



University of Maryland University College

**BUILDING SKILLS OF TECHNOLOGY
FLUENCY THROUGHOUT THE CURRICULUM**

Prepared by:

**Office of Outcomes Assessment
University of Maryland University College**

Spring 2006

TABLE OF CONTENTS

Introduction	1
Defining Technology Fluency and Identifying Associated Skills.....	2
Research Supporting the Development of Technology Fluency	4
Imbedding Technology Fluency across the Curriculum	6
Assessment of Technology Fluency	7
Ensuring Technology Fluency through General Best Practices	8
References	10

INTRODUCTION

Technology skills enable an individual to use electronic devices, software programs, and digital mediums to achieve a wide variety of academic, work-related, and personal goals (American Library Association, 2000). Recent reports highlight the need to ensure college graduates possess cognitive processes that complement technology skills so that a level of technology fluency is attained. Technology fluency is associated with an understanding and increasingly skilled use of technology, making technology fluency quite different from being technologically savvy. Fluency focuses on understanding the underlying concepts of technology, applying problem-solving and critical thinking when using technology, as well as having skills which allow an individual to navigate software programs and computer hardware (American Library Association, 2000; Educational Testing Service [ETS], 2002a; National Research Council, 1999).

Traditional-age college students (18-23 years of age) as well as adult learners who are already part of the labor force are being challenged by an information and technology driven economy. Attaining technology fluency is necessary for success in today's society and is a key component in sustaining life-long learning (American Association of State Colleges and Universities [AASC&U], 2004; United States Department of Education, 2004). For instance, the development of other important educational objectives, such as information literacy, critical and analytical thinking, and communication skills require technology fluency (EDUCAUSE, 2006; Ehrmann, 2004; Oblinger, 2005; Partnership for the 21st Century, n.d.). In addition, technical skills that are paired with the capability to analyze and synthesize complex information is especially important as workers are expected to be able to multi-task, work within project-based groups, and adapt to technological developments (National Research Council, 1999). Ensuring technology fluency among college students is an important first step in increasing fluency for society as a whole (AASC&U, 2004; Twigg, 2005; United States Department of Education, 2004).

The University of Maryland University College (UMUC) has established technology fluency as a core learning area for all graduates. The selection of technology fluency as a core learning is considerate of the expectations for all Maryland higher education institutions, as well as the accreditation standards of the Middle States Commission on Higher Education.

This literature review will provide an overview of issues associated with defining technology fluency and identifying associated skills and capabilities. Current research that supports developing technology fluency among undergraduates is discussed. Initiatives implemented at other institutions to facilitate technology fluency among students are described as well as general best practices for developing and assessing technology fluency in postsecondary education.

DEFINING TECHNOLOGY FLUENCY AND IDENTIFYING ASSOCIATED SKILLS

Due in part to the rapid pace at which technology itself continues to advance, technology fluency is fluid in nature making the concept difficult to define. With regard to postsecondary education, groups such as the National Research Council, the Educational Testing Service (ETS), and regional accrediting bodies provide a framework that can be used by individual institutions to define technology fluency and identify associated outcomes.

The National Research Council highlights three main areas which reinforce one another and when achieved demonstrate technology fluency. An individual who is technologically fluent would possess:

- Intellectual capabilities that allow an individual to apply technology to complex and sustained situations and understand the consequences of doing so;
- An understanding of enduring concepts that are fundamental to information and computing; and
- Skills that allow users to manipulate and access contemporary technology through hardware and software (National Research Council, 1999).

ETS defines technology proficiency as “the ability to use digital technology, communication tools, and/or networks appropriately to solve information problems in order to function in an information society. “ This includes the ability to use technology as a tool to research, organize, evaluate, and communicate information, and a fundamental understanding of the ethical/legal issues surrounding the access and use of information (ETS, 2002a, p. 5).

Regional accrediting bodies, including the Middle States Commission on Higher Education (2006), require institutions to have a general education curriculum that promotes technological competency. General practice appears to hold individual institutions or state-wide governing boards responsible for designating specific outcomes or measurable objectives associated with technology fluency among undergraduates (Middle States Commission on Higher Education, 2006; New England Association of Colleges and Schools, 2006; North Central Association of Colleges and Schools, 2006; Northwest Association of Schools and Colleges, 2006; Southern Association of Colleges and School, 2006; Western Association of Schools and Colleges, 2001).

Some institutions conceptualize technology fluency as a set of intellectual capabilities that have personal, interpersonal, professional and societal dimensions. Each capability is tied to related concepts and skills that provide a framework for inclusion in the curriculum so that the capabilities and skills are developed among students. For instance, personal capabilities, such as the

ability to think critically, solve problems, and test solutions with and about technology are tied to the ability to understand differences between data and information. In this instance, students demonstrate having attained the personal capabilities and fundamental concepts through the use of technology to analyze and interpret data (Matthews-DeNatale & Matthews-DeNatale, 2006). A complete description of the capabilities, concepts, and skills is available at <http://www.educause.edu/ir/library/word/NCP0622B.doc>.

Within this framework, UMUC defines technology fluency as the ability “to understand information technology broadly enough to apply technology productively to academic studies, work, and everyday life; recognize when information technology would assist or impede the achievement of a goal; adapt to the changes in and advancement of information technology.” In looking to assess whether students are technologically fluent, UMUC has identified several key expected outcomes for the School of Undergraduate Studies (SUS) and the Graduate School of Management and Technology (GSMT).

Within SUS, technology fluency is demonstrated through the ability to:

- Use
 - A computer to create a text document
 - A graphics and/or artwork package to create image based expressions of ideas
 - The internet effectively to locate information and resources;
 - A computer to communicate
 - A spreadsheet to model simple processes or financial tables
 - A database system to set up and access useful information
 - Instructional materials to learn how to use new applications or features;
- Understand
 - What a computer is and how a computer works
 - Information systems features and structure
 - Networks and how information is routed between computers
 - Locating and structuring information in digital format
 - Limitations of information technology systems
 - Societal implications of information and information technology;
- Manage computer projects that involve information technology;
- Organize information structures;
- Navigate information structures;
- Evaluate information structures;
- Collaborate in remote and asynchronous environments; and
- Adapt to new and changing technologies (UMUCa, 2005).

Within GMST, technology fluency is demonstrated through the ability to:

- Explain the generic nature and uses of technologies, both physical and information technologies, for competitiveness; and
- Exhibit technical and managerial competencies in employing, integrating, and managing technologies within organizations to achieve a competitive edge (UMUCb, 2005).

The UMUC definition describes technical skills students should possess in a comprehensive manner and highlights specific computer programs students should be familiar with. However, the definition does not elaborate on specific cognitive skills associated with technology fluency.

RESEARCH SUPPORTING THE DEVELOPMENT OF TECHNOLOGY FLUENCY

Technology fluency is best achieved through a broad based approach that integrates cognitive and technical learning across the curriculum (ETS, 2002a). Instructional strategies, which are paired with technology, enhance best practices in undergraduate education and also help accomplish educational objectives related to developing technology fluency among students (Chickering & Ehrmann, 1996; Ehrmann, 2004; Nelson, Laird, & Kuh, 2005).

A curriculum that integrates computer and technical skills as well as an understanding of how to apply those skills in a wide range of contexts will help accomplish multiple learning objectives (Oblinger, 2005). For instance, students will gain a more complete understanding of technological concepts through application across the curriculum as well as gain an enriched understanding of discipline specific knowledge. Internalization of technological concepts allows students to gain a greater understanding of the connections between technology and knowledge that can be applied to work and daily life (ETS, 2002a; Matthews-DeNatale & Matthews-Denatale, 2006).

Embedding efforts to promote technology fluency across the curriculum has additional benefits as technology promotes several effective instructional practices in undergraduate education. Technology can increase student engagement in learning by encouraging student interaction with faculty as well as student interaction with information being presented in class (Chickering & Ehrmann, 1996; Ehrmann, 2004; Nelson, Laird, & Kuh, 2005). For instance, communication technology, such as email facilitates frequent contact between students and faculty both in and out of class. This contact encourages student involvement and motivation and allows faculty members to share useful information and provide prompt feedback. Technology also allows students to interact with one another, making the learning process a cooperative and collaborative endeavor. Learning environments that utilize technology in such a manner allow learning to be more of an active process. Instructional practices

can incorporate a variety of technology so students are encouraged to reflect on what they are learning, relate new information to past experiences, apply knowledge gained to their daily lives, and address different learning styles by presenting information in a variety of ways. All of these activities are associated with greater gains in student learning (Chickering & Ehrmann, 1996; Ehrmann, 2004).

The strong relationship between productive student use of technology and student engagement through effective educational practices is underscored by results from the 2003 *National Survey on Student Engagement* (Nelson, Laird, & Kuh, 2005). Students who frequently used technology for classroom related activities were more likely than their counterparts who had not used technology for academic activities to report their courses emphasized higher order thinking skills. Frequent users of technology were also more likely to report interaction with faculty and the same students were more likely to be enrolled in courses which emphasized synthesizing and organizing ideas and information. Students who reported that their instructors required frequent use of technology or that they frequently used technology in class were more likely to report working in groups outside of class than peers who reported infrequent use (Nelson, Laird, & Kuh, 2005).

Additional studies conducted among college students demonstrate that student use of technology positively affects students' self-reported gains in general education, personal development and intellectual development (Hu & Kuh, 2001; Kuh & Vesper, 2001). Institutions which make considerable investments in technology and encourage applying technology to enhance the learning environment also encourage active learning among undergraduates. Students who are enrolled at these institutions report they participate in active learning activities, such as seeking additional information, applying material learned in class to other areas of their lives, and contributing to class discussion more frequently than peers who attend institutions that make considerably lower investments in technology. This finding holds true for traditional students as well as adult learners (Hu & Kuh, 2001). Students who indicate an increased familiarity with computers while enrolled in college were also more likely to develop other important skills and competencies, such as learning on one's own, thinking analytically, synthesizing ideas and concepts, writing clearly and working effectively with others (Kuh & Vesper, 2001).

Research illustrates the benefits associated with a curriculum that embeds experiences and opportunities for students to utilize and interact with technology in meaningful ways, thus creating students who are technologically fluent. While stakeholders associated with colleges and universities agree that technology fluency is an important outcome of postsecondary education there is less consensus with regard to what particular skills and abilities should be used to gauge whether fluency has been attained.

IMBEDDING TECHNOLOGY FLUENCY ACROSS THE CURRICULUM

Given the independence granted to individual institutions to develop their own definition of technological fluency, there is a great deal of variation in how technological competencies of undergraduates are addressed through the curriculum. However, several institutions have developed noteworthy cross-curricular initiatives that incorporate effective and meaningful experiences designed to develop technological fluency among students in an efficient manner.

A cooperative effort of the NorthWest Center for Emerging Technologies, the Regional Advanced Technology Education Consortium, the Washington State Board for Community and Technical Colleges, the Washington Software and Digital Media Alliance (WSDMA), and the Society for Information Management (SIM) has resulted in the identification of technology fluency standards that are closely aligned with careers in the technology sector. The process to develop the curriculum standards required researching market needs and communicating with business leaders about desired workforce technology skills. Identified needs were compared with the existing curriculum at higher education institutions so that gaps could be identified. Institutions elect whether to participate; however, participants hope to increase the employability of students who graduate from programs that incorporate the technology fluency standards into their curriculum (National Workforce Center for Information Technology, n.d.).

Institutions have addressed the technology fluency of students by using a specific course to target technology skills and capabilities. Technology fluency is initially targeted through a course that must be taken by all first year students. The initial course addresses fundamentals that all students are expected to know and engages students regardless of their major course of study. Topics addressed in the initial course are later expounded upon in disciplinary majors and in courses that use technology as part of the educational process. Technology skills and capabilities are built upon in later courses so that connections are made within the discipline and experiences outside of the student's major. Institutions that have used this approach hope that the three main components of technology fluency are addressed by developing intellectual capabilities related to technology, addressing fundamental technology concepts and providing technology skills (Calvin College, n.d.).

George Mason University has taken similar measures to address technology fluency among students. Practices designed to develop basic-level technology skills are incorporated into general education courses. More advanced technology skills and concepts are incorporated into courses required for majors. Departments are encouraged to examine the use of technology in their curricula as a whole and develop departmental plans for technology. Technology skills goals that are discipline specific are articulated and assignments, resources, and courses to help achieve them are developed in concert with the Technology

Across the Curriculum Advisory Committee. Outcomes associated with attainment of technology fluency are mapped out across the curriculum and displayed in a series of technology skills grids (George Mason University, n.d.).

ASSESSMENT OF TECHNOLOGY FLUENCY

As a whole, higher education makes considerable investments in technology in order to create learning environments that provide multiple opportunities for students to learn and apply skills and capabilities associated with technology fluency. As technological competency becomes an increasingly important outcome, institutions are making a concerted effort to examine and document whether students are technologically fluent. A range of assessment tools have been designed for this purpose.

Nationally administered survey instruments gauge access to technology, frequency of use, and how technology is used in classes to assess whether students have an opportunity to develop technological fluency (EDUCAUSE Center for Applied Research, 2006). For instance, the *ICT Literacy Assessment* developed by ETS measures information and communication technology proficiency through real-time, scenario-based tasks to assess the cognitive and technical skills required of today's higher education students. Results can be used to provide support for institutional initiatives, guide curriculum, and inform institutional policy. California's system of public higher education has chosen to use this tool to assess technology fluency among their students (ETSb, 2002). Other national surveys, such as the one developed by the EDUCAUSE Center for Applied Research, collect data on what computer software and hardware programs students are most familiar with and whether they have access to the most up-to-date computer systems.

Institution specific assessments in the form of surveys collect data on how students would troubleshoot technology problems, whether students can distinguish between software applications to accomplish specific tasks, and whether students are knowledgeable about fundamental concepts related to technology (Matthews-DeNatale & Matthews-DeNatale, 2006). Other institutions, such as several liberal arts colleges, use student portfolios to gather information on the ways in which students use and apply technology skills. Although using portfolios is a time intensive process for those charged with conducting the assessment, portfolios provide a wide range of information and specific examples of students' ability to apply technical skills to their academic work (Lorenzo & Ittelson, 2005).

UMUC has chosen to use an institutionally designed instrument to assess technology fluency among undergraduate students. The Fluency in Technology Exam (FIT Exam) will be used to collect data in relation to the skills and outcomes associated with the UMUC core learning area of technology fluency

(UMUCa). The FIT Exam is the final course exam in the UMUC general education course IFSM 201 (Introduction to Computer-Based Systems).

ENSURING TECHNOLOGY FLUENCY THROUGH GENERAL BEST PRACTICES

The literature suggests several general best practices that can be employed by college and university faculty to encourage technology fluency among students. Practices are best viewed as a complete system that addresses the technology infrastructure at an institution, curriculum design, and assessment efforts.

Institutions that establish technology fluency as an outcome of an undergraduate education must first have in place the structural components necessary to create effective technology-rich learning environments. Success in this regard requires faculty who are informed about effective instructional practices that incorporate technology. Faculty must feel comfortable and knowledgeable about utilizing different computer applications. Having an appropriate level of technical support is also necessary if learning environments are going to effectively promote technology fluency among students (Agee & Zenelis, 2002).

Before creating an institutional definition of technology fluency, institutions may wish to conduct an environmental scan that examines perceptions among stakeholders about what skills demonstrate technological fluency. Examining what skills are valued helps ensure consistency in application of efforts across the curriculum and establishes lines of communication that are helpful in accomplishing institution-wide goals. Common definitions with regard to skills, capabilities and outcomes associated with technology fluency are important. Commonly understood definitions can be integrated across the curriculum in a broad range of courses (Agee & Zenelis, 2002).

Technology fluency requires applying cognitive skills in concert with the ability to access and use information effectively. Therefore, definitions of technology fluency should target both the cognitive and technical skills needed to navigate computer hardware and software and definitions should be tied closely to information literacy standards (ETS, 2002c).

Promoting technological fluency among students requires program-wide thinking so that connections are made between one set of skills and more advanced ones. Technology fluency is best achieved when efforts to promote desired outcomes are incorporated across the curriculum rather than in one entry-level course (Agee & Zenelis, 2002).

An assessment plan that is directly tied to the institutional definition of technology fluency is an important component of an undergraduate curriculum designed to promote this core learning area. In this regard, assessment tools should measure cognitive as well as technical skills associated with fluency (ETS, 2002c).

Assessment plans should utilize system-wide measures of technology fluency but also report on what students are learning in technology enhanced courses. Reporting at the institutional- and course-level allows for a more complete understanding of what experiences promote technology fluency among students (Agee & Zenelis, 2002).

In concert with more traditional forms of assessment, institutions may wish to consider alternative forms of assessment of technology fluency, such as e-portfolios. Examples of student work can provide information about what technology skills are being accomplished in specific classes and how students are applying those skills (Lorenzo & Ittelson, 2005).

In summary, technology fluency is set of intellectual capabilities, an understanding of fundamental technology concepts and a set of skills that allow students to interact and engage with technology in meaningful ways (National Research Council, 1999). Gaining discipline specific knowledge as well as technology skills and capabilities that can be applied in a variety of settings are important outcomes associated with undergraduate education. Technology fluency allows graduates to actively contribute to the workforce and economy (National Research Council, 1999; Partnership for the 21st Century, n.d.). A curriculum that embeds experiences designed to allow students to utilize and interact with technology in meaningful ways is more likely to develop technology fluency among undergraduates. Additional benefits of a curriculum that embeds technology skills and capabilities include increased student-faculty interaction and student engagement (Chickering & Ehrmann, 1996; Ehrmann, 2004; Nelson, Laird, & Kuh, 2005). Effective cross-curricular models designed to promote technology fluency take into account work-force needs, the institutional mission, and a variety of academic goals (National Workforce Center for Information Technology, 2005). Finally, linking assessment practices to curricular efforts is an important component of institutional goals to develop technology fluency among students (ETS, 2002c).

References

- Agee, A.S., & Zenelis, J.G. (2002). Technology across the curriculum: Information literacy and IT fluency. In Hawkins, B.L., Rudy, J.A., & Wallace, W.H. (Eds.), *Technology Everywhere: A Campus Agenda for Educating and Managing Workers in the Digital Age* (pp. 93-110). San Francisco: Jossey-Bass.
- American Association of State Colleges and Universities (2004). *The Key to Competitiveness: Understanding the Next Generation Learning*. NY: American Association of State Colleges and Universities.
- American Library Association (2000). *Information Literacy Competency Standards for Higher Education*. Chicago, IL: American Library Association. Retrieved April 20, 2006 from <http://www.ala.org/ala/acrl/acrlstandards/standards.pdf>
- Calvin College (n.d.) *Building Information Technology Fluency into a Liberal Arts Core*. Retrieved April 20, 2006 from <http://www.calvin.edu/admin/rit/fipse1.htm>
- Chickering, A.W., & Ehrmann, S.C. (1996). *Implementing the Seven Principles (for Good Practice in Undergraduate Education): Using Technology as a Lever*. Retrieved April 20, 2006 from <http://www.tltgroup.org/programs/seven.html>
- Educational Testing Service (2002a). *Digital Transformation: A Framework for ICT Literacy*. Retrieved April 10, 2006 from [http://www.ets.org/Media/Tests/Information and Communication Technology Literacy/ictreport.pdf](http://www.ets.org/Media/Tests/Information_and_Communication_Technology_Literacy/ictreport.pdf)
- Educational Testing Service (2002b). *ICT Literacy Assessment Overview*. Retrieved April 10, 2006 from <http://www.ets.org/portal/site/ets/menuitem.1488512ecfd5b8849a77b13bc3921509/?vgnextoid=fde9af5e44df4010VgnVCM10000022f95190RCRD&vgnnextchannel=cd7314ee98459010VgnVCM10000022f95190RCRD>
- Educational Testing Service (2002c). *Succeeding in the 21st Century: What Higher Education Must Do to Address the Gap in Information and Communication Technology Proficiencies*. Retrieved April 10, 2006 from [http://www.ets.org/Media/Tests/Information and Communication Technology Literacy/ICTwhitepaperfinal.pdf](http://www.ets.org/Media/Tests/Information_and_Communication_Technology_Literacy/ICTwhitepaperfinal.pdf)

- EDUCAUSE Center for Applied Research (2006). *Student Information Technology Use and Skills in Higher Education*. Retrieved April 10, 2006 from <http://www.educause.edu/LibraryDetailPage/666?ID=ESI06B>
- Ehrmann, S. (2004). Beyond computer literacy: Implications of technology for the content of a college education. *Liberal Education, Fall*. Retrieved April 10, 2006 from <http://www.aacu.org/liberaleducation/le-fa04/le-fa04feature1.cfm>
- George Mason University (n.d.). *Technology Across the Curriculum*. Retrieved April 10, 2006 from <http://tac.gmu.edu/>
- Hu, S., & Kuh, G.D. (2001). Computing experience and good practices in undergraduate education: Does the degree of campus "wiredness" matter? *Education Policy Analysis Archives, 9*(49). Retrieved April 10, 2006 from <http://epaa.asu.edu/epaa/v9n49.html>
- Kuh, G.D., & Vesper, N. (2001). Do computers enhance or detract from student learning? *Research in Higher Education, 42*(1), 87-103.
- Lorenzo, G., & Ittelson, J. (2005). *Demonstrating and Assessing Student Learning with E-Portfolios*. Retrieved April 10, 2006 from <http://www.educause.edu/ir/library/pdf/ELI3003.pdf>
- Matthews-DeNatale, B., & Matthews-DeNatale, G. (2006). *Fluency in Information Technology (FIT): Setting Expectations and Understanding Students' Learning Needs*. Retrieved April 10, 2006 from <http://www.educause.edu/LibraryDetailPage/666?ID=NCP0622>
- Middle States Commission on Higher Education (2006). *Characteristics of Excellence in Higher Education: Eligibility Requirements and Standards for Accreditation*. Philadelphia, PA: Middle States Commission on Higher Education.
- National Research Council (1999). *Being Fluent with Information Technology*. Washington, D.C.: National Academy Press.
Retrieved April 10, 2006 from <http://www.nap.edu/catalog/6482.html>
- Nelson Laird, T.F., & Kuh, G.D. (2005). Student experiences with information technology and their relationship to other aspects of student engagement. *Research in Higher Education, 46*(2), 211-233.
- New England Association of Colleges and Schools (2006). *Standards for Accreditation*. Retrieved April 10, 2006 from [http://www.neasc.org/cihe/standards for accreditation 2005.pdf](http://www.neasc.org/cihe/standards_for_accreditation_2005.pdf)

- North Central Association of Colleges and Schools (2006). *Standards and Criteria for Accreditation of Schools Approved for Postsecondary Education*. Retrieved April 10, 2006 from http://www.ncacasi.org/postsecondary/resource/pdf/PS_Criteria_April2006.pdf
- Northwest Association of Schools and Colleges (2006). *Annual Report and Standards for Supplemental Education Schools*. Retrieved April 10, 2006 from <http://www.boisestate.edu/naas/publications/standards.shtml>
- NorthWest Center for Emerging Technologies (n.d.). *Building a Foundation for Tomorrow: Skill Standards for Information Technology*. Retrieved April 10, 2006 from <http://www.nwcet.org/products/skillStandards.asp>
- Oblinger, D.G. (2005). Learners, learning, and technology: The EDUCAUSE learning initiative. *EDUCAUSE Review*, 40(5), 66-75.
- Partnership for the 21st Century* (n.d.) *Partnership for the 21st Century*. Retrieved April 10, 2006 from <http://www.21stcenturyskills.org>
- Southern Association of Colleges and Schools (2006). *Principles of Accreditation*. Retrieved April 10, 2006 from <http://www.sacscoc.org/pdf/PrinciplesOfAccreditation.PDF>
- Twigg, C.A. (2005). *Course Redesign Improves Learning and Reduces Cost*. National Center for Public Policy and Higher Education. Retrieved April 10, 2006 from http://www.highereducation.org/reports/pa_core/core.pdf
- United States Department of Education (2004). Toward a new golden age in American education: How the Internet, the law and today's students are revolutionizing expectations. *National Educational Technology Plan*. Retrieved April 10, 2006 from http://www.ed.gov/about/offices/list/os/technology/plan/2004/plan_pg5.htm
- University of Maryland University College (2005a). *School of Undergraduate Studies Assessment Plan*. Office of Outcomes Assessment.
- University of Maryland University College (2005b). *Graduate School of Management and Technology Assessment Plan*. Office of Outcomes Assessment.

Western Association of Schools and Colleges (2001). *WASC Handbook of Accreditation*. Retrieved April 10, 2006 from http://www.wasc.org/wasc/Doc_Lib/2001%20Handbook.pdf

For more information on UMUC learning assessment activities, please contact:

Office of Outcomes Assessment
University of Maryland University College
3501 University Boulevard, East
Adelphi, MD 20783
(301) 985-7358
learningassessment@umuc.edu