Use simple functions of command menus to open, save, and print a file if the application is already running
- Ask a friend, family member, or co-worker for help if there is a problem
- Use simple technologies for communication, or use more sophisticated technologies with considerable assistance (such as using a cell phone independently after cursory instruction in its use, reading and responding to simple email messages with assistance)
- Use simple strategies for accessing information (such as identifying 1-3 search terms for basic web searches)

Show Fluency, Independence, and Ability to Perform in a Range of Settings
Adults performing at Level 1 can Use Information and Communications Technology with considerable assistance to perform very simple, highly structured tasks in a familiar environment. They may make many errors and may be easily distracted or hesitant to perform the task.

Level 1 Examples of Proficient Performance

Adults performing at Level 1 can Use Information and Communications Technology to accomplish a variety of goals, such as:
- Complete a simple email enrollment form, with assistance
- Use a pictorial guide to videotape a television program
- Use mouse practice software to improve mousing skills

PERFORMANCE LEVEL 2

Use Information and Communications Technology

How adults at Level 2 **Use Information and Communications Technology:**
- Determine the purpose for using information and communications technology
- Select the technology tools(s) and resources appropriate for the purpose
- Apply technological knowledge, skills, and strategies to use technology tool(s) and resources to locate, process, or communicate information
- Monitor own ability to use the tool(s) and resources and their effectiveness in achieving the purpose, and, if needed, adjust strategies to overcome barriers to achieving goals

Level 2 Indicators

Use Key Knowledge, Skills, and Strategies
Adults performing at Level 2 can:
- Demonstrate an oral and written understanding of basic technological terms related to software and hardware (such as enter, save, print; mouse, fax, scanner)
- Understand that data may consist of text, graphics, and audio files
- Turn equipment on and off safely
- Use technological tools in a basic way (such as launching a few highly familiar applications) and with a beginning understanding of technological systems such as the internet
- Follow simple directions to accomplish a routine task with technology; may require step-by-step reminders (such as opening, modifying, saving, and printing a file with assistance or visual guide)
- Try to use application's Help feature before asking for outside assistance
- Use communications technologies with limited assistance (such as sending email or a fax, or creating a simple slide presentation from a template with help)
- Use basic strategies for managing information (such as sorting information into 2-3 categories in a database application with some inconsistencies in use of organizing strategy)

Show Fluency, Independence, and Ability to Perform in a Range of Settings
Adults performing at Level 2 can Use Information and Communications Technology with noticeable effort and requiring some assistance, to perform highly structured tasks which may have more than one step, but are conducted in a familiar environment with the instructor and peers nearby for encouragement and guidance. They may have many errors and be easily discouraged when things go wrong.

Level 2 Examples of Proficient Performance

Adults performing at Level 2 can Use Information and Communications Technology to accomplish a variety of goals, such as:
- Total monthly budget items using a calculator
- Type and print a shopping list on a word processor using a step-by-step guide
- File text documents into folders by topic with some assistance

PERFORMANCE LEVEL 3

Use Information and Communications Technology

How adults at Level 3 **Use Information and Communications Technology:**
- Determine the purpose for using information and communications technology
- Select the technology tools(s) and resources appropriate for the purpose
- Apply technological knowledge, skills, and strategies to use technology tool(s) and resources to locate, process, or communicate information
- Monitor own ability to use the tool(s) and resources and their effectiveness in achieving the purpose, and, if needed, adjust strategies to overcome barriers to achieving goals

Level 3 Indicators

Use Key Knowledge, Skills, and Strategies
Adults performing at Level 3 can:
- Understand and apply, the basic vocabulary needed for using common applications of technology, such as using a word processor or operating a digital camera
- Identify common problems encountered when using everyday technology (such as media not installed, batteries need to be changed, etc.)
- Describe, with general accuracy, the internet
- Demonstrate a basic understanding of responsible use of technology (such as using simple rules of netiquette in email or listserv posts)
- Adopt personally useful technologies, such as electronic dictionaries, and use in a consistent way
- Operate some basic technological tools and follow directions to perform some more sophisticated applications (such as to change font sizes or formats in a word processor, enter an address into an address book and then use the address book to route an email message)
- With occasional guidance, use conceptual knowledge of technology to strategize solutions to problems (such as finding a forgotten user name from printed copies of previous messages)
- More consistently use Help functions of applications and/or printed manuals to find solutions to problems
- Use online communications (such as use email applications with ease, including attachments, or participate in listserv discussions on a topic of interest)
- Organize information from the general to the specific
- Understand that information on the Internet should be evaluated for accuracy and appropriateness to need

Show Fluency, Independence, and Ability to Perform in a Range of Settings
Adults performing at Level 3 can Use Information and Communications Technology with occasional assistance to perform structured, multi-step tasks with few errors in a familiar environment. They may be able to identify barriers in the accomplishment of the task and begin to problem-solve solutions.

Level 3 Examples of Proficient Performance

Adults performing at Level 3 can Use Information and Communications Technology to accomplish a variety of goals, such as:

- Enter three names and telephone numbers into a cell phone directory, then use the directory to call one of them
- Compile a list of keywords to use in an internet search of desired vacation spots, then use them to find one or more potential vacation destination websites
- Generate two strategies for dealing with a computer that won't turn on

PERFORMANCE LEVEL 4

Use Information and Communications Technology

How adults at Level 4 **Use Information and Communications Technology:**
- Determine the purpose for using information and communications technology
- Select the technology tools(s) and resources appropriate for the purpose
- Apply technological knowledge, skills, and strategies to use technology tool(s) and resources to locate, process, or communicate information
- Monitor own ability to use the tool(s) and resources and their effectiveness in achieving the purpose, and, if needed, adjust strategies to overcome barriers to achieving goals

Level 4 Indicators

Use Key Knowledge, Skills, and Strategies
Adults performing at Level 4 can:
- Understand an extensive vocabulary of technological terms (such as those related to using a word processor and the internet), as well as less commonly used features of basic applications
- Use prior knowledge in the application of technology (such as knowing which software is needed to open a file by recognizing common computer file formats)
- Describe, in general terms, a computer network and what advantages/disadvantages it presents to the user
- Connect and disconnect basic technology components (such as a computer monitor, keyboard, mouse, printer, CPU/box)
- Perform very basic maintenance in equipment (such as cleaning mouse or keyboard)
- Assess equipment's suitability for common uses (such as determine if current hardware has sufficient memory and speed to install and efficiently run a new application); Choose the software tool that will yield desired results (such as using a word processor to create a custom calendar)
- Perform basic computer operations with ease, and to transfer some skills (such as using menu functions within software) from application to another; Use basic to intermediate functions of a range of software applications, including word processors, spreadsheets, databases, graphic packages, presentation software
- Perform basic trouble shooting strategies independently (such as checking to see if all components are plugged in; rebooting system; trying to print a file from another application if files won't print from one application to see if the trouble is with the application or the printer)
- Select from a wide range of communication technologies as appropriate to complete a collaborative project (such as using telephones, email, instant messaging, groupware, faxes)
- Use strategies to identify, organize, and use important information (such as searching the internet to find sites with relevant information, or fast forwarding through videos to access relevant information, or using sort functions in spreadsheets or databases, or using spam filters to eliminate junk email)

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Show Fluency, Independence, and Ability to Perform in a Range of Settings
Adults performing at Level 4 can Use Information and Communications Technology to complete moderately complex, sequential tasks, requiring only very occasional assistance, and with minimal errors, in a familiar setting.

Level 4 Examples of Proficient Performance

Adults performing at Level 4 can Use Information and Communications Technology to accomplish a variety of goals, such as:
- Use three different search engines to search for information on childproofing your home, then describe some strengths and weaknesses of each search engine
- Use copy and paste functions to enter a dentist's name and telephone number from a PDA's address book to its appointment calendar
- Use an internet-enabled cell phone to retrieve and read email

PERFORMANCE LEVEL 5

Use Information and Communications Technology

How adults at Level 5 **Use Information and Communications Technology:**
- Determine the purpose for using information and communications technology
- Select the technology tools(s) and resources appropriate for the purpose
- Apply technological knowledge, skills, and strategies to use technology tool(s) and resources to locate, process, or communicate information
- Monitor own ability to use the tool(s) and resources and their effectiveness in achieving the purpose, and, if needed, adjust strategies to overcome barriers to achieving goals

Level 5 Indicators

Use Key Knowledge, Skills, and Strategies
Adults performing at Level 5 can:
- Understand and apply a large vocabulary of technological terms, and use knowledge to determine some unfamiliar terms from context
- Recognize the advantages and disadvantages/limitations of using technology, and plan strategies accordingly to accomplish goals (such as using the internet to anonymously access job information at a company website, then visiting the company to talk to employees for the information <u>not</u> on the website)
- Describe precautions to consider when going online (such as the security of network and personal information)
- Skillfully use a variety of technologies together (such as being able to upload images from a digital camera to the computer, crop and edit them, then save them in different file formats for different purposes such as pasting into web pages, slide presentations, or attaching to email)
- Search user-group archives, company online help databases, and other online resources to resolve difficult problems with hardware or software, and use problem-solving skills when online searches do not yield desired results
- Routinely perform preventive maintenance such as defragmenting hard drives, updating virus protection software, and backing up critical data
- Create and share products to communicate ideas and other information (such as web pages, slide shows, and videos/DVDs); the products demonstrate an understanding of the target audience
- Use communications technologies for other purposes (such as working with peers to investigate problems or issues relevant to the groups, or to participate in online learning opportunities)
- Manage and evaluate information from a variety of sources; use abstract thinking to determine how to apply relevant research results for multiple purposes in a variety of contexts and understand when/under what conditions to apply it

Show Fluency, Independence, and Ability to Perform in a Range of Settings
Adults performing at Level 5 can Use Information and Communications Technology with great ease to perform complex, multi-step tasks, with few or no errors and without need for assistance in both familiar and unfamiliar settings. They are often able to assist others with the task. They show a willingness to

experiment with solutions to any barriers encountered, and are willing to go beyond their "comfort zone" to upgrade their skills and knowledge, demonstrating the confidence to explore solutions on their own.

Level 5 Examples of Proficient Performance

Adults performing at Level 5 can Use Information and Communications Technology to accomplish a variety of goals, such as:

- Use the internet to research education requirements and long-term employment projections for a chosen career, then prepare a presentation of the information using PowerPoint
- With a team of peers, create a digital story using images taken with digital cameras, other graphics found on the internet, and text; all elements are united in a logical sequence in a word processor
- Read messages from three different listservs and/or websites about presidential candidates, perform any internet searches indicated to verify key information, and send an email to friends and relatives justifying your choice of candidate

How to Read the EFF Performance Continuum for

Use Information and Communications Technology

Each performance level of the EFF Performance Continuum for each EFF Standard is divided into three sections:

The Definition of the Standard

The definition of the standard in the components of performance is a useful tool for communicating to adult learners and their teachers the essential features of the construct for each standard. By "unmasking the construct" in this way (making it clear how the skills of using information and communication technology are defined), adult learners are better able to articulate their own learning goals for improving proficiency and teachers are better able to focus learning and instructional activities that build toward the goal of increasing ability to Use Information and Communication Technology to accomplish everyday activities.

The definition of the EFF Standard *Use Information and Communication Technology* is repeated in the same form at each level of the continuum. This repetition serves as a reminder that the integrated skill process defined by the components of performance for this standard is constant across all levels, from novice to expert levels of performance. Thus, the standard does not change from level to level. It remains a consistent focal point for learning and instruction. What changes from level to level is the growth and complexity of the underlying knowledge base and the resulting increases in fluency and independence in using the standard to accomplish an increasing range and variety of tasks. These changes are reflected in the level indicators (descriptions of key knowledge, skills, and strategies at each level and of fluent and independent performance in a range of settings at each level, and in the examples of real-world activities that can be accomplished at each level.

The definition of the EFF Standard *Use Information and Communication Technology* through its components of performance is:
- Determine the purpose for using information and communications technology
- Select the technology tools(s) and resources appropriate for the purpose
- Apply technological knowledge, skills, and strategies to use technology tool(s) and resources to locate, process, or communicate information
- Monitor own ability to use the tool(s) and resources and their effectiveness in achieving the purpose, and, if needed, adjust strategies to overcome barriers to achieving goals

Level Indicators

The second section of the performance continuum for *Use Information and Communication Technology* contains descriptions of level indicators in two forms. First, there is a listing of the

key knowledge, skills, and strategies that support and reveal evidence of proficient performance on the standard at each level. Second is the description of the degree of fluency, independence and ability to perform in a range of settings expected for proficient performance on the standard at each level.

The listing of key knowledge, skills, and strategies is specific to each level and is the foundation for designing assessments to measure performance at that level. Beyond serving as guide for assessment development, the key knowledge, skills, and strategies described at each performance level can also be used to identify instructional objectives or can be included in the criteria used for placement of learners in instructional levels. The items listed under Key Knowledge, Skills and Strategies at each level of the standard are not intended to be comprehensive, but rather to be illustrative. The Key Knowledge, Skills and Strategies for *Using Information and Communication Technology* are organized into six strands:

- Knowledge of terminology related to technology, and of technology components
- Conceptual knowledge (systems, digital representations of information, limitations of IT, societal impact)
- Selecting, using, and evaluating tools (hardware and software)
- Problem solving and trouble shooting strategies
- Communication
- Information literacy (access, manage, integrate, evaluate, create)

Each of these strands is reflected in the bulleted descriptors of key knowledge, skills, and strategies at each level of performance on the standard.

The first bullet point at each level of performance describes a level of knowledge of terminology related to technology, and of technology components. This strand reflects the importance of mastering the jargon associated with technology. Perhaps more than many other fields, technology has generated (and continues to generate) new terminology and components on a regular basis. Novice users of technology must learn a basic vocabulary in order to identify and use hardware and software, as well as to continue their learning about technology. As adults become more expert in the use of ICT their vocabulary and familiarity with technology components increases in both size and complexity.

For example, at Performance Level 1, we expect to see oral (listening and speaking) command of a relatively small and simple set of basic technology-related vocabulary. We expect to see vocabulary knowledge grow at higher levels of performance. By Performance Level 4, adults are expected to show understanding of a fairly extensive vocabulary that extends well beyond basic and common terminology.

Growth of conceptual knowledge and understanding of ICT is reflected in a second set of bulleted descriptors of key knowledge, skills, and strategies. This strand describes a progression that begins with understanding components of ICT – computers, telephones, networks, etc. – as discrete components, then progresses to ability to conceptualize basic systems, local area networks, and, finally, at the higher levels, understanding of the ethics and responsible use of global systems such as the internet.

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This strand parallels a variety of descriptions of increasing levels of conceptual understanding of ICT in the literature. For example, the NETS technology foundation standards 1 and 2 – "Students demonstrate a sound understanding of the nature and operation of technology systems; students understand the ethical, cultural, and societal issues related to technology" (see http://cnets.iste.org/students/s_stands.html). Also, the University of Massachusetts Information Literacy Project (see http://www.lib.umassd.edu/INFOLIT/InfoLitComp.html) developed a taxonomy of levels of cognitive aspects of information literacy, moving from basic fact finding at the lowest level to conceptualizing at the highest level. The IC3 White Paper (see http://www.tie.net/membership/discounts/pdf/IC3WhitePaper.pdf) also lists knowledge of how individual computers fit into larger systems, as well as being able to identify the relationship between computer networks, other communications networks and the Internet as important to basic technology competence.

Some examples of increasing levels of conceptual understanding can be seen in the following descriptors:

Performance Level 1
- Understand the software and hardware are both needed for the computer to work

Performance Level 2
- Understand that data may consist of text, graphics, and audio files

Performance Level 3
- Describe, with general accuracy, the internet
- Demonstrate a basic understanding of responsible use of technology (such as using simple rules of netiquette in email and listserv posts)

Performance Level 4
- Describe, in general terms, a computer network and what advantages/ disadvantages it presents to the user
- Assess equipment's suitability for common uses (such as determine if current hardware has sufficient memory and speed to install and efficiently run a new application)

Performance Level 5
- Recognize the advantages and disadvantages/limitations of using technology, and plan strategies accordingly to accomplish goals (such as using the internet to anonymously access job information at a company website, then visiting the company to talk to employees for the information not on the website)
- Describe precautions to consider when going online (such as the security of network and personal information)

The third strand of bulleted descriptors is closely related to the second. As an adult's conceptual understanding of ICT increases we also expect to see evidence of increasing proficiency in selecting, using, and evaluating technology tools (hardware and software).
The most common set of competencies related to Use ICT that we found across the sets of standards we consulted relates to being able choose the right technological tool for the job, using it, and continuing to evaluate its suitability for the job (an artifact of technology's constant, rapid evolution). Users of ICT progress from inconsistent ability to operate basic components of

technology with considerable assistance to being able to effectively use multiple technology components together with no assistance, and being able to help others.

Numerous examples of descriptions of proficiency in selecting, using, and evaluating technology tools can be found at each performance level. As we move up the continuum of performance, we expect to see a greater depth and breadth of understanding of the affordances (functionality) of particular technology tools and increasing understanding of the suitability (advantages and disadvantages) of particular tools for particular purposes.

Some indications of the nature of the progression of increasing proficiency in selecting, using, and evaluating technology tools can be seen in the following selected level descriptors:

Performance Level 1
- Use input devices (such as a mouse, keyboard, remote control, or buttons/switches) with inconsistent levels of control
- Use simple functions of command menus to open, save, and print a file if the application is already running

Performance Level 2
- Use technological tools in a basic way (such as launching a few highly familiar applications) and with a beginning understanding of technological systems such as the internet
- Follow simple directions to accomplish a routine task with technology; may require step-by-step reminders (such as opening, modifying, saving, and printing a file with assistance or visual guide)

Performance Level 3
- Adopt personally useful technologies, such as electronic dictionaries, and use in a consistent way
- Operate some basic technological tools and follow directions to perform some more sophisticated applications (such as to change font sizes or formats in a word processor, enter an address into an address book and then use the address book to route an email message)

Performance Level 4
- Assess equipment's suitability for common uses (such as determine if current hardware has sufficient memory and speed to install and efficiently run a new application); Choose the software tool that will yield desired results (such as using a word processor to create a custom calendar)
- Perform basic computer operations with ease, and to transfer some skills (such as using menu functions within software) from one application to another; Use basic to intermediate functions of a range of software applications, including word processors, spreadsheets, databases, graphic packages, presentation software

Performance Level 5
- Describe precautions to consider when going online (such as the security of network and personal information)
- Skillfully use a variety of technologies together (such as being able to upload images from a digital camera to the computer, crop and edit them, then save them in different file

formats for different purposes such as pasting into web pages, slide presentations, or attaching to email)

Problem solving and trouble shooting strategies are another fundamentally important support for and indicator of proficient use of ICT. A fourth set of bullets in the listing of key knowledge, skills, and strategies describe growth and development in this area. At lower levels of proficiency, problem solving may take the form of asking for help. At higher levels of proficiency, conceptual understanding of how technology works is joined with more diverse, independent, and active trouble shooting strategies.

Mastery of the communication functions of technology is a fifth area of skill development. As overall proficiency in use of ICT increases, an increasing variety of communication tools can be used, to meet an expanding range of communication needs, in increasingly creative ways.

A sixth and final area of growth and development described in the key knowledge, skills, and strategies relates to the increasing skill in application of cognitive and metacognitive abilities in technology-supported processing of information. As proficiency increases, adults move from use of simple strategies for locating information to development of more complex strategies for organizing and evaluating the quality of information.

Like the description of key knowledge, skills and strategies, the descriptions of fluency, independence and ability to perform in a range of settings are specific to each level and are intended to serve as a basis for guiding assessment, learning and instruction that is appropriate to that level.

With regard to *Use Information and Communication Technology*, key features of this section are developmental descriptions of performance related to

- amount of assistance required
- complexity and structure of the task
- the range of environments in which an individual can competently perform
- efficiency and effectiveness in finding solutions to problems encountered.

At the novice level, then, proficient performance of the standard may show a need for considerable assistance and be limited to simple, highly structured, and familiar tasks. At intermediate levels, proficient performance is characterized by a reduced need for assistance, ability to handle more complex tasks, and increasing ability to identify and overcome barriers to effective use of ICT. At the highest levels of performance, proficiency is possible in very complex task environments and there is a degree of comfort in use and creativity in experimentation even with new and previously unfamiliar technologies.

Examples of Proficient Performance

The third section of the performance level descriptions provides a short list of examples of the purposeful applications of the standard (activities) that can be accomplished by an adult who is proficient at each level. This list of examples is illustrative and not exhaustive. Like the level

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indicators, the descriptions of activities in this section are specific to each performance level. These examples of things that adults can accomplish in the real world at each level of performance on the continuum are useful to adult learners and to their teachers as ways of making concrete the purpose and need for attaining increasing proficiency in performance on the standard. By making it clear what can be accomplished at each level, the descriptions of activities also provide motivation for higher levels of learning. The listing of real-world accomplishments also provides guidance for selecting and designing the content for instructional materials and assessments.

Background to the EFF *Use Information and Communications Technology* Performance Continuum

The EFF Standard, *Use Information and Communications*, one of the four interrelated and sometimes overlapping EFF Standards that are categorized as "Lifelong Learning Skills," highlights one domain of adult knowledge and skills that is critical for adults to be able to draw from in order to carry out their responsibilities in their roles as family members, workers, and citizens. The ability to successfully use information and communications technology is becoming more important in many realms – at work, at home, and at school, to only name a few - given the increasing presence of technology in all of these contexts; as technology becomes more pervasive in everyday living, the need to be able to proficiently use it simultaneously increases. Over the past 20 years, more and more attention has been given to understanding how students learn to use technology and more emphasis has been given to teaching students how to use technology, as a way of responding to the ever-increasing presence of technology in our day-to-day lives. It should be noted that the dynamic nature of technology requires a dynamic approach to defining skills needed for proficient use of technology. As technology changes, we will need to keep pace by continually revising and maintaining the contemporary relevance of the standard.

The empirical basis for the five performance level descriptions for the *Use Information and Communications Technology* Performance Continuum was data on adult learner performance collected by EFF field researchers who developed and piloted activities and performance tasks based on this EFF Standard in their ABE, GED, and ESL classes. We are particularly grateful to the teachers and learners who "tread new ground" with this standard in order to provide rich descriptions of learner performance of the standard in their instructional contexts. Our current data does not support definitions of performance levels below or above the five levels we have described. In the future, research to support the description of higher performance levels or of "pre-Level 1" performance levels for more beginning level learners may be developed.

The EFF approach to defining performance levels for *Use Information and Communications Technology* depends on a conception of information and communications technology as a dynamic, results-oriented process that requires of each individual
- The ability to determine the purpose for using information and communications technology
- The ability to select the appropriate technology tool(s) and resources for the purpose
- The ability to apply technological knowledge, skills, and strategies to use technology tool(s) and resources to locate, process, or communicate information
- The ability to monitor his or her own abilities to use the tool(s) and resources and their effectiveness in achieving the purpose, and, if needed, adjust the strategies to overcome any barriers to achieving the intended goals.

Compared to other basic skills, such as being able to reach and write, the ability to make effective use of information and communications technology (ICT) is a relatively new, albeit fundamentally important skill for adult basic education. As a result of the newness of the

technology, the body of theory and research that examines the nature of skills and abilities that adult learners need to make effective use of ICT is also relatively new (see Stites, 2004).. At this point, a good amount of the literature available focuses on the effects of introducing technology to the classroom, how it affects student learning (Daley, Watkins, Williams, Courtenay & Davis, 2001), and how it is best integrated into the classroom (Harrison, Redman & Kotrlik, 2000; Redman, Kotrlik & Douglas, 2003). In the literature that deals with how students learn to use technology and the standards that have been developed to assess proficiency with technology, the newness is also apparent. For example, there does not seem to be any consensus on a preferred nomenclature for using information and communications technology in classrooms, and as a result, there are several different terms currently available. As an example, the International Society for Technology in Education (ISTE) uses the term "technology literate" (1998). The American Library Association (ALA) has developed standards for "information literacy" (2000) (a broader term that includes the use of information technology). Educational Testing Service (ETS) have created a framework for "ICT literacy" (2002). Others (National Research Council, 1999; Baker & O'Neil, Jr., 2003) prefer the term "fluency" over "literacy." These differences in terminology reflect some differences in the conceptualization of the nature of skills and abilities needed to make effective use of ICT and also differences in conceptualization of the purpose or outcome of using ICT. Some constructs (such as the ALA's "information literacy") stress the informational aspect of using ICT and focus more attention on cognitive abilities to process information while others (such as the ETS construct of "ICT literacy") stress the technical aspects of using ICT and focus more attention on facility in manipulating technology tools. Notwithstanding these differences, the types of knowledge, skills, and abilities included in the descriptions of these terms show remarkable similarities. Furthermore, these skill similarities transcend levels of expertise and educational attainment; we found that a student in a K-12 program is expected to have the same fundamental skills as a student at a higher education level. The similarities across different constructs of information provide a reliable set of definitions and skill sets evaluating the components of performance and performance level descriptions for the EFF Standard *Use Information and Communications Technology*.

The ability to successfully use information and communications technology is called "ICT literacy" by ETS (2002). They define this as "using digital technology, communications tools, and/or networks to access manage, integrate, evaluate, and create information in order to function in a knowledge society" (p. 2). For ETS, levels of ICT literacy are on a continuum ranging between basic skills and complete proficiency, and they have placed 5 components along this continuum that are integral to being ICT literate:

- Access – knowing about and knowing how to collect and/or retrieve information.
- Manage – applying an existing organizational or classification scheme.
- Integrate – interpreting and representing information. It involves summarizing, comparing, and contrasting.
- Evaluate – making judgments about the quality, relevance, usefulness, or efficiency of information.
- Create – generating information by adapting, applying, designing, inventing, or authoring information (2002, p.3).

Further, in order to be ICT literate, ETS suggests that an individual have both cognitive proficiency (such as literacy, numeracy, problem-solving, and spatial/visual literacy) and

technical proficiency (foundational knowledge of various technical tools such as hardware, software, networks, and digital technology). A person who has ICT proficiency is one who has integrated and applied these cognitive and technical skills. ETS writes, "ICT proficiencies are seen as enablers; that is, they allow individuals to maximize the capabilities of technology. At the highest level, ICT proficiencies result in innovation, individual transformation, and societal change" (p.18).

For the National Research Council (NRC), technological literacy (meaning the basic level of competency) is "too modest a goal in the presence of rapid change" (1999, p. 2). For them, as well as others who do not use the word "literacy" (Baker and O'Neil, Jr., 2003), the dynamic nature of the technological world and its requisite components requires a student to be able to readily adapt to technological changes and respond to social forces that are increasingly placing importance on technological knowledge as a benchmark for success in education and the workforce. In order to do so, a student needs to acquire foundational skills to use technology as well as skills to facilitate fluid transitions with technological changes. They suggest that the more robust term, "fluency" adequately captures their conception of lifelong technological proficiency. It should be said, however, that in the conceptualizations of ICT literacy by ETS and other definitions of related "literacies" (ISTE, 1998; ALA, 2000) the notion of technological literacy is not static; for them, becoming literate is also a lifelong process. The fundamental difference between literacy and fluency is actually within the conceptualization of what's important to know and be able to do with regard to information technology. Technological literacy, to all intents and purposes, focuses more on technological tools themselves, and the use of technological tools. Facility with technology is something that is acquired in a limited amount of time; the information literate individual is one who can use technological tools after learning how to do so in a particular time period. Technological fluency, on the other hand, appears to be more concerned with the processing of technological information and a deep understanding of technological tools and concepts. This understanding is so extensive that the fluent individual would be ready and able to adapt as technology changes around him or her. We see this distinction more clearly in the following paragraph that outlines one definition of technological fluency.

Baker and O'Neil, Jr. (2003), define technological fluency as "An individual's well-developed skills, propensities, and knowledge required to use, design, or develop electronic and bionic hardware and software in order to enhance various aspects of life" (p. 247). Similarly, the NRC's concept of technological fluency (or FITness – Fluency with Information Technology) includes individuals who are "able to express themselves creatively, to reformulate knowledge, and to synthesize new information. Fluency with information technology… entails a process of lifelong learning in which individuals apply what they know to adapt to change and acquire more knowledge to be more effective at applying information technology to their work and personal lives" (p. 2). The framework for FITness includes three kinds of knowledge that a person is required to have in order to become FIT. They are:
- Intellectual capabilities
- Information technology concepts
- Information technology skills

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Use Information and Communications Technology Performance Continuum

According to the FITness experts, having these three types of knowledge prepares a person for a lifetime of learning and using ever-changing technology.

The EFF Standard and performance continuum for *Use Information and Communications Technology* encompasses both ideas of literacy and fluency. First and foremost, the standard expects the use of information and communications technology to be a lifelong process; a core assumption of the EFF model is that adult students are lifelong learners. Secondly, the components of performance that we outline in this document require the student to have the same fundamental knowledge base as a person who is ICT literate, as defined by ETS. A student who uses information and communications technology has to be able to know the purpose for using technology and be able to select the technology tool to achieve the purpose (which echoes the concept of access). The student needs to be able to apply technological knowledge, skills, and strategies to use the tools and resources to locate, process, or communicate information (which shares some of the same ideas as manage and integrate). The student, finally, needs to be able to monitor his or her own ability to use the tools and resources and their effectiveness in achieving the purpose, and if needed, adjust strategies to overcome barriers to achieving goals (not unlike the knowledge to evaluate). We compared the EFF Standard and performance continuum for *Use Information and Communications Technology* with the ISTE NETS profiles for technology literate students in grades K-12, and found similarities between the two. Most notably, we found that the EFF Standard and the NETS profiles were fundamentally the same in terms of the components of performance and the key knowledge skills and abilities. For example, both EFF and NETS stress the need for students to be able to determine and select the appropriate technology tools to complete a variety of tasks and problems. Students in both models are expected to evaluate the effectiveness of technological tools, collaborate with peers, and have a technological vocabulary that increases with their experience using technology. In both models, students are expected to have a growing knowledge of both hardware and software applications, as well. There is more emphasis in the EFF model, however, on the student use of strategies to solve problems and troubleshoot, as well as encouraging the student to have the ability to determine the purpose for using technology. The NETS model, meanwhile, expects students to be able to understand and discuss technological concepts with increasing levels of accuracy and detail. Students are also expected to be able to have an increasing understanding of the legal and ethical implications of technology use. These two details do not appear in the EFF model.

The EFF Standard also illuminates some of the aspects of technological fluency; however, while the processing and understanding of technological information is a part of the EFF Standard *Use Information and Communications Technology*, it is not the most important aspect of it. The standard and the continuum of performance emphasize the use of technological tools in order to achieve practical, real-world goals (some of which do include information processing) that would be relevant to an adult. So, the Standard *Use Information and Communications Technology* aligns with the FITness model, but does not necessarily illuminate all of the same things, but we do see that the components of performance and the key knowledge, skills, and strategies in the EFF Standard require the student to have many of the same intellectual capabilities, knowledge of technology, and technological skills that a FIT student is expected to have. The following table presents comparisons of the EFF Standard and performance continuum for *Use Information and Communications Technology* with the FITness model.

Equipped for the Future
Use Information and Communications Technology Performance Continuum

Table 1. Comparison of the EFF Standard and performance continuum for *Use Information and Communications Technology* with the NRC FITness model

EFF Standard *Use Information and Communications Technology*	Information Technology Fluency (NRC, 1999, p.4)
As a student moves up the levels of performance, he or she is expected to have increasing intellectual capability to acquire and use technological knowledge, skills, and strategies to use technology tools and resources in order to locate, process, or communicate information. The abilities to communicate and collaborate, using technology are of particular importance, as well as having a growing knowledge of problem solving and trouble shooting skills and strategies.	**A FIT student has intellectual capabilities, such as:** Engage in sustained reasoning Manage Complexity Test a solution Manage problems in faulty solutions Organize and navigate information structures and evaluate information Collaborate Communicate to other audiences Expect the unexpected Anticipate changing technologies Think about information technology abstractly
A proficient student is expected to have an increasing conceptual understanding of things such as systems, digital representations of information, limitations of IT, and the societal impact of IT (for example) as he or she moves up the levels of performance. These understandings are typically rudimentary and do not always require the student to be able to do anything concrete with his or her understanding (so, for example, a student might understand the concept of programming, but would not be expected to write a program in order to achieve proficiency at a particular level).	**A FIT student has knowledge of information technology concepts, such as:** Computers Information systems Networks Digital representation of information Information organization Modeling and abstraction Algorithmic thinking and programming Universality Limitations of information technology Societal impact of information and information technology
A proficient student is expected to have increasing ability to select, use, and evaluate hardware and software tools as he or she moves up the performance levels. Examples of hardware knowledge and skills include: computers, keyboards, scanners, digital cameras, remote controls, electronic dictionaries, and printers. Examples of software knowledge and skills include: saving and printing files, using the internet, using word processing software (including being able to change format styles and font sizes), sending and receiving email, and using software applications for spreadsheets, databases, graphics and presentations.	**A FIT student has information technology skills, such as:** Setting up a personal computer Using basic operating system features Using a word processor to create a text document Using a graphics and/or artwork package to create illustrations, slides, or other image-based expressions of ideas Connecting a computer to a network Using the internet to find information and resources Using a computer to communicate with others Using a spreadsheet to model simple processes or financial tables Using a database system to set up and access useful information Using instructional materials to learn how to use new applications or features

There is considerable alignment with the EFF Standard and the FITness model, when one considers the information technology skills needed for FITness and the knowledge, skills, and strategies needed for proficiency using information and communications technology according to EFF. However, we do see that there are areas where the EFF Standard and the FITness model do not always match. A FIT student is expected to have considerable intellectual capabilities that go beyond the scope of the EFF Standard. Particularly, we see that the EFF Standard encourages the use of information and communications technology so that tasks and goals can be facilitated by use of technology, and technological tasks can be completed successfully throughout an adult's life, but there isn't so much emphasis on the depth of knowledge and skills so much so that an

adult could anticipate and easily adapt to technological changes. The EFF Standard and performance continuum also only expects students to have a rudimentary knowledge of technological concepts. It stresses the need for a student to have an increasingly extensive technological vocabulary and the ability to define what certain technological concepts are, but again, these understandings do not have to be as in-depth as they would be for a technologically fluent student.

The skills needed for FITness, as well as other standards that have been developed to measure technological fluency and literacy, have been explored in several educational contexts and standards have been developed. We included the standards developed the by following organizations in our review of existing standards as a way of shaping our standard:

- The American Library Association's Information Literacy Competency Standards for Higher Education (2000)
- The International Society for Technology in Education's National Educational Technology Standards for Students (NETS) (1998)
- The Internet and Computing Core Certification (IC^3) White Paper on Building a Dynamic Standard (2000)

These three sets of standards were especially useful because they allowed us to compare standards that have been developed across three very different educational contexts. The ALA standards were developed for higher education learners and focus on the broader concept of information literacy, while the NETS standards are designed for K-12 learners' proficient use of technology. The IC^3 standards, meanwhile, are being used to develop a generic certification exam for Internet and computing, using the FITness framework (which was developed with university students in mind). As mentioned earlier, the standards are strikingly similar in terms of the skills needed to perform successfully in all three of these contexts; the differences that exist are more specific to the audience that they are addressing and the ultimate goal of the standards themselves. The EFF Use Information and Communications Technology standard echoes some of the skills outlined in the three standards reviewed, but is designed to assess adult learners' technology skills in ABE, GED, and ESL classrooms, and so the standard itself is shaped to fit these particular contexts. The Continuum of Performance and level descriptors for the EFF Standard *Use Information and Communications Technology* will explicate this in greater detail.

There is no one learning process model that has been adopted as the standard for learning to use information and communications technology, but researchers Daley, Watkins, Williams, Courtenay, and Davis (2001, p. 128) identify three that are of interest. These models are raised because they were used in studies that show that using technology in the classroom does enhance learning. They discuss Ciognani's (2000) four-stage model for learners advancing in an on-line environment. The stages include:

- Generalization – being introduced to on-line tools and materials
- Focusing – focusing on and understanding the specifics of the subject matter
- Application – focusing on problem solving using knowledge gathered during the generalization and focusing stages
- Consolidation – consolidating knowledge through summary, posing new problems and finding their solutions.

They then bring up Jonasseen's 2000 study of learning in a technology-enhanced environment, where the 1989 Iowa Department of Education's Integrated Thinking Model is used. This model describes thinking in three parts that are inextricably linked:
- Content/basic thinking
- Critical thinking
- Creative thinking

According to Daly, Watkins, Williams, Courtenay, and Davis, Jonasseen argues that the use of computers enhances use of multiple thinking and, as a result, also enhances learning. Their final example of a learning process model is Marzano's and Pickering's (1997) five dimensions of learning. These dimensions include:
- Attitudes and Perceptions;
- Acquire and Integrate Knowledge;
- Extend and Refine Knowledge;
- Use Knowledge Meaningfully; and,
- Habits of Mind.

They explain that these dimensions are always connected and do not move sequentially throughout the learning process.

Having learning process models such as these are useful, especially when we consider their application to the acquisition of skills needed to be able to use information and communications technology successfully.

References

American Library Association (2000). *Information literacy competency standards for higher education*. Retrieved May 27, 2004 from http://www.ala.org/ala/acrl/acrlstandards/standards.pdf

Baker, E.L., & O'Neil, Jr., H.F. (2003). Technological fluency: Needed skills for the future. In H.F. O'Neil, Jr. & R.S. Perez (Eds.), *Technology applications in education: A learning view* (pp. 245-265). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Certiport, Inc. (2001). *IC3 certification*. Retrieved May 27, 2004 from http://www.certiport.com/yourPersonalPath/ic3Certification/

Daley, B.J., Watkins, K., Williams, S.W., Courtenay, B., & Davis, M. (2001). Exploring learning in a technology-enhanced environment. *Educational technology and society, 4*(3), 126-138.

Educational Testing Service. (2002). *Digital transformation: A framework for ICT literacy – A report of the international ICT literacy panel.* Retrieved May 27, 2004 from http://www.ets.org/research/ictliteracy/ictreport.pdf

Harrison, B.C., Redman, D.H., & Kotrlik, J.W. (2000). The value and usefulness of information technology in family and consumer sciences as perceived by secondary FACS teachers. *Journal of family and consumer sciences education, 18*(1), 1-8.

International Society for Technology in Education. (1998). *National educational technology standards (NETS) Project*. Retrieved May 27, 2004 from http://cnets.iste.org/index.shtml

Linberg, S. (2000). *Adult literacy and basic education teacher technology competencies v2.1.* Retrieved May 27, 2004 from http://maltt.org/publications/teachcomps.pdf

National Research Council (1999). *Being fluent with information technology*. Committee on Information Technology Literacy, Computer Science and Telecommunications Board, Commission on Physical Sciences, Mathematics, and Applications. Washington, DC: National Academy Press.

National Research Council and Institute of Medicine. (2000). *From neurons to neighborhoods: The science of early childhood development.* Committee on Integrating the Science of Early Childhood Development, J.P. Shonkoff & D.A. Phillips (Eds.), Board on Children, Youth, and Families, Commission on Behavioral and Social Sciences and Education. Washington, DC: National Academy Press.

Redman D.H., Kotrlik, J.W., & Douglas, B.B. (2003). Factors related to technology integration in instruction by marketing education teachers. *Journal of career and technical education, 19*(2), 29-46.

Stites, R. (2004). Implications of new learning technologies for adult literacy and
learning. In J. Comings, B. Garner, & C. Smith (Eds.), *Review of adult learning and
literacy, volume 4: Connecting research, policy, and practice* (pp. 109-155). Mahwah,
NJ: Lawrence Erlbaum Associates, Inc.

The internet and computing core certification (IC^3): Building a dynamic standard.
Retrieved May 27, 2004 from
http://www.tie.net/membership/discounts/pdf/IC3WhitePaper.pdf

University of Massachusetts, Dartmouth. (1997). *UMass information literacy project:
Information literacy competencies*. Retrieved May 27, 2004 from
http://www.lib.umassd.edu/INFOLIT/InfoLitComp.html