ITEST Learning Resource Center

July 2004

ITEST Learning Resource Center
Information Brief, Volume 1

About ITEST

The Information Technology Experiences for Students and Teachers (ITEST) program was established by the National Science Foundation in direct response to the concern about shortages of IT workers in the United States. The ITEST program funds projects that provide opportunities for both school-age children and teachers to build the skills and knowledge needed to advance their study and to function and contribute in a technologically rich society. The ITEST program also funds a National Learning Resource Center to support, synthesize, and disseminate the program's learnings to a wider audience.

In This Issue

Active Learning in the Information Age:

Integrating IT Skill Development into STEM Curricula

Despite the deployment of computers, software, and high-speed Internet access in schools and community centers across the country over the last decade, educators in both formal and informal learning environments throughout the United States still struggle to help learners develop the information technology (IT) skills needed for success in living, learning, and working. In these days of No Child Left Behind and other elevated accountability efforts, educators are also increasingly challenged to improve academic performance, especially in the four main content areas that lead to high-tech jobs: science, technology, engineering, and math (STEM). Some leaders in the youth development and education fields are beginning to find success in building both IT and STEM skills through an integrated approach that employs experiential learning methods, addresses academic standards, and makes the content relevant to the lives of learners and their communities. This first volume of the ITEST Learning Resource Center Information Brief *will address key questions related to this integrated approach, which is at the core of the ITEST experience, and will highlight relevant research and resources.*

1 What IT skills are essential to living, learning, and working? And how do we integrate these essential skills into both formal and informal learning?

In today's technologically advanced information society, a strong foundation of IT skills is needed in all areas of life and work. With the majority of U.S. schools now equipped with computers and the Internet, both technology instruction and educational technology, or the use of technology tools in learning, are commonplace elements of the school day. Home computers provide easy access to information, personal finances, government, health resources, and continuing education opportunities. Even the most entry-level work environments require workers to possess a core set of "IT user" skills. These skills include basic business support technologies as well as more sophisticated applications of technology integration in areas once thought of as manual labor, such as auto mechanics, agriculture, health care, and manufacturing. Today, whether as "users" or "producers" of technology, fundamental skills for success with technology in life and work are learned in both formal and informal environments in communities all around us.

Individuals with basic technology skills are that much more likely to succeed in the home, workplace, or classroom and have greater access to opportunities and information. But young people need more than the ability to use technological tools. To be IT literate, young people must be able to apply their cognitive skills and technical abilities to the processes of problem solving, critical thinking, self-expression, and innovation. This higher order of applied technology use is best learned through hands-on, project-based experiences, modeled in the classroom or informal settings.

Young people can be creative, explore, and have fun as they learn independently and collaboratively with others when essential IT skills are integrated into project-based learning that is driven by student inquiry, relevant to their life experiences, and designed to support diverse learning styles. A youth-centered approach affords the opportunity to address students' social and emotional needs as well as academics. In both formal and informal settings, technology tools can link learners to vast resources and reference materials while also connecting them to other students and educators for dialogue and collaboration.

The best educational technology is thoughtfully applied to enhance and expand on existing academic goals and standards. However, there are barriers to overcome when trying to use technology for experiential learning. Educators may themselves be techno-phobic, not being first-generation technologists like their students, and may be afraid to reveal that the young people know more about the equipment than they do. These educators should locate themselves and their programs on a continuum of technology-enhanced, project-based learning and begin to chart steps they can take to deepen their programs, with healthy doses of organizational planning and professional development along the way. This staged approach to integrating technology into experiential learning enables such educators to gradually build their capacity to engage youth in technology.

Another key challenge is getting educators to facilitate the development of information literacy as it pertains to new technology. The Internet and the multimedia capacity of the latest hardware afford the opportunity and almost require educators to explore with students the meaning behind images and messages. These days, truly literate young people need the ability to decipher information content and recognize bias. For young people to be full citizens in an information age, they must have these essential information literacy skills, and educators are bound to facilitate this development through curriculum that continually examines information content.

Supporting Reference Materials

- *Learning for the 21st Century: A Report and Mile Guide for 21st Century Skills,* The Partnership for 21st Century Skills, 2003
  www.21stcenturyskills.org/downloads/P21_Report.pdf
- *Technically Speaking: Why All Americans Need to Know More About Technology,* Committee on Technological Literacy, National Academy of Engineering and National Research Council, 2002
  www.nae.edu/nae/techlithome.nsf (overview website)
  books.nap.edu/books/0309082625/html/index.html (full text)
- *Being Fluent with Information Technology,* National Academy of Sciences, 1999
  books.nap.edu/html/beingfluent/
- *Teachers' Tools for the 21st Century: A Report on Teachers' Use of Technology,* National Center for Education Statistics, 2000
  nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2000102
- "Information Literacy Standards for Student Learning," *Information Power: Building Partnerships for Learning,* American Library Association and Association for Educational Communications and Technology, 1998
  www.ala.org/aasl/ip_nine.html
- *Digital Transformation: A Framework for ICT Literacy,* Educational Testing Service (ETS), 2000
  www.ets.org/research/ictliteracy/ictreport.pdf

2 Why is it beneficial to integrate technology through project-based learning into formal and informal STEM learning?

Traditional STEM learning has historically involved the rote memorization of theories and principles removed from the life experiences of a young person. But more and more STEM educators are becoming aware that students learn best when key principles are discovered through hands-on experiential approaches. In this setting, educators develop curricula that facilitates the discovery of key academic principles in the students' environment and community so that learning is truly relevant and contextual. With STEM learning rooted in student inquiry, technology tools can be harnessed to further exploration, experimentation, and communication.

When STEM educators take an experiential approach to their curriculum, they are also afforded the opportunity to draw linkages to employment and careers, thereby demonstrating for young people the skills required to succeed in various life paths. By drawing connections to the world of work, STEM experts become assets in the classroom, serving as advisors and mentors, either in person or virtually. This is particularly useful with regard to IT and high-tech careers, where students often struggle to understand concepts and career paths. Educators and expert mentors can help learners understand that they can apply IT skills in two ways: as "users" of technology and as "producers" of technology. IT careers as producers of technology

Spotlight on: Ocean Explorers

ITEST Project Locations: Santa Barbara, Ventura, and Los Angeles counties, California
edc.org/itestlrc/Frames2/ProjectsFrameset.html

Using ocean science as a hook to capture the interest and attention of teachers and students, Ocean Explorers coordinates carefully constructed activities to introduce teams of participants to the use of GIS (Geographic Information Systems) and IPA (Image Processing and Analysis).

> *The activities were planned as a result of a collaborative effort involving the project staff, a committee of industry and federal agency advisors, and local educational administrators (primarily district and county-level personnel). The project is making good use of its project mentors—scientists and managers from IT industries and ocean science agencies—as resources for developing and sustaining the project. One project mentor—a female African-American scientist who uses GIS extensively in her ocean science research—has participated as an instructor and participant in one of the project's four-day summer field workshops on Santa Cruz Island, California. Other project mentors, including educational and research personnel from the National Marine Sanctuaries program, have been very active in the planning and execution of the project activities. Additional mentors, including scientists from IT industries such as Hewlett Packard, Aquilent, and ClearOne, will be moving from their project advisory roles to active mentoring, serving as role models for the project participants.*
>
> —Steven Moore, Ph.D., Principal Investigator, Center for Image Processing in Education (CIPE)

Resources Used:

Mapping an Ocean Sanctuary: Using GIS to Study Ocean Science, CIPE, 2003
www.cinms.nos.noaa.gov/edu/pdf/Flyer.pdf

Mapping Our World: GIS Lessons for Educators, Lyn Malone, Anita M. Palmer, and Christine L. Voigt, ESRI Press, 2002
gis.esri.com/

Discovering Image Processing, CIPE, 2002
www.evisual.org/www/Instr/DIP.html

Understanding by Design, Grant Wiggins and Jay McTighe, Association for Supervision and Curriculum Development, 1998
www.ascd.org/publications/books/198199/

Technology Standards

ISTE National Educational Technology Standards
www.iste.org/standardswww.iste.org/standards

include designing, developing, managing, and supporting the hardware, software, multimedia, and systems integration services—careers that are found in every industry sector.

Responsible STEM educators will be responsive to the diversity of their students, drawing on culturally appropriate community resources and expertise to strengthen their curricula. For many students, these encounters may be the first time they engage with someone of their own ethnic background or gender who has expertise in a particular STEM field. Research shows that young people use their prior cultural knowledge to gain IT literacy and to understand and use IT and other tools that mediate their interaction with the world. Therefore, the more a learning experience draws on the prior cultural knowledge of the student, the more likely s/he is to benefit most fully from the experience. Again, technology can enable this process by linking both students and educators to additional resources and expertise.

Supporting Reference Materials

- *Meeting the Need for Scientists, Engineers, and an Educated Citizenry in a Technological Society,* Paul E. Barton, Educational Testing Service (ETS), 2002
  www.ets.org/research/pic/meetingneed.pdf
- *CEO Forum Year 4 Report: Key Building Blocks for Student Achievement in the 21st Century,* CEO Forum on Education and Technology, 2001
  www.ceoforum.org/downloads/report4.pdf
- *Land of Plenty, Diversity as America's Competitive Edge in Science, Engineering and Technology,* Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, 2000
  www.nsf.gov/od/cawmset/report.htm
- *Using Real-World Projects to Help Students Meet High Standards in Education and the Workplace,* Southern Regional Education Board, 2000
  www.sreb.org/programs/hstw/publications/site-guides/usingrealworldprojects.asp
- *IT Pathway Pipeline Model: Rethinking Technology Learning in Schools,* Education Development Center, Inc., 2000
  www2.edc.org/ewit/materials/pipeline.pdf

3 What kinds of technology standards have been developed to guide IT and STEM integration?

Standards are valuable guideposts and benchmarks for learning and working. Two kinds of technology standards are used as source material to guide education programs in IT: education standards for STEM content areas, and IT industry skill standards. Education standards for STEM content areas provide structure and content for educators as they design programs and develop integrated curriculum to encourage student achievement. IT industry skill standards identify what professional and technical IT workers need to know and be able to do to succeed in their jobs. Together, the two types of standards serve as a map for educators and employers as they cooperate to build education programs for "users" and "producers" of technology. The standards also add value as a set of challenges for students as they begin to explore career options and prepare for their futures, and serve as a roadmap for easing the college-to-career transition.

The very best standards will do the following:

- Engage stakeholders from industry, education, and the community in the design and validation process—developing a common language and respect for the contributions of each sector
- Encourage restructuring of learning—focusing on student mastery of both technical and academic skills through problem-solving
- Create a framework for implementing alternative assessment strategies—such as portfolios, products produced, oral reports, and research projects—measuring the new demands of high-performance workplaces
- Serve as a guide for the professional development of workplace mentors, teachers, and workplace supervisors, all of whom will be engaged in helping learners succeed
- Promote flexibility about where learning takes place—drawing on the very best mix of workplaces, community settings, and schools
- Hold everyone accountable to a higher level of student achievement for all students—promoting effective teaching and learning strategies, such as cooperative and team learning and the appropriate use of new technologies

Here are just a few of the standards available over the Internet:

- *National Education Technology Standards* (NETS), International Society for Technology in Education (ISTE), 2000
  cnets.iste.org/

ISTE is recognized as the go-to place with regard to defining IT standards for the academic environment. In addition to NETS, ISTE is home to the Center for Applied Research in Education Technology (CARET), with its detailed online archive of reference materials, and the National Educational Computing Conference (NECC), a major annual gathering of educators and the IT sector.

- *Standards for Technological Literacy: Content for the Study of Technology, International Technology* Education Association (ITEA), 2000
  www.iteawww.org/TAA/Publications/STL/STLMainPage.htm

ITEA developed these content standards for the study of technology, from grades K–12. They incorporate both cognitive skills and hands-on activities designed to help sudents become technologically literate.

- *Foundation Knowledge and Skills,* IT Career Cluster Initiative, Education Development Center, Inc., 2000
  www2.edc.org/ewit/materials/ITCCFN-KS.pdf

Foundation Knowledge and Skills articulates those skills, both academic and technical, that all students within the IT Career Cluster should achieve, regardless of their pathway selection.

- *National Science Education Standards,* National Academy of Sciences, 1996
  www.nap.edu/readingroom/books/nses/

Educators can use these criteria to determine the knowledge and skills that students must attain to demonstrate scientific literacy at different grade levels. The standards are organized into six areas: science teaching, professional development, assessment, science content, science education programs, and science education systems.

- *Principles and Standards for School Mathematics,* National Council of Teachers of Mathematics (NCTM), 2000
  standards.nctm.org/

This definitive resource includes a set of principles for s chool mathematics and detailed descriptions of content and process standards for PreK–12.

- *Skill Standards for Information Technology,* National Workforce Center for Emerging Technologies (NWCET), 2003
  www.nwcet.org/ProductServices/Products.aspx

IT skill standards developed by NWCET identify what people need to know and be able to do to succeed in eight career areas that provide immediate entry into the IT industry. These skill standards identify the tasks, performance criteria, technical knowledge, foundation skills, and personal qualities needed for work in these IT careers. Related Tech-Prep curricula provide benchmarks for students in grades 12–14 who are moving into IT "producer" careers.

4 What resources are available for educators to better plan activities that integrate IT and STEM?

As more and more educators weave IT skill development and STEM learning into both formal and informal settings, the Internet has become a valuable repository of promising practices. In our scan of those resources available, we found that the very best materials do the following:

- Promote experiential learning that draws on youth interests and curiosity
- Use technology tools to solve problems and link students and teachers to resources, expertise, and collaborators
- Build creativity and skills in critical thinking, and communication
- Connect academic principles to real-world contexts drawn from the lives and cultures of the learners
- Link learning, skill development, and careers so that learners are aware of real employment opportunities
- Promote the creation of projects and products that articulate lessons learned

The following sites offer a range of valuable resources:

- Apple Learning Interchange
  ali.apple.com/

This portal is Apple Computer's contribution to the integration of IT in the classroom. The site is a clearinghouse on technology-integrated curricula that provides practical information on methods, standards, and tools for projects in all grade levels.

- Exploratorium
  www.exploratorium.com/educate/index.html

Referring to themselves as "the museum of science, art and human perception," San Francisco's Exploratorium offers an interactive website for both educators and young people that includes a digital library, hands-on activities, photos, movie clips, and webcasts of demonstrations.

- The YouthLearn Initiative, Education Development Center, Inc.
  www.youthlearn.org

Developed through rigorous fieldwork with community-based, youth development agencies, YouthLearn offers a range of resources for educators on how best to integrate technology into non-formal learning, with

Spotlight on: DAMSALS²

ITEST Project Locations: Mississippi River Delta of Northeast Louisiana
www.ulm.edu/damsals2/

Using GPS (Global Positioning Systems) and GIS (Geographic Information Systems) technology, the Delta Agriculture Middle School Applied Life Science or "DAMSALS²" project explores agriculture-related concepts with students and teachers in grades 7–12 from rural schools in the Mississippi River Delta section of northeast Louisiana.

> *We used activities that we developed for previous professional development projects and found ways to enhance them with IT. For example, we used the Ecolog XL to collect temperature, humidity, light intensity, and air pressure data while we were conducting experiments with plants. This data was then put into spreadsheets for analysis and representation. We also found ways of incorporating GPS/GIS technology by putting the data we collected about specific sites into a GIS and used remote images to display the sites. As we began to do these things we began to see more and more ways of integrating the technology with the STEM content. A culminating project allowed the teachers to use all of the skills they had developed to solve a problem and present their solution in PowerPoint at a "Scientists' Convention" attended by an invited audience of school personnel, community representatives, and university researchers and agri-businessmen.*
>
> —Patty Watts, Ph.D., Principal Investigator, University of Louisiana—Monroe

Resources Used

The GLOBE Program
www.globe.gov/globe_flash.html

Journey North: A Global Study of Wildlife Migration and Seasonal Change
www.learner.org/jnorth/

Technology Standards

Louisiana Technology Standards
www.doe.state.la.us/DOE/lcet/curric/k12stand.pdf

Louisiana's standards are aligned with the National Educational Technology Standards
www.iste.org/standards

planning guides, activities, and an active online community of practice.

- The George Lucas Educational Foundation
  www.glef.org/getstarted/educators.php

Established by filmmaker George Lucas as an operating foundation to support educators in the development of more active, meaningful curriculum, the GLEF website offers a vast archive of resources for in-school programs, profiling innovative applications of project-based learning, school-to-career approaches, and technology integration methods.

- ScienceQuest, Education Development Center, Inc.
  www2.edc.org/sciencequest/

Funded through a grant from the National Science Foundation, ScienceQuest provides tools to guide young people in developing inquiry-based projects, including sample activities to spark young people's interest in science and online resources on a variety of specialized science areas.

- "Using Technology to Improve Instruction and Raise Achievement: Outstanding Practices," Southern Regional Education Board (SREB), 2001
  www.sreb.org/programs/hstw/Outstanding/op2001.asp

These case studies collected by SREB are notable examples of high school programs that engage young people in the use of technology in effective and innovative ways that actually lead to positive academic results.

About the ITEST Learning Resource Center

The National ITEST Learning Resource Center at Education Development Center, Inc. (EDC), collaborates with the 12 ITEST projects across the United States to achieve program goals, weave together promising practices, and leverage the programs' combined achievements into new knowledge. The results will inform and guide formal and informal educators in planning, implementing, and evaluating IT-enriched STEM initiatives.

The ITEST Learning Resource Center at
Education Development Center, Inc.
55 Chapel Street
Newton, MA 02458
Phone: 617-618-2920
Fax: 617-332-4318
http://www.edc.org/itestlrc

This Information Brief is published by ITEST Learning Resource Center, a project at Education Development Center, Inc., under contract #0323098 from the National Science Foundation.

Additional Resources

Educator's Website for Information Technology (EWIT)
www2.edc.org/ewit/resource.asp

EWIT is a learning community of academic and technical educators and community-based and business partnerships that provides a starting place for educators interested in developing, expanding, and/or strengthening their IT programs. EWIT links to various technology skill standards and resources for integrating academic learning and IT.

Information Technology Association of America (ITAA)
www.itaa.org

ITAA's website provides information on issues relevant to the IT industry. Their resources section includes an IT Events Directory and a Speakers Bureau. ITAA has a broad network of members representing the IT industry and holds national and regional meetings on topics of interest to IT employers.

America Connects Consortium (ACC)
www.americaconnects.net

ACC provides resources for the community technology sector. The ACC website features an extensive resources section, including information and tools for designing technology and education programs, as well as research briefs on promising practices for project-based learning, community engagement, building partnerships, and conducting evaluation.

ICT Literacy
www.ictliteracy.info/

This is website is a rich, centralized portal for ICT literacy resources, including publications, webcasts, and an online community. It highlights innovative efforts and partnerships promoting ICT Digital Literacy, and facilitates the interaction between researchers, business, government, and educational stakeholders.

Other Useful Reference Materials

enGauge® 21st Century Skills: Literacy in the Digital Age, North Central Regional Education Laboratory, 2003
www.ncrel.org/engauge/skills/skills.htm

Technology Connections for School Improvement, North Central Regional Education Laboratory, 1997
www.ncrel.org/tplan/tplanB.htm

How People Learn: Brain, Mind, Experience, and School, National Academy of Sciences, 1999
http://www.nap.edu/html/howpeople1/

Tech-Savvy: Educating Girls in the New Computer Age, American Association of University Women, 2000
www.aauw.org/research/girls_education/techsavvy.cfm

Science for All Americans, American Association for the Advancement of Science, 1990
www.project2061.org/tools/sfaaol/sfaatoc.htm