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Literacy in the Digital Age

enGauge® 21st Century Skills: Literacy in the Digital Age

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Message to the Reader

Today's school leaders face a serious dilemma: Communities expect their graduates to be ready to thrive in the Digital Age, but the 21st century skills required for such success are not well defined. Those skills are not included in many state learning standards or measured on most state and local assessments.

The current era of high-stakes testing will have a positive impact on students *only* if we get the metrics right. Without 21st century skills, students are being prepared to succeed in yesterday's world—not tomorrow's.

Schools must do more to keep pace with rapid technology, research, and societal changes. To ensure that students will be ready to thrive in today's knowledge-based, global society, three significant things need to occur:

- The public must acknowledge 21st century skills as essential to the education of today's learner.
- Schools must embrace new designs for learning based on emerging research about how people learn, effective uses of technology, and 21st century skills in the context of rigorous academic content.
- Policymakers must base school accountability on assessments that measure both academic achievement and 21st century skills.

This publication represents an important first step toward Digital Age readiness. Readers are invited to use the *enGauge* 21st Century Skills as a platform for the shifts in school policy and practices necessary to give our students the education they require in a knowledge-based, global society.

Extra! Extra! The World Is Different!

The Workplace	Farmers are checking soil moisture from their hand-held computers, and factory workers are guiding robots.
Education	Teachers are serving as facilitators, exploring with their students the vast world of ideas and information.
Health Care	More efficient systems are linking together county, state, and federal facilities, accelerating the study, diagnosis, and treatment of diseases through networked applications and medical databases.
Public Safety	Officials are gaining access to instantaneous emergency-response information and inter-operation of critical equipment regardless of jurisdiction.
Government	Free and universal access to information is increasing for all citizens, whose informed opinions are in turn shaping policy and fostering greater global democracy.
Ethics	Ethical issues are no longer just about right and wrong but also about informed choices between two rights—such as doing all we can to save lives and allowing people to die with dignity.

Information presented in this table was found in two sources:

Computer Systems Policy Project. (2000). *Building the foundation of the networked world* (p. 8). Washington, DC: Author.

Cornish, E. (Ed.). (1996). *Exploring your future: Living, learning, and working in the Information Age* (pp. 7-11). Bethesda, MA: World Future Society.

Executive Summary

Are your graduates ready to thrive in today's Digital Age? Upon serious reflection, most schools must answer with a resounding "no!" This publication is a guide for those interested in changing that answer to the affirmative. As the CEO Forum on Education and Technology (2001) concluded in *Key Building Blocks for Student Achievement in the 21st Century*, "The definition of student achievement must be broadened to include the 21st century skills that will be required for students to thrive in the future" (p. 1).

The world in which our children live is significantly different from that of yesterday. Today's youngsters use laptops, pagers, instant messaging, and cell phones to connect to friends, family, experts, and others in their community and around the globe. They are bombarded with visual messages from the media—messages specifically targeted to tap into the billions in discretionary spending they control or influence. Members of this generation *expect* to actively participate in and through their media, hence the decrease in time spent by teens in viewing television and the corresponding increase in time spent on computers, gaming, and the Internet. (See "Media Trade-Offs" on page 4.) Our children now have at their fingertips a virtual world—with all its promises and pitfalls.

Hard as it is to believe, the Internet became available to the average American less than a decade ago. Today, we still find ourselves in the process of defining cultural and societal norms for Internet and Web usage. Our children are not looking to or waiting for adults to establish those norms—they are simply jumping into the fray, exploring the world of chat rooms, avatars, MP3s, and digital communication with aplomb.

As cyberculture analyst (and author of *Playing the Future*) Douglas Rushkoff (2001, personal communication) quips, "Children are native to cyberspace and we, as adults, are immigrants." And therein lies both a challenge and an opportunity: How do we, as adults, with the least experience in this milieu, provide leadership? How do we help children use their native intelligence about technology in sophisticated, responsible ways that serve them well as they make their way in the Digital Age?

The solution lies in public acknowledgment that yesterday's education is not sufficient for today's learner. Academic excellence must be acquired within the context of today's technological environment in order to fully prepare students to thrive in the Digital Age.

The 21st Century Workforce Commission's (2000) National Alliance of Business summed up the economic implications for us: "The current and future health of America's 21st century economy depends directly on how broadly and deeply Americans reach a new level of literacy—'21st Century Literacy' " (p. 4).

A report from the 21st Century Literacy Summit (2002) contends that "the explosive growth of technology in every aspect of society offers us a unique opportunity to engage our citizens in economic and civic life" (p. 4). The report further states that to take advantage of this opportunity, we must continually acquire and develop new knowledge and skills. Summit participants noted, "Information and communication technologies are raising the bar on the competencies needed to succeed in the 21st century, and they are compelling us to revisit many of our assumptions and beliefs" (p. 4).

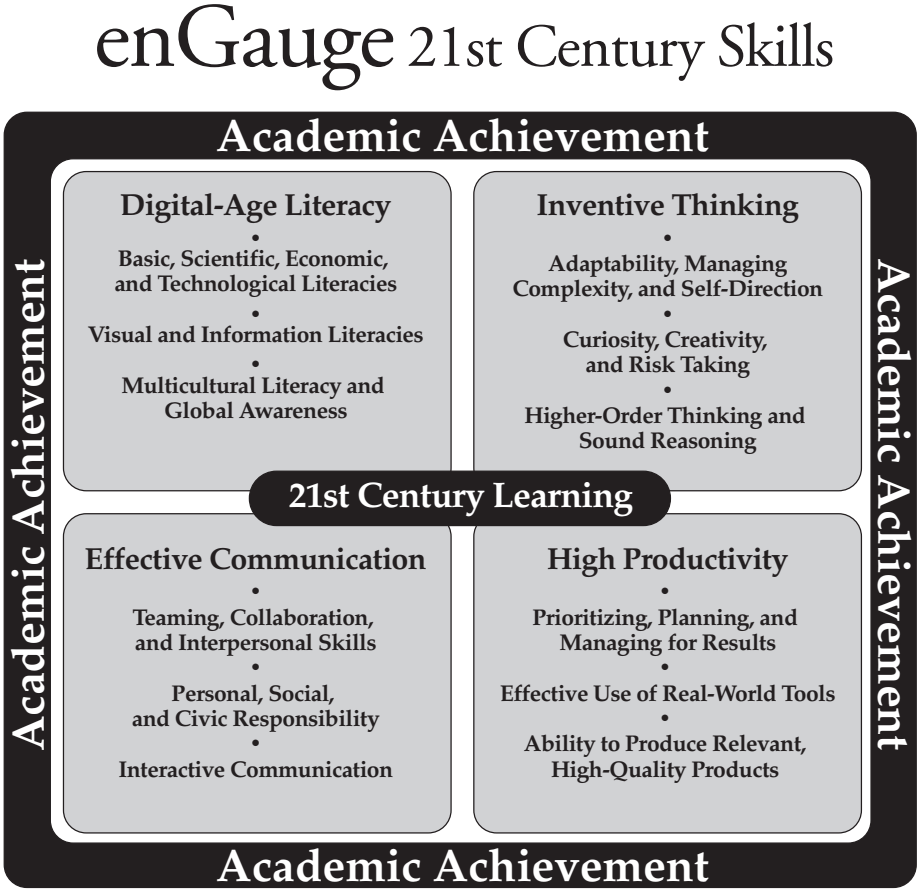
> *"Information and communication technologies are raising the bar on the competencies needed to succeed in the 21st century."*
>
> **— 21st Century Literacy Summit**

The sheer magnitude of human knowledge, world globalization, and the accelerating rate of change due to technology necessitates a shift in our children's education—from plateaus of knowing to continuous cycles of learning. Therefore, policymakers and educators alike must define 21st century skills, highlighting the relationship of those skills to conventional academic standards. As they do so, they must also recognize the need for multiple assessments to measure these skills within the context of academic standards, evaluating their application to today's technological, global society.

The sheer magnitude of human knowledge, globalization, and the accelerating rate of change due to technology necessitates a shift in our children's education—from plateaus of knowing to continuous cycles of learning.

enGauge 21st Century Skills

The *enGauge* 21st Century Skills should be considered within the context of rigorous academic standards. They are a bridge to authentic, intellectually challenging work by students.



Growing Up Digital

Today's children are "growing up digital." Their view of the world is very different from that of adults, thanks to unprecedented access to information, people, and ideas across highly interactive media. It is precisely this real-time, webbed interactivity, suggests Don Tapscott (1998) in *Growing Up Digital*, which has spurred societal changes in ways prior technologies did not.

> ***"Our children…are the latest model of human being. Looking at the world of children is not looking backward at our own past—it's looking ahead. They are our evolutionary future."***
>
> ***— Rushkoff***

Douglas Rushkoff (1999), in *Playing the Future*, agrees: "Our children…are the latest model of human being. Looking at the world of children is not looking backward at our own past—it's looking ahead. They are our evolutionary future" (p. 4).

"Consider any family of immigrants," Rushkoff continues. "Who learns the language first? Who adopts the aesthetic, cultural, and spiritual values of the new country? The children, of course….Well, welcome to the 21st century. We are all immigrants in a new territory" (p. 4).

More than half the people in our nation—and 65 percent of our children—are now online. The latest research from the U.S. Department of Commerce puts the current growth rate for Internet use at 2 million new users per month, with children and teens being the fastest growing group of new users (Economics and Statistics Administration, 2002). As a country, we now use the Internet for business transactions, shopping, entertainment, information searches, communication, and of course, learning. In January 2001, the Web-Based Education Commission reported that this increased use "is bringing rapid and radical change into our lives—from the wonderfully beneficial to the terrifyingly difficult" (Kerry & Isakson, 2001, p. i). The challenge to educators is to help students develop the 21st century skills that enable them to fully realize technology's most positive effects.

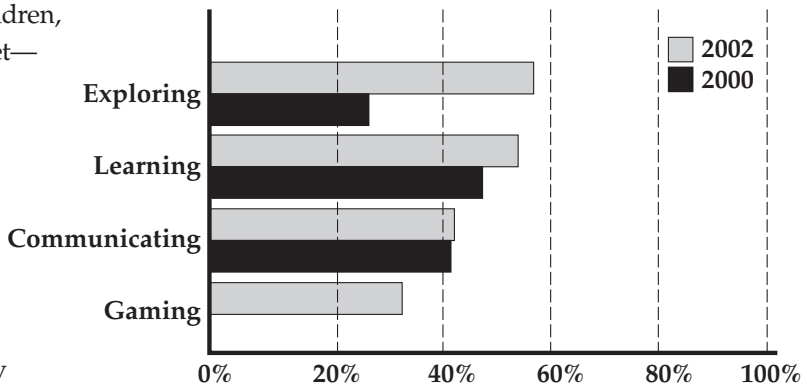
Media Trends

Over 65 percent of American children, aged 2 to 17, now use the Internet—up from 41 percent in 2000.

Media Trade-Offs:

Kids who use the Internet spend 37 percent less time watching television—and 16 percent more time with friends and family. Teenagers (aged 13 to 17) in 2002 spent more time each day with digital media (3.5 hours) than they did watching television (3.1 hours).

Activities that kids aged 9 to 17 engage in online at least weekly:



Information presented in the above exhibit was found in two sources:

Corporation for Public Broadcasting. (2003). *Connected to the future: A report on children's Internet use*. Retrieved April 7, 2003, from http://www.cpb.org/ed/resources/connected/.

Grunwald Associates. (2000). *Children, families, and the Internet. Burlingame*, CA: Author.

A Digital Divide

In the 1990s, the digital divide was characterized as a gap in technology access that translated into inequities in educational, economic, social, and civic opportunities among sectors of the population. Since then, education leaders have come to realize that access is simply the first step. Equally important are robust home access and the readiness of individuals to use technology, communication networks, and information efficiently, effectively, and productively.

According to the Corporation for Public Broadcasting's 2003 report, *Connected to the Future*, digital access today is more a factor of income than ethnicity. With children's home access to the Internet increasing, with life and school tasks becoming more and more Internet-dependent, and with quality content requiring higher and higher bandwidth, low-income students are at a potential disadvantage. This disparity is increasing the pressure on schools to provide robust Internet access for all children.

With quality, interactive content becoming increasingly bandwidth intensive, access to broadband is redefining the digital divide. The Corporation for Public Broadcasting (2003) also stated that children with broadband access at home report spending more time online (65 percent), watching less television (37percent), and getting better grades (23 percent) than children without access. While more cautious than their children, in general, parents confirm these findings.

If this situation were solely an issue of access, by all accounts we would be making good progress in closing the digital divide. *Children, Families, and the Internet* (Grunwald Associates, 2000), for example, found that "girls are on the Net in proportions equal to or greater than boys," and the U.S. Department of Commerce's study *A Nation Online: How Americans Are Expanding Their Use Of The Internet* (National Telecommunications Information Administration & Economics and Statistics Administration, 2002) reports that:

- Some 143 million Americans—regardless of income, race, age, gender, geographic location, or disability—were online in September 2001, an increase of 26 million from just one year earlier.
- Between December 1998 and September 2001, Internet use in the lowest income households increased at a 25 percent annual growth rate. Internet use in the highest income households increased from a higher base but at a much slower 11 percent annual growth rate.
- Children and teenagers use computers and the Internet more than any other age group.
  - Ninety percent of children between the ages of 5 and 17 (or 48 million) now use computers.
  - Seventy-five percent of 14- to 17-year-olds and 65 percent of 10- to 13-year-olds use the Internet.
  - Computers at schools substantially narrow the gap in usage rates for children from high- and low-income families.

While this progress is certainly encouraging, access is just the first step. According to the U.S. Department of Commerce study, *Falling Through the Net* (National Telecommunications and Information Administration, 1999), the digital divide also represents differences in the capacity to use technology tools efficiently and effectively. True equity requires high levels of technology proficiency to ensure broader, more meaningful, and increasingly innovative uses of technology by all segments of the population. In turn, these heightened levels of technology proficiency—so critical in the Digital Age—require higher levels of 21st century education.

True equity will require high levels of technology proficiency to ensure broader, more meaningful, and increasingly innovative uses of technology by all segments of the population.

In *Digital Transformation*, the International Information and Communication Technologies (ICT) Literacy Panel (2002), argues that our conception of the digital divide must be expanded: "A continued focus on building infrastructure should be complimented by an effort to identify those without an ability to manage, integrate, evaluate, and create information in a traditional sense and to provide them with the necessary tools to acquire these skills" (p. 1). Without these skills as a foundation, "all the hardware and access in the world will not… decrease the existing gaps currently defined by the digital divide" (Gonzalez, 2002).

In many schools and homes, students now have the access to technology that is the first step toward closing the digital divide. Now, says the CEO Forum (2001), we must shift our emphasis to "how [technology] should be applied to achieve educational objectives" (p. 3) for all. Students today are graduating from high school and attending college in record numbers. It's up to parents and educators to ensure that they're truly spending that time well, developing the skills necessary for successfully living, learning, and working in the 21st century.

A Digital-Age Economy

Experts at the U.S. Department of Labor stated it best: "We are living in a new economy—powered by technology, fueled by information, and driven by knowledge" (Secretary's Commission on Achieving Necessary Skills, 1991, p. 1). Because of this, they assert, "The influence of technology will go beyond new equipment and faster communications, as work and skills will be redefined and reorganized" (p. 1).

> ***"We are living in a new economy—powered by technology, fueled by information, and driven by knowledge. The influence of technology will go beyond new equipment and faster communications, as work and skills will be redefined and reorganized."***
>
> ***— Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor***

Despite the boom and bust of the dot-com craze, a recent University of California–Berkeley study finds that "the adoption of Internet business solutions has already yielded a current, cumulative cost savings of $155.2 billion to U.S. organizations" (Varian, Litan, Elder, & Shutter, 2002, p. 5). *Digital Economy 2000*, a report by the U.S. Department of Commerce, attributes most productivity gains since 1995 to information technology (IT) and its resulting organizational change, despite the economic slowdown that began in 2000 and the economic repercussions of September 11 (Economics and Statistics Administration, 2002).

Given the rapid diffusion of technology during the past 30 years, many analysts have also considered technological change to be a major factor in determining wages (Mishel, Bernstein, & Boushey, 2003). Some studies estimate that, on average, IT jobs pay 85 percent more than other jobs (Pociask, 2002). *Digital Economy 2002* reports that the average wages per worker in IT industries are twice the national average ($73,800 compared to $35,000) for all workers engaged in private, nonfarm industries (Economics and Statistics Administration, 2002, p. 41). Even in non-IT industries, most analysts agree that technologically skilled workers are likely to earn higher wages than those without such skills. The U.S. Department of Commerce also further reports that "workers who use a computer at work can earn 17 to 22 percent more than other workers" (Economics and Statistics Administration, 2002, p. 49). These same analysts note that rapid change and increased competition require that workers use their "soft skills" (e.g., interpersonal, management, and problem-solving skills) to adapt quickly to changing technologies and organizational structures (Economics and Statistics Administration, 2002, p. 49).

> ***"Students require higher levels of education to succeed in the new, knowledge-based economy."***
>
> ***— CEO Forum on Education and Technology***

Even economists—such as the analysts at the Economic Policy Institute—who find it "difficult to identify the role of technological change in recent wage trends," (Mishel et al., 2003, p. 201) agree with the assertion regarding the need for soft skills. Mishel et al. (2003) cite a wage gap within groups of workers with similar education and experience as a sticking point to more cut-and-dried theories relating technology to increased wages. They do say, however, that this within-group wage inequality can be related to technological change "if it is interpreted as a reflection of growing economic returns to those worker skills (motivation, aptitudes for math, and others) that are not easily measured" (p. 203). In other words, simple technology proficiency is not enough.

So experts agree: Education—when it means developing the skills needed to live, learn, and work successfully in the Digital Age—does pay, especially in an information-based economy (Mandel, 2002). And it will continue to pay, according to others. The CEO Forum (2001) advises that "students require higher levels of education to succeed in the new knowledge-based economy. Today, 85 percent of jobs

require education beyond high school, compared to 61 percent in 1991" (p. 5).

Authors of the National Research Council's *Building A Workforce for the Information Economy* suggest that workforce preparation is dependent on the ability of schools to promote students' cognitive abilities, such as logical thinking, problem solving, analysis, careful observation, and data management. The authors contend that "these abilities are highly valued in the workplace" and vital to successful performance (Committee on Workforce Needs in Information Technology, 2001, p. 225).

Furthermore, according to *Technically Speaking*, a report by the National Academy of Engineering and the National Research Council, "Technologically literate workers are more likely than those lacking such literacy to have a broad range of knowledge and abilities, such as the critical thinking skills identified by the Secretary's Commission on Achieving Necessary Skills (SCANS)" (Pearson & Young, 2002, pp. 40-41).

"Look beyond the schoolhouse to the roles students will play when they leave to become workers, parents, and citizens."

– SCANS, 1992

SCANS encourages schools to "look beyond the schoolhouse to the roles students will play when they leave to become workers, parents, and citizens" (SCANS, 1992, p. 10). These recommendations build upon the principles set forth in the 1991 SCANS report, *What Work Requires of Schools*. In its 1992 report, the commission links the economy, schools, and the need for continued renewal of workers' skills according to three key concepts:

- The qualities of high-performance that today characterize our most competitive companies must become the standard for the vast majority of employers, public and private, large and small, local and global.
- The nation's schools must be transformed into high-performance organizations.
- All Americans should be entitled to multiple opportunities to learn. (SCANS, 1992, p. xv)

Empirical research shows that small firms, in particular, contribute significantly to economic growth as measured by new job creation. Of these, the most innovative firms have been shown to "create a disproportionately greater share of net new jobs than those firms with lesser innovative intensity," suggesting that "highly innovative new firms are a major source of economic growth" (BJK Associates, 2002, p. 2). Researchers Armington and Acs found that highly innovative firms are more likely to form in labor market areas (LMAs) with a higher percentage of educated and skilled workers. These researchers conclude that "a positive relationship may actually exist between the 'size' of a region's knowledge base and new firm formation" (BJK Associates, 2002, p. 3).

Not providing students with opportunities to develop 21st century skills and proficiencies will create a disconnect between the innovative jobs being created and the skills of the workforce.

The Bureau of Labor Statistics sums it up: "Education is essential to getting a high-paying job" (Bureau of Labor Statistics, Office of Occupational Statistics and Employment Projections, 2003). With our economy making such an "unprecedented transition" into high-skilled, information-based industries, not providing students with opportunities to develop 21st century skills and proficiencies will create "a disconnect" between the innovative jobs being created and the skills of the workforce (Chao, 2001, p. 7).

Digital-Age Learning

Given the realities of globalization, knowledge work, and accelerating societal change, it's obvious that *what* students learn—as well as *how* and *when* they learn—is changing.

Over the last decade, there were tremendous advances in the science of learning, made possible by the convergence of research in the cognitive sciences, neuroscience, human development, and technology. As a result, we know more today about how people think and learn (Bransford, Brown, & Cocking, 1999).

For starters, the research clearly shows that students learn more when they are engaged in meaningful, relevant, and intellectually stimulating work (Newmann, Bryk, & Nagaoka, 2001). While all learning is deeply personal, the frequency and relevance of such moments increase when technology enables us to tap outside experts; visualize and analyze data; link to real-world contexts; and take advantage of opportunities for feedback, reflection, and analysis (Bransford et al., 1999).

There will be changes in* what *students learn. But it's just as important to recognize the ongoing shifts in* how *and* when *they learn.

Technology influences learning in three significant ways. A synthesis of recent research and national skill sets shows that technology can be a driver of change, a bridge to academic excellence, and a platform for informed decision making and accountability:

1. A Driver for Change: The 21st Century Skills

Technology has catapulted us into a knowledge-based, global society. It is clear that success in this society will require significantly different skills than in the past (CEO Forum, 2001; International ICT Literacy Panel, 2002). However, policymakers and educators have not yet clearly defined what it means to be "educated" in a Digital Age. The irony of a call for 21st century skills in this era of high-stakes testing based on conventional metrics is not lost on teachers. To fully realize the educational opportunities that 21st century skills can bring to students, education leaders must formally incorporate them into the mainstream of school curriculum, instruction, and assessment.

2. A Bridge to High Academic Achievement

Technology serves as a bridge to more engaged, relevant, meaningful, and personalized learning—all of which can lead to higher academic achievement. Research indicates that when technology is used appropriately, children learn more, even as measured by conventional tests (Newmann et al., 2001; Wenglinsky, 1998). It is important to demonstrate this research link to teachers, thereby encouraging them to incorporate technology into the mainstream of student learning.

3. A Platform for Informed Decision Making and Accountability

Technology provides a platform for more informed decision making using timely, meaningful data to shape learning opportunities. This situation translates into more personalized learning based on continuous feedback available to students, teachers, and parents. The challenge lies in building such accountability systems on the foundation of the right indicators—indicators that lead to high academic standards and 21st century skills. Only this foundation will enable true Digital Age readiness.

Educators have no choice. The times require that schools change or become obsolete. Just as doctors must stay abreast of the latest medical research and lawyers must keep up with case law, educators must stay current with practices that optimize student learning. While this practice may be happening in some schools and districts, all of our schools need to become organizations that formally and systematically use research results to drive systemwide change. This approach is particularly important in the current era of high-stakes assessment.

It's time for the education of our children to shift from plateaus of knowing to continuous cycles of learning.

Such a transition will require teachers and administrators themselves to become knowledge workers with 21st century skill sets. School leaders need to drive change, taking on new, collaborative roles and using inventive thinking to integrate the emerging "science of learning" into their school systems. All students should have the opportunity to attend dynamic, high-quality schools designed to meet the challenges of the Digital Age. The implications for pedagogy, teacher and student roles, curriculum, assessment, infrastructure, and the community are significant. In short, the 21st century skills should form a major part of the foundation of improvement processes in schools.

The 21st century skills should form a major part of the foundation of improvement processes in schools.

The 21st century skills identified in this publication are meant to be considered in the context of academic content and standards-based reform. Examples of actual classroom practices follow the briefing pages describing each of the skills. These classrooms exemplify the ways in which 21st century skills can breathe new life into academic content, leveraging technology in ways that powerfully advance learning by strengthening student engagement in challenging, authentic, and intellectual work.

The research indicates that all children—regardless of age, gender, socioeconomic status, and academic status—can excel when immersed in such meaningful, challenging work (Newmann et al., 2001).

The *enGauge* 21st Century Skills

Based on two years of study, the *enGauge* 21st Century Skills represent the fresh, serious, new perspective required in light of recent historical events, globalization, and the idiosyncrasies of the Digital Age. The following skill clusters, when considered within the context of rigorous academic standards, are intended to provide the public, business and industry, and educators with a common understanding of—and language for discussing—what is needed by students, citizens, and workers in the Digital Age.

Digital-Age Literacy

- Basic, scientific, economic, and technological literacies
- Visual and information literacies
- Multicultural literacy and global awareness

Inventive Thinking

- Adaptability and managing complexity
- Self-direction
- Curiosity, creativity, and risk taking
- Higher-order thinking and sound reasoning

Effective Communication

- Teaming, collaboration, and interpersonal skills
- Personal, social, and civic responsibility
- Interactive communication

High Productivity

- Prioritizing, planning, and managing for results
- Effective use of real-world tools
- Ability to produce relevant, high-quality products

Each skill cluster is further broken down into representative skill sets, which offer guidance on recognizing student performance in developing the *enGauge* 21st Century Skills.

Methodology

The *enGauge* 21st Century Skills were developed through a process that included literature reviews, research on emerging characteristics of the Net Generation, a review of current reports on workforce trends from business and industry, analysis of nationally recognized skill sets, input from educators, data from educator surveys, and reactions from constituent groups. Many of these important works, in particular the nationally recognized skill sets, are cross-matched to the *enGauge* 21st Century Skills.

Some of these sources are listed below. A full list of sources and cross-matches to national skill sets are listed toward the end of this publication.

- ***National Educational Technology Standards (NETS) for Students***, 2000, International Society for Technology in Education. Available at ***cnets.iste.org/students/s_book.html.***
- ***What Work Requires of Schools***, 1991, Secretary's Commission on Achieving Necessary Skills, U.S. Department of Labor. Available at ***wdr.doleta.gov/SCANS/whatwork/whatwork.html.***
- ***Standards for Technological Literacy: Content for the Study of Technology***, 2000, International Technology Education Association. Available at ***www.iteawww.org/TAA/PDFs/xstnd.pdf.***
- ***21st Century Literacy in a Convergent Media World***, 2002, 21st Century Literacy Summit. Available at ***www.21stcenturyliteracy.org/white/WhitePaperEnglish.pdf.***
- ***Being Fluent With Information Technology***, 1999, Committee on Information Technology Literacy, National Research Council. Available at ***www.nap.edu/html/beingfluent/***.
- ***Information Literacy Standards for Student Learning***, 1998, American Association of School Librarians (AASL), Association of Educational Communications Technology (AECT), and American Library Association (ALA). Available at ***www.ala.org/aasl/ip_nine.html***.
- ***Technically Speaking: Why All Americans Need to Know More About Technology***, 2002. National Academy of Engineering and National Research Council. Available at ***www.nap.edu/books/0309082625/html/***.
- ***Preparing Students for the 21st Century***, 1996, American Association of School Administrators.
- ***Digital Transformation: A Framework for ICT Literacy***, 2002. Report by the International Information and Communication Technologies (ICT) Literacy Panel for the Educational Testing Service (ETS). Available at. ***www.ets.org/research/ictliteracy/ictreport.pdf***.
- ***How People Learn: Brain, Mind, Experience, and School***, 1999. J. Bransford, A. Brown, & R. Cocking (Eds.). Available at ***www.nap.edu/html/howpeople1/***.

In addition, data was gathered from educators at state-level conference sessions in 10 states, surveys, and focus groups in Chicago and Washington, D.C. Initial drafts of the *enGauge* 21st Century Skills were reviewed by experts in the field prior to inclusion in the *enGauge* list.

Development of Student Profiles

After the skills were identified, a second wave of study was conducted that drew on a vast body of work dealing with each skill (see References). After analyzing and summarizing that work, we sought to develop profiles of students who have obtained the skills (see boxes in the pages that follow).

Early in the process, it became clear that many of the skills identified were not new constructs; existing research was able to substantially inform the qualities that make up those skills. What these sources typically did not address (with some exceptions) was the shape these skills can take, either in 21st century environments or in the context of the technology tools available today. Thus, the strategy for developing the profiles was twofold: We drew on existing work as much as possible to inform the content, and we supplemented this content with our own expertise on teaching and learning in Digital Age classrooms.

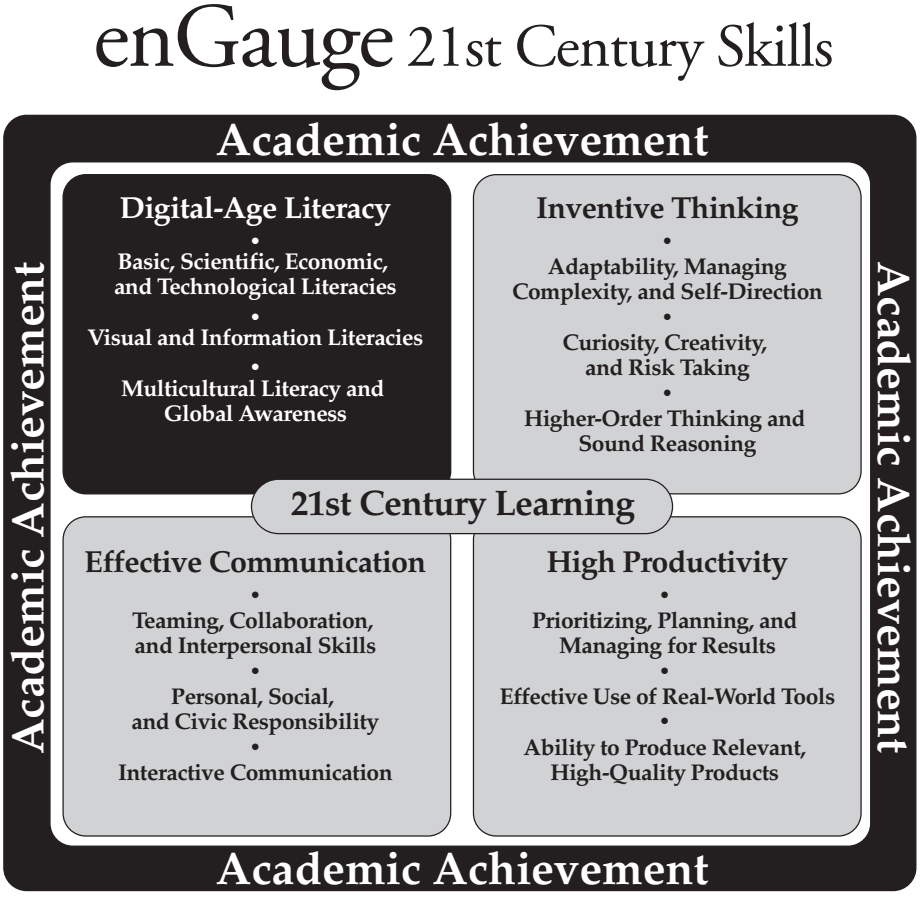
A wide range of sources was used in this process. When possible, empirical studies and theoretical work from psychology and education were used for generating specific facets of the skills. Sometimes this process itself involved repeated passes through the literature. Publications by organizations specializing in a skill (e.g., the American Library Association's work on information literacy, and the National Academy of Sciences' work on scientific literacy), as well as publications by experts in a field (e.g., Daniel Goleman's work on emotional intelligence), also were used to build both the profiles and the continua. These sources typically represented field-based expertise. Together, the three types of sources represent "best thinking" by researchers, theorists, and organizations about what qualities characterize an individual possessing each of the skills. (Specific resources used to generate each student profile are listed at the end of each skill section.)

Digital-Age Literacy

As society changes, the skills needed to negotiate the complexities of life also change. In the early 1900s, a person who had acquired simple reading, writing, and calculating skills was considered literate. Only in recent years has the public education system expected all students to build on those basics, developing a broader range of literacies (International ICT Literacy Panel, 2002). To achieve success in the 21st century, students also need to attain proficiency in science, technology, and culture, as well as gain a thorough understanding of information in all its forms.

Digital-Age Literacy *includes the following:*

- ***Basic Literacy:*** Language proficiency (in English) and numeracy at levels necessary to function on the job and in society to achieve one's goals and to develop one's knowledge and potential in this Digital Age.
- ***Scientific Literacy:*** Knowledge and understanding of the scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity.
- ***Economic Literacy:*** The ability to identify economic problems, alternatives, costs, and benefits; analyze the incentives at work in economic situations; examine the consequences of changes in economic conditions and public policies; collect and organize economic evidence; and weigh costs against benefits.
- ***Technological Literacy:*** Knowledge about what technology is, how it works, what purposes it can serve, and how it can be used efficiently and effectively to achieve specific goals.
- ***Visual Literacy:*** The ability to interpret, use, appreciate, and create images and video using both conventional and 21st century media in ways that advance thinking, decision making, communication, and learning.
- ***Information Literacy:*** The ability to evaluate information across a range of media; recognize when information is needed; locate, synthesize, and use information effectively; and accomplish these functions using technology, communication networks, and electronic resources.
- ***Multicultural Literacy:*** The ability to understand and appreciate the similarities and differences in the customs, values, and beliefs of one's own culture and the cultures of others.
- ***Global Awareness:*** The recognition and understanding of interrelationships among international organizations, nation-states, public and private economic entities, sociocultural groups, and individuals across the globe.



Basic Literacy

Basic literacy *is language proficiency (in English) and numeracy at levels of proficiency necessary to function on the job and in society to achieve one's goals and to develop one's knowledge and potential in this Digital Age.*

Students Who Have Basic Literacy Skills:

In Relation to Language Proficiency

- Meet standards for the following areas in the context of traditional and media-based prose*, documents**, and communication venues encountered in everyday living:
  - Reading – Writing
  - Listening – Speaking

In Relation to Numeracy (Quantitative Literacy)

- Meet standards for the following areas in the context of traditional and media-based prose*, documents**, and communication venues encountered in everyday living:
  - Arithmetic computing
  - Mathematical reasoning and problem solving

In Relation to Information and Technological Literacy

- Meet standards for the following areas in the context of traditional and media-based prose*, documents**, and communication venues encountered in everyday living:
  - Recognizing when information is needed
  - Locating information
  - Evaluating all forms of information
  - Synthesizing and using information effectively

* *Prose includes (but is not limited to) literature, editorials, newspaper articles, poems, and stories*

** *Documents include print and media-based artifacts, such as job applications, bus schedules, maps, checks, tax forms, and tables.*

Digitization blurs the lines between text, voice, video, and data. Now they're all just packets of electronic information across global networks. The interpretation of such multimedia communiqués belies the question: What constitutes basic literacy in the Digital Age?

Basic literacy—the ability to read, write, listen, and speak—is more important than ever, and the definition of basic literacy has changed over time to reflect that increasing importance. In the early 1900s, basic literacy meant the ability to write one's name. That definition was later expanded to mean the decoding of text, and by the 1930s it had come to include reading and expressing oneself through writing (Bransford et al., 1999).

The National Literacy Act of 1991 defined *literacy* as "an individual's ability to read, write, and speak in English, and compute and solve problems at levels of proficiency necessary to function on the job and in society to achieve one's goals, and develop one's knowledge and potential" (National Literacy Act of 1991, Sec. 3).

The National Assessment of Adult Literacy measures basic adult literacy along three scales—prose, document, and quantitative—composed of literacy tasks that simulate the types of demands that adults encounter in everyday life. Prose literacy tasks include understanding and using information from texts such as editorials, newspaper articles, poems, and stories. Document literacy tasks include locating and using information found in common artifacts such as job applications, bus schedules, maps, payroll forms, indexes, and tables. Quantitative literacy tasks include performing arithmetic operations required as prose and documents encountered in everyday life (e.g., bank deposit slips, checkbooks, order forms, loan applications) (National Center for Education Statistics, 2003).

The authors of *Digital Transformation*, a recent report published by the Educational Testing Service's Center for Global Assessment, define today's literacy as the ability to use "digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society" (International ICT Literacy Panel, 2002, p. 2). In other words, although reading, writing, listening, and speaking are paramount, today's students must be able to decipher meaning and express ideas through a range of media.

Resources Used to Develop the Content for Basic Literacy

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Scientific Literacy

Scientific literacy *is knowledge and understanding of the scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity (National Academy of Sciences, 1995).*

Students Who Are Scientifically Literate:

- Have the knowledge and understanding of scientific concepts and processes required for participation in a Digital Age society.
- Can ask, find, or determine answers to questions derived from curiosity about everyday experiences.
- Have the ability to describe, explain, and predict natural phenomena.
- Are able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions.
- Can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed.
- Are able to evaluate the quality of scientific information on the basis of its source and the methods used to generate it.
- Have the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately.

Technology and science are tightly interwoven, and breakthroughs are occurring in both at astounding rates. In the past decade alone, scientists have mapped the genome, discovered how to clone animals, and sent probes past the outer edges of the solar system—advances that were possible only through accelerating advances in technology.

Many of the social and political issues that have come to the forefront in the past decade have a strong scientific component. Issues related to reproductive technologies, the environment, and energy, for example, require a scientifically literate population for wise decision making in the coming years. Yet the current scientific literacy of the American people is a bit suspect. In a survey of American adults conducted by the National Science Foundation, less than a quarter of the adults surveyed could define the word *molecul*e, and only about a third could describe what it means to study something "scientifically" (National Science Board & National Science Foundation, 2002).

To address this issue, prominent national groups such as the National Research Council, the American Association for the Advancement of Science, and the National Council of Teachers of Mathematics have revolutionized thinking about science and mathematics education by setting standards that emphasize scientific inquiry, scientific process, problem-based learning, and the integration of science and mathematics (Linn, Kessel, Lee, Levenson, Spitulnik, & Slotta, 2000). These groups are calling for new approaches to science, numeracy (quantitative literacy), and the use of mathematics to investigate, explore, estimate, systematize, and visualize phenomena across the curriculum.

Scientific literacy is important throughout students' lives as they participate in public policy issues related to technology; as they stay current with advances in areas such as biotechnology, medicine, and space exploration; and especially as they enter an increasingly scientifically based workforce (National Academy of Sciences, 1995).

Resources Used to Develop the Content for Scientific Literacy

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Larsen, T. (Ed.) (2001). *Entertaining science: A forum for the promotion of science and scientific literacy in popular culture*. Retrieved April 11, 2003, from http://www.scientificliteracy.org/newsletter.htm

National Academy of Sciences. (1995). *National science education standards*. Retrieved April 11, 2003, from http://www.nap.edu/readingroom/books/nses/

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Saskatchewan Learning. (1992). *Science: A curriculum guide for the secondary-level biology*. Regina, Saskatchewan, Canada: Government of Saskatchewan. Retrieved April 11, 2003, from http://www.sasked.gov.sk.ca/docs/biology/index.html

Economic Literacy

Economic literacy *is the ability to identify economic problems, alternatives, costs, and benefits; analyze the incentives at work in economic situations; examine the consequences of changes in economic conditions and public policies; collect and organize economic evidence; and weigh costs against benefits.*

Students Who Are Economically Literate:

- Can evaluate costs, benefits, and the limitations of resources, using this knowledge to make informed choices as consumers, producers, savers, investors, and citizens.
- Are able to evaluate different methods for allocating goods and services by comparing the costs and benefits of each method.
- Can identify economic incentives that affect people's behavior and explain how incentives affect their own behavior.
- Understand how competition, trade barriers, shortages and surpluses, and the interaction between buyers and sellers can influence prices.
- Are able to describe the roles of various public and private economic institutions, including the Federal Reserve.
- Understand the basics of income and its distribution, interest rates, inflation, unemployment, investment, and risk.
- Can identify and evaluate the benefits and costs of alternative public policies, and assess who enjoys the benefits and who bears the costs.
- Understand the value of entrepreneurialism and the roles of small and large businesses in the U.S. economy.

Thanks in part to technological and communications advances, ordinary people are wearing more economic hats than ever before. In their roles as consumers, producers, workers, and investors, productive citizens need a level of economic literacy that will help them better comprehend the world and make good decisions for the future. Furthermore, because economic issues play an important role in local, state, national, and international policymaking, they frequently influence voter choices. A better understanding of economic issues, including the role businesses play in society, can enable citizens to recognize the forces that affect them every day, helping them identify and evaluate the consequences of private decision making and public policies. It is only when citizens are articulate and well informed that the institutions of a democratic market economy will function effectively (National Council on Economic Education [NCEE], 2003).

By the time they graduate, students should have developed a high degree of economic literacy. According to NCEE and its corporate sponsors, students should understand basic concepts and be able to reason logically about key economic issues that affect their lives as workers, consumers, and citizens. They should know some pertinent facts about the American economy—including its size and the current rates of unemployment, inflation, and interest—and they should have an understanding of what those facts mean. Last, students should understand that economists often hold differing views on economic issues. This last understanding is especially important for topics such as the appropriate size of government in a market economy, how and when a government should deal with unemployment and inflation, and how and when it should promote economic growth (NCEE, 2003).

To foster this knowledge, NCEE, in partnership with the National Association of Economic Educators and the Foundation for Teaching Economics (1996), developed a list of 20 *Voluntary National Content Standards in Economics* (see profile at left for eight of these standards). The full version—developed by a panel of economists and economic educators and supported by business leaders—includes rationale, benchmarks for students, samples of what students can do to enhance or demonstrate their understanding of economic issues, resources, and more (see http://www.ncee.net/ea/standards/). Another rich source of technology-based, economic lesson materials for K–12 students and educators is EconEdLink (http://www.econedlink.org/index.cfm), a program of NCEE and a member of the MarcoPolo consortium.

Resources Used to Develop the Content for Economic Literacy

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MarcoPolo Education Foundation. (n.d.). *Internet content for the classroom*. Retrieved April 11, 2003, from http://www.marcopolo-education.org/

Technological Literacy

Technological literacy *is knowledge about what technology is, how it works, what purposes it can serve, and how it can be used efficiently and effectively to achieve specific goals.*

Students Who Are Technologically Literate:

- Demonstrate a sound conceptual understanding of the nature of technology systems and view themselves as proficient users of these systems.
- Understand and model positive, ethical use of technology in both social and personal contexts.
- Use a variety of technology tools in effective ways to increase creative productivity.
- Use communication tools to reach out to the world beyond the classroom and communicate ideas in powerful ways.
- Use technology effectively to access, evaluate, process and synthesize information from a variety of sources.
- Use technology to identify and solve complex problems in real-world contexts.

Just 20 years ago, cell phones, laptops, pagers, and fax machines were in the realm of scientists and science fiction. Today, those technologies and the Internet have gained widespread public acceptance and use. It is clear that, in today's Digital Age, students must be technologically literate to live, learn, and work successfully. The No Child Left Behind Act requires participating states to strive for technological literacy by all eighth graders (No Child Left Behind Act of 2001, Part D, Sec. 2402).

Most schools acknowledge the importance of technology to their students' futures, but to date few have successfully incorporated technology into the mainstream of academic learning (Pearson & Young, 2002, pp. 104-105). While E-Rate (federal discounts for school infrastructure) monies have enabled schools to make significant gains in building the technical infrastructure required, the shifts in policy and practice needed to ensure that all students learn to use technology effectively have been more difficult to achieve.

National standards and guidelines have been developed for K–12 students' technological literacy. The National Educational Technology Standards (NETS) for students, developed by the International Society for Technology in Education's (ISTE, 2000), are widely accepted by K–12 schools. The profile on the left includes the six categories into which the 14 NETS standards are classified.

In addition to the NETS standards for students, the Secretary's Commission on Achieving Necessary Skills (SCANS) report and the American Association of School Administrators include competency in the use of computers and other technologies as an essential skill for students in the 21st century (SCANS, 1992; Uchida, Cetron, & McKenzie, 1996).

These reports assert that technological literacy is an essential component of job readiness, citizenry, and life skills. Students must not only become competent in the use of technology and associated applications, they also must be able to apply their skills to practical situations. Most experts agree that students should develop technological skills in the context of learning and solving problems related to academic content (Baker & O'Neil, 2003).

Resources Used to Develop the Content for Technological Literacy

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Alaska Department of Education and Early Development. (2001). *Content standards for Alaska students*. Retrieved April 11, 2003, from http://www.educ.state.ak.us/ContentStandards/Technology.html

Arizona Department of Education. (2001). *Academic standards and accountability*. Retrieved April 11, 2003, from http://www.ade.state.az.us/standards/technology/default.asp

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Visual Literacy

Visual literacy *is the ability to interpret, use, appreciate, and create images and video using both conventional and 21st century media in ways that advance thinking, decision making, communication, and learning.*

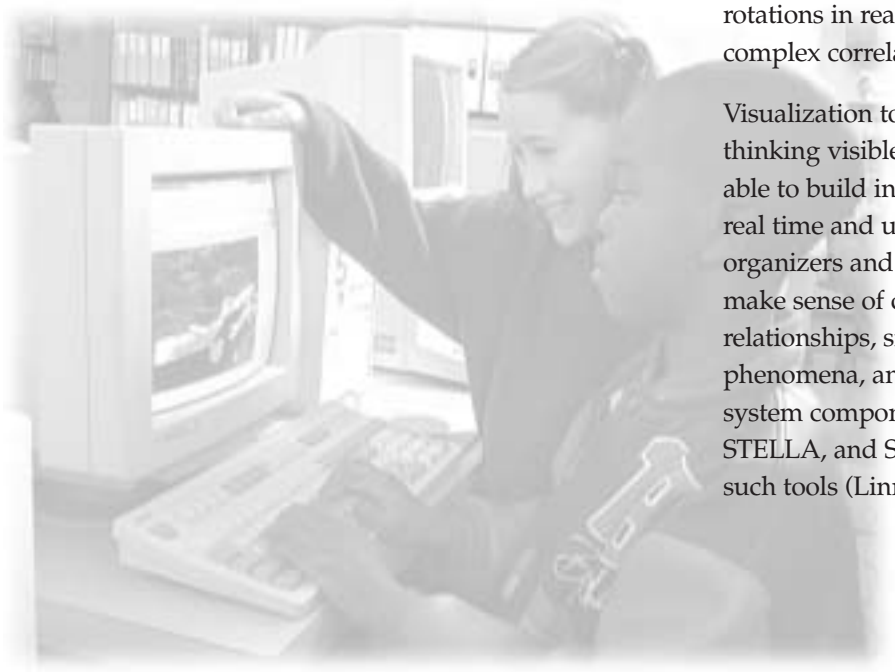
Students Who Are Visually Literate:

Have Working Knowledge of Visuals Produced or Displayed through Electronic Media

- Understand basic elements of visual design, technique, and media.
- Are aware of emotional, psychological, physiological, and cognitive influences in perceptions of visuals.
- Comprehend representational, explanatory, abstract, and symbolic images.

Apply Knowledge of Visuals in Electronic Media

- Are informed viewers, critics, and consumers of visual information.
- Are knowledgeable designers, composers, and producers of visual information.
- Are effective visual communicators.
- Are expressive, innovative visual thinkers and successful problem solvers.



The graphic user interface of the World Wide Web and the convergence of voice, video, and data into a common digital format have increased the use of visual imagery dramatically. Through advances such as digital cameras, graphics packages, streaming video, and common standards for imagery, visual imagery is now routinely used in communication. Experts in many fields—from architecture, to medicine, to farming—are now using visualization tools to represent data in ways never before possible. (For example, visuals are used to model phenomena such as population growth, weather and traffic patterns, and the spread of disease.) From three-dimensional representations of data, to geographic information systems, to representation icons, a picture is truly worth a thousand words. Students need good visualization skills to be able to decipher, interpret, detect patterns, and communicate using imagery—especially given the ease with which digitized visuals can be manipulated.

Computer-based visualization and analysis tools have fundamentally changed the nature of inquiry in mathematics and science. Scientists use these powerful modeling tools to detect patterns and understand data using colors, time-sequenced series, three-dimensional rotations in real-time, and graphic representation of complex correlations (Bransford et al., 1999).

Visualization tools enable students to make their thinking visible in all academic areas. Students are able to build interactive models to test theories in real time and use graphics to display results. Graphic organizers and visual mapping tools enable students to make sense of complex subjects by exploring linkages, relationships, similarities, and differences between phenomena, and visually representing interplay among system components. The software packages Inspiration, STELLA, and SemNet are three excellent examples of such tools (Linn & Hsi, 2000).

Resources Used to Develop the Content for Visual Literacy

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Bransford, J., Brown, A., & Cocking, R. (Eds.). (1999). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

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Wilde, J. (1991). *Visual literacy*. New York: Watson-Guptill.

Williams, R. (1994). *Non-designer's design book*. New York: Peachpit Press.

Information Literacy

Information literacy *is the ability to evaluate information across a range of media; recognize when information is needed; locate, synthesize, and use information effectively; and accomplish these functions using technology, communication networks, and electronic resources.*

Students Who Are Information Literate:

Before Accessing Information

- Determine what is known and what is needed for problem solving.
- Identify different sources of information, including text, people, video, audio, and databases.
- Prioritize sources based on credibility and relevance.

When Accessing Information

- Identify and retrieve relevant information from sources; use technology to enhance searching.
- Revise information-gathering strategies that prove to be ineffective.
- Understand how information retrieved does or does not address original problem.
- Evaluate information in terms of credibility and social, economic, political, legal, and ethical issues that may impact it; use technology to facilitate evaluation.

After Information Is Extracted

- Use retrieved information to accomplish a specific purpose.
- Present information clearly and persuasively using a range of technology tools and media.
- Evaluate the processes and products of these activities, including resulting social consequences.

In their publication I*nformation Power: Building Partnerships for Learning*, the American Association of School Librarians and the Association for Educational Communications and Technology (1998) called *information literacy* "a keystone of lifelong learning" (p. 1). The publication also lists 12 key standards under three umbrella areas: information literacy, independent learning, and social responsibility. Information literacy includes accessing information efficiently and effectively, evaluating it critically and competently, and using it accurately and creatively.

Accessing information has become increasingly important as databases previously accessible only to library media specialists are now available to students directly. Browsing, searching, and navigating online have become essential skills for all students, as has recognition of the limitations of digital archives. (Some things remain unavailable electronically.) Familiarity with natural inquiry, Boolean search strategies, and organizational systems (cataloging, abstracting, indexing, rating) is extremely important as students locate information from sources across the globe (Brem & Boyes, 2000).

The digitizing of resources raises new issues of analysis and evaluation. The International ICT Literacy Panel (2002) asks us to consider a student who is asked to prepare a presentation based on information from the Web. That student can access vast quantities of information without a lot of understanding, because search engines make accessing information so simple. But the panel cautions:

> Using search engines well requires an increased skill level. Evaluating and synthesizing information found in a variety of sources requires even more advanced skills, representing a literacy that is far beyond what is needed in a more constrained environment, such as with textbooks where all the information is contained within one source. In effect, because technology makes the simple tasks easier, it places a greater burden on higher-level skills (p. 6).

Ultimately, students need to understand the interrelationships between library collections, proprietary databases, and other Internet documents to ensure appropriate, effective searching and accurate evaluation of sources. Furthermore, as students access electronic resources, it is critical that they recognize the importance of honoring the intellectual property of others by strictly adhering to copyright and fair-use laws.

Resources Used to Develop the Content for Information Literacy

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Multicultural Literacy

Multicultural literacy *is the ability to understand and appreciate the similarities and differences in the customs, values, and beliefs of one's own culture and the cultures of others.*

Students Who Are Multiculturally Literate:

Value Diversity

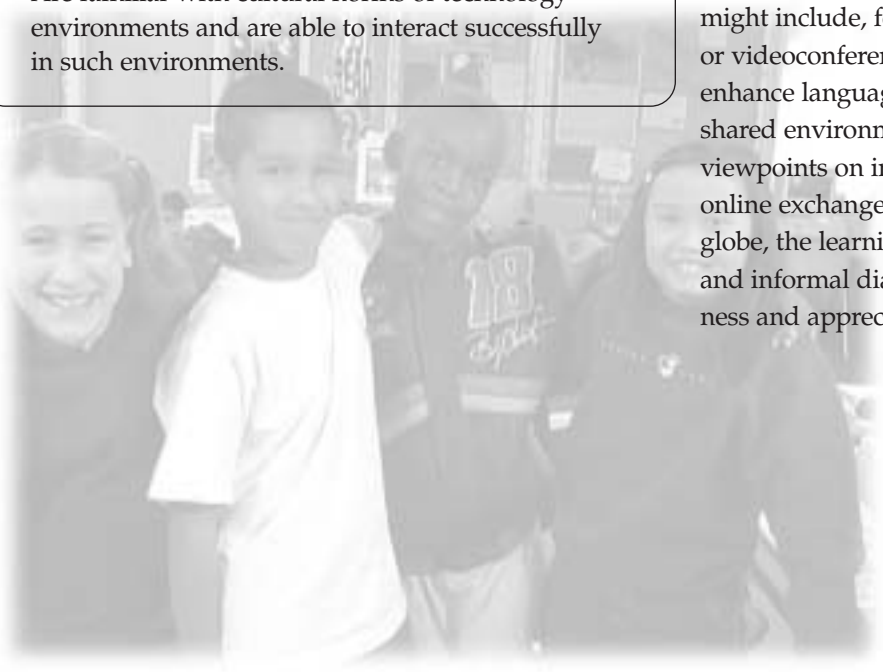
- Are aware of how cultural beliefs, values, and sensibilities affect the way they and others think and behave.
- Appreciate and accept similarities and differences in beliefs, appearances, and lifestyles.
- Understand how technology impacts culture.

Exhibit an Informed Sensitivity

- Know the history of both mainstream and nonmainstream American cultures.
- Can take the perspectives of other cultural groups.
- Are sensitive to issues of bias, racism, prejudice, and stereotyping.

Actively Engage with/in Other Cultures

- Are bilingual/multilingual or are working toward becoming bilingual/multilingual.
- Communicate, interact, and work with individuals from other cultural groups, using technology where appropriate.
- Are familiar with cultural norms of technology environments and are able to interact successfully in such environments.



Within the virtual worlds of e-mail, chat rooms, virtual classrooms, and even multiplayer gaming environments, individuals from cultures and societies are interacting with a frequency that was unimaginable even a decade ago. As e-commerce, e-communication, and advances in transportation bring the people of the world closer together, it is increasingly important for students to understand and appreciate diversity and other cultures.

In order to work cooperatively with individuals from vastly different backgrounds, students must have opportunities to learn about, appreciate, and understand the beliefs and values that drive them. These qualities must reflect a notion of multicultural literacy that is broader than it has been in the past. First, it must be sensitive to the many subcultures that exist within the larger American society. Second, it must include newly developing technological cultures such as virtual workspaces and chat-room environments. Third, it must recognize the evolutionary nature of culture and the impact that technology has—and will continue to have—on cultures worldwide (Banks et al., 2001).

Every student should have the opportunity to interact cross-culturally in meaningful ways. Such interaction might include, for example, communicating via e-mail or videoconference with peers in other countries to enhance language proficiency; participating in an shared environmental science project; or sharing viewpoints on international events via moderated, online exchanges. Whether across town or across the globe, the learning that takes place from both formal and informal dialogues can serve as a bridge to openness and appreciation of diversity and other cultures.

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Global Awareness

Global awareness *is the recognition and understanding of interrelationships among international organizations, nation-states, public and private economic entities, sociocultural groups, and individuals across the globe.*

Students Who Are Globally Aware:

- Are knowledgeable about the connectedness of the nations of the world historically, politically, economically, technologically, socially, linguistically, and ecologically.
- Understand that these interconnections can have both positive benefits and negative consequences.
- Understand the role of the United States in international policies and international relations.
- Are able to recognize, analyze, and evaluate major trends in global relations and the interconnections of these trends with both their local and national communities.
- Understand how national cultural differences impact the interpretation of events at the global level.
- Understand the impact of ideology and culture on national decisions about access to and use of technology.
- Participate in the global society by staying current with international news and by participating in the democratic process.

In *The Lexus and the Olive Tree*, author Thomas Friedman (1999) says that globalization has replaced the Cold War in defining international relationships. Access to telecommunications and technology has caused shifts in power from nation-states to multinational corporations, public and private economic entities, sociocultural groups, and even individuals.

Today, international commerce accounts for nearly a quarter of the American economy. A third of U.S. economic growth and a quarter of new job creations are due to exports (Foreign Policy Association, 2000). But as U.N. Secretary-General Kofi Annan (1998) reminds us: "Unless the basic principles of equity and liberty are defended in the political arena and advanced as critical conditions for economic growth," the rewards reaped from a global economy will be limited. Indeed, informed citizens worldwide are beginning to articulate wider principles, policies, and politics of global awareness.

As recent events have demonstrated, the need to maintain a broad and accurate perspective on global trends and events has never been more pressing. As virtually every decision in our society—political, social, ecological, and technological—has a rippling effect on our world, participation in a democratic decision-making process requires a level of sophisticated understanding and analysis for which our current educational system may leave students unprepared.

Communications technology, of course, is a tremendously important component of global awareness. According to John Naisbitt (1994),

> With the activities of the world being replayed for us in our living rooms each night, none of us can feign ignorance about affronts to society's ethical standards. We have all become our brother's keepers—at least in this sense. Communications technology has empowered individuals and communities through instant access to information of all kinds. Responsibility comes with that access. Are we up to the task? (p. 193)

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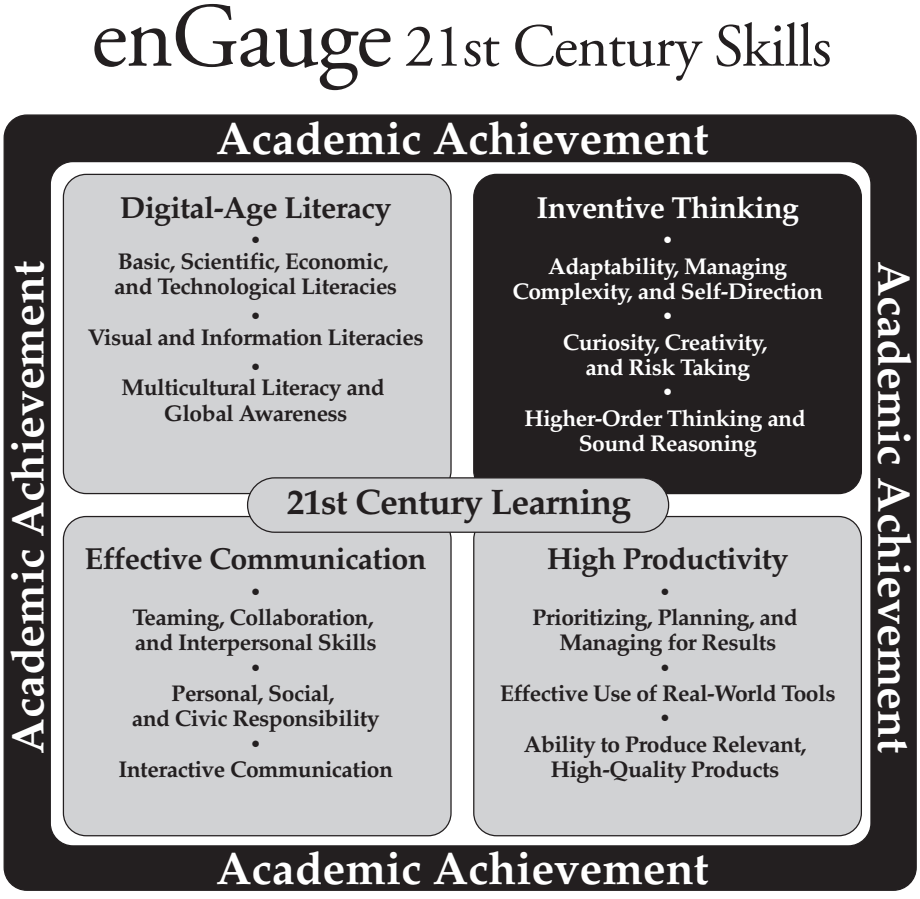
Inventive Thinking

Experts agree: As technology becomes more prevalent in our everyday lives, cognitive skills become increasingly critical. "In effect, because technology makes the simple tasks easier, it places a greater burden on higher-level skills" (International ICT Literacy Panel, 2002, p. 6). The Committee on Workforce Needs in Information Technology (2001) defines *intellectual capabilities* as "one's ability to apply information technology in complex and sustained situations and to understand the consequences of doing so" (p. 18). These capabilities are "life skills" formulated in the context of Digital Age technologies.

***Inventive Thinking** is comprised of the following "life skills":*

- ***Adaptability and Managing Complexity:*** The ability to modify one's thinking, attitude, or behavior to be better suited to current or future environments; and the ability to handle multiple goals, tasks, and inputs, while understanding and adhering to constraints of time, resources, and systems (e.g., organizational, technological).
- ***Self-Direction:*** The ability to set goals related to learning, plan for the achievement of those goals, independently manage time and effort, and independently assess the quality of learning and any products that result from the learning experience.
- ***Curiosity:*** The desire to know or the spark of interest that leads to inquiry.
- ***Creativity:*** The act of bringing something into existence that is genuinely new and original, whether personally (original only to the individual) or culturally (where the work adds significantly to a domain of culture as recognized by experts).
- ***Risk Taking:*** The willingness to make mistakes, advocate unconventional or unpopular positions, or tackle extremely challenging problems without obvious solutions, such that one's personal growth, integrity, or accomplishments are enhanced.
- ***Higher-Order Thinking and Sound Reasoning:*** The cognitive processes of analysis, comparison, inference and interpretation, evaluation, and synthesis applied to a range of academic domains and problem-solving contexts.



Adaptability and Managing Complexity

Adaptability and managing complexity *is the ability to modify one's thinking, attitudes, or behaviors to be better suited to current or future environments; and the ability to handle multiple goals, tasks, and inputs while understanding and adhering to constraints of time, resources, and systems (e.g., organizational, technological).*

Students Who Are Adaptable and Able to Manage Complexity:

When Dealing With Change

- Are positive about change and recognize the gains that might result from it.
- Adapt to change quickly and calmly, without idealizing earlier methods and ideas.

When Faced with Complex Problems or Multiple Goals

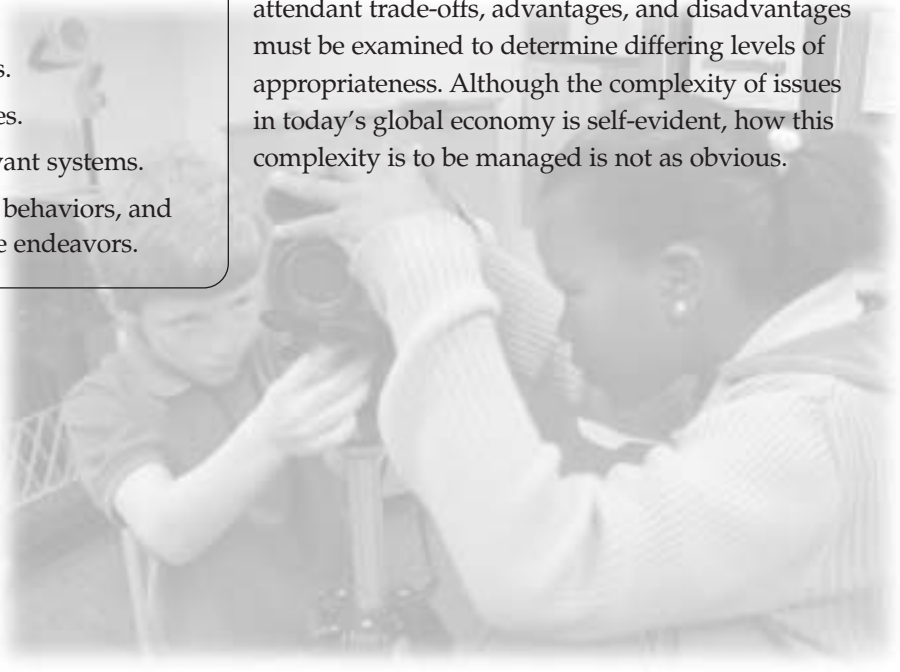
- Think about problems from multiple perspectives; understand they can be solved using different strategies and can involve more than one solution.
- Anticipate contingencies and handle them with confidence.
- Look for and correct problems as they occur; abandon strategies that prove to be ineffective.
- Manage multiple goals and set subgoals in service of larger ones; stay focused under pressure; and keep sight of "the big picture."
- Use self-management strategies to:
  - Allocate time and resources.
  - Remain organized.
  - Be accountable for meeting goals.
- Strive towards goals despite obstacles.
- Understand the components of relevant systems.
- Reflect on lessons learned from past behaviors, and use these insights to help plan future endeavors.

The Digital Age is inherently complex. In the past, multitasking was called for periodically. In this era of accelerating change, however, multitasking often is a requirement.

Many of today's students have grown up multitasking. They listen to CDs and MP3s on earphones while completing homework and interacting in online chat rooms.

Such complexity requires individuals to plan, think, design, and manage in new ways—taking into account contingencies, anticipating changes, and understanding interdependencies within systems (Goleman, 1998; Committee on Information Technology Literacy & National Research Council. 1999). In doing so, resource management (time, space, materials) is increasingly required to execute a plan successfully. Any such approach often will result in components of a system interacting in complex, unexpected ways. As projects are executed, it is important to trace interdependencies among information systems to look for, understand, and monitor cause and effect (Committee on Information Technology Literacy & National Research Council, 1999).

As a variety of solutions become apparent, their attendant trade-offs, advantages, and disadvantages must be examined to determine differing levels of appropriateness. Although the complexity of issues in today's global economy is self-evident, how this complexity is to be managed is not as obvious.



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Self-Direction

Self-direction *is the ability to set goals related to learning, plan for the achievement of those goals, independently manage time and effort, and independently assess the quality of learning and any products that result from the learning experience.*

Students Who Are Self-Directed:

In the Planning Phase

- Set goals.
- Plan strategically.
- Believe in their abilities.

During Learning Activities

- Work to reach goals.
- Develop interest in their work.
- Focus and maintain their attention.
- Constantly teach themselves.
- Monitor their own performance.
- Seek help when needed.

Upon Completion

- Evaluate their work.
- Understand that hard work and perseverance breed success.
- Have positive self-images of themselves as learners.
- Use what they have learned to adapt to new situations.

Because change occurs constantly in our information-rich society, self-directed, continuous learning is no longer seen as an option for successful workers in the Digital Age (Chao, 2001). According to the U.S. Department of Labor (SCANS, 1992), today's workers are participating in more out-of-school learning to improve their job skills than at any time in the past, and they must continue to do so. The complexity of today's workplace makes competence with new literacies and new skills imperative.

Technology can serve as a causal agent in this process; the rate of technological change drives the rate of workplace change. The self-directed learner who can anticipate these changes and is constantly upgrading his or her skill set is extremely valuable in the 21st century (BJK Associates, 2002; CEO Forum, 2001). Conversely, those who lack the ability to learn and adapt will find themselves in jeopardy in the modern workplace.

In addition to contributing to the need for lifelong learning, technology also can provide support for learners in ways that were unrealistic 10 years ago. Access to knowledge resources, opportunities for collaboration, online courses, and just-in-time learning environments have caused an exponential growth in the resources that are available to support self-directed learning. For the learner who has internalized the processes that support self-directed learning, this profusion of resources makes learning more readily available today than at any time in history.

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Curiosity

Curiosity *is the desire to know or the spark of interest that leads to inquiry.*

Students Who Are Curious:

Display Personal Characteristics

- React positively to novel elements in the environment and often seek new experiences.
- Are more tolerant of ambiguity and less anxious in uncertain situations than students who are not curious.
- Explore novel elements in the environment by moving toward, manipulating, or asking questions about those elements.
- Persist in examining new elements in order to know more about them.

Approach Learning in Unique Ways

- Often learn more than is required.
- Are more likely to look for patterns or engage in hypothesis testing.
- Stumble upon topics that prompt spontaneous inquiry.
- Make an active attempt to learn about and keep abreast of novel ideas and current events.
- Are intrinsically rather than extrinsically motivated to learn.

Curiosity has never been more important than in this Digital Age of entrepreneurship, innovation, and accelerated change. During the Industrial Age, students and workers were expected to follow explicit orders and procedures. Today, knowledge workers are expected to adjust and adapt to changing environments (Cline, 1997; Pearson & Young, 2002). To do so, they must maintain their curiosity and drive, thereby staying current and informed (BJK Associates, 2002). Curiosity fuels lifelong learning as it contributes to the quality of life and to the intellectual capital of the country.

Just as business and industry have redefined the types of workers they need, the science of learning is beginning to unlock the secrets of how people learn. Researchers such as Bransford et al. (1999) now understand how the thinking of the expert differs from that of the novice, enabling educators to develop learning strategies that teach students to become expert learners. In fact, the very structure of the brain can be changed through intellectual pursuits. Bransford et al. (1999) explain that there is "a relationship between the amount of experience in a complex environment and the amount of structural change" in the brain (p. 113). In other words, learning organizes and reorganizes the brain. But just being in such environments is not enough. Students who are curious about the world around them have the intrinsic motivation to seek out answers to perplexing, complex questions. Today that propensity to maintain a high level of curiosity is truly an attribute.

Curiosity can fuel lifelong learning as it contributes to quality of life and to the intellectual capital of the country.

Resources Used to Develop the Content for Curiosity

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Creativity

Creativity *is the act of bringing something into existence that is genuinely new, original, and of value either personally (of significance only to the individual or organization) or culturally (adds significantly to a domain of culture as recognized by experts).*

Students Who Are Personally Creative:

Exhibit Innovation and Risk Taking

- Produce original, unique, and cogent ideas, phrases, and products.
- Exhibit expertise in at least one domain.
- Take risks and excel despite mistakes.

Are Intrinsically Motivated

- Exhibit curiosity, inquisitiveness, wonder, and excitement.
- Are flexible and adaptable.
- Become immersed in challenging learning for intrinsic reasons.
- Tolerate ambiguity well and respond with spontaneity and ingenuity.

Exhibit Complex Personalities

These students are often:

- Energetic, yet able to quietly contemplate ideas.
- Divergent thinkers, yet able to think convergently at appropriate times.
- Playful, yet disciplined and able to persevere.
- Imaginative, yet rooted in reality.
- Extroverted, yet able to be introspective.
- Passionate and committed to learning, yet analytical and objective.
- Driven and aggressive, yet sensitive.
- Rebellious, yet able to operate within traditions.

Caveat: Although a student may be personally creative, that is no guarantee that the student will be able to be creative within a group or organization. Creativity within a group requires a learning environment that promotes creativity within strong teaming and collaboration. Creativity within an organization requires a learning environment that promotes and encourages creativity among individuals as valued members of the organization (Williams & Yang, 1999).

Creativity is defined here at two important levels: that which is culturally significant, and that which is personally or organizationally significant. Both hold great value.

Human social, emotional, and intellectual development has been driven by creativity. Perhaps more than any other human quality, creativity has left permanent and lasting marks on cultures worldwide—and it is at the very heart of the knowledge-based age. According to the Progressive Policy Institute (2002), "The New Economy is all about economic dynamism…and is epitomized by fast-growing, entrepreneurial companies, one of its hallmarks. The ability of firms to innovate…is becoming a more important determinant of competitive advantage" (p. 1). President George W. Bush (2002) believes "the strength of our economy is built on the creativity and entrepreneurship of our people" (p. 1).

Many individuals and teams of individuals have creatively influenced our culture through emerging technologies (e.g., breakthroughs such as the silicon chip, laser surgery, and the Internet). The literature confirms that such cultural creativity requires not only originality and a deep understanding of a given field but also widespread societal acceptance of the cultural breakthrough or invention in order to be considered creative (Csikszentmihalyi, 1996; Weisberg, 1999).

Today, the creative individual potentially has more to offer—and gain—from society, than ever before. Our knowledge-based age has shifted power from those who own raw physical materials to those who have *intellectual capacity*—the capacity to create and produce knowledge. At an economic level, creative, knowledge-producing individuals and organizations are highly likely to be economically solvent. At a personal level, the lives of persons who are personally creative can be richer, more interesting and, possibly, more fulfilled (Collins & Amabile, 1999; Nickerson, 1999). In addition, technology has provided individuals and communities with the time to spend in creative pursuits, resulting in extraordinary extensions and expansion of domains as well as the establishment of new ones such as biotechnology (Csikszentmihalyi, 1996). To that end, the current federal administration is aggressively promoting innovation and entrepreneurship—encouraging creativity in the worlds of science, business, and industry.

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Risk Taking

Risk taking *is the willingness to make mistakes, advocate unconventional or unpopular positions, or tackle extremely challenging problems without obvious solutions, such that one's personal growth, integrity, or accomplishments are enhanced.*

Students Who Are Risk Takers:

- Are willing to tackle challenging tasks, even when success is uncertain.
- Choose tasks involving reasonable or intermediate risk rather than excessive risk.
- Share and advocate ideas they believe in, even when those ideas are unconventional.
- Are willing to hold their work or thinking up to critical appraisal and amend thinking when successfully challenged.
- Are willing to be incorrect and willingly take on tasks that might result in errors.

The very nature of learning requires risk taking. A small child would never learn to walk, talk, or socially interact without taking risks, experiencing successes and failures, and then monitoring and adjusting accordingly.

Quantum leaps in learning, solving problems, inventing new products, and discovering new phenomena require risk taking. Risk taking within the learning environment requires a willingness to think deeply about a subject or problem, share that thinking with others to hear their perspectives, listen to their critiques, and then build on those experiences toward a solution or solutions (Dweck, 2000; Weiner, 1994). Too often, students are engaged in learning activities that focus on the 'right answers.' Instead, students should be encouraged to engage in discussions about numerous approaches—and potential solutions—to a problem (Brophy, 1998; Vispoel & Austin, 1995).

In order to take risks that lead to intellectual growth, students must be in environments that they perceive to be safe—places in which to share ideas, reflect on and discuss perspectives, and learn new things. Research shows that students learn more when they are engaged in intellectually stimulating assignments where they engage in meaningful, intellectually stimulating work in which they construct knowledge (Newmann, 1996; Newmann et al., 2001). This research applies to all students regardless of socioeconomic status or prior academic achievement.

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Higher-Order Thinking and Sound Reasoning

Higher-order thinking and sound reasoning *includes the cognitive processes of analysis, comparison, inference and interpretation, evaluation, and synthesis applied to a range of academic domains and problem-solving contexts.*

Students Who Are Higher-Order Thinkers and Sound Reasoners:

- Identify the essential elements in a problem as well as the interaction between those elements; use electronic tools to facilitate analysis.
- Assign relative values to essential elements of a problem and use those values to rank elements in meaningful ways; assess similarities and differences in problems and their elements.
- Construct relationships between the essential elements of a problem that provide insight into it; extract implications and conclusions from facts, premises, or data.
- Create and apply criteria to gauge the strengths, limitations, and value of information, data, and solutions in productive ways.
- Build new solutions through novel combinations of existing information.

For decades, researchers have been calling for higher-order thinking and sound reasoning in K–12 curricula. The 1991 SCANS report included thinking skills in the foundation competencies necessary for solid job performance. In this report, the authors define thinking skills as "thinking creatively, making decisions, solving problems, seeing things in the mind's eye, knowing how to learn, and reasoning" (SCANS, 1991, p. 13). The International Society for Technology in Education (2000), in its release of the National Education Technology Standards (NETS) for students, included critical thinking, informed decision-making, and real-world problem solving through technology. The National Research Council's Committee on Information Technology Literacy (1999) included "intellectual capabilities" as being critical to technological fluency, citing "engagement in sustained reasoning" and "expecting the unexpected" as two of the 10 key elements that enable students to plan, design, execute, and evaluate a solution. All of these are critical aspects of higher-order thinking and sound reasoning

Higher-order thinking in the context of a fast-paced, knowledge-based society requires both divergent and convergent thinking. Divergent thinking uses the creativity to play "what if," establishing multiple scenarios and ideas to consider as hypotheses. Convergent thinking enables students to use sound reasoning and common sense to analyze those possibilities to select the hypothesis with the most potential based on a set of criteria for expected outcomes.

Resources Used to Develop the Content for Higher-Order Thinking and Sound Reasoning

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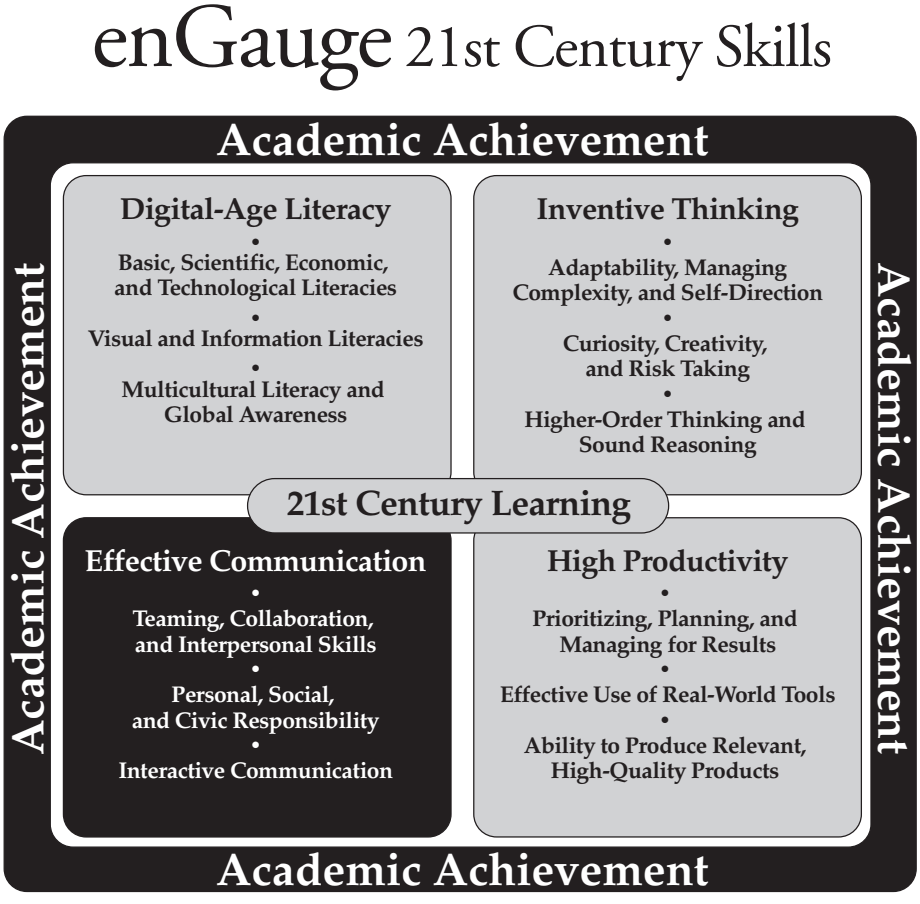
READ
18

Effective Communication

According to the 21st Century Literacy Summit (2002), "Information and communications technologies are raising the bar on the competencies needed to succeed in the 21st century" (p. 4). Both researchers and the business community agree: Effective communication skills are essential for success in today's knowledge-based society. The 1991 SCANS report, for example, lists the following as necessary for success in this area: participating in a team, teaching others new skills, serving clients and customers, exercising leadership, negotiating, and working with diverse groups of people (SCANS, 1991, p. 81). Information technology can play a facilitative role in effective communication, but emerging technologies also can present ethical dilemmas. As information and communication technologies become more pervasive in society, citizens will need to manage the impact on their social, personal, professional, and civic lives.

Effective Communication involves:

- ***Teaming and Collaboration:*** Cooperative interaction between two or more individuals working together to solve problems, create novel products, or learn and master content.
- ***Interpersonal Skills:*** The ability to read and manage the emotions, motivations, and behaviors of oneself and others during social interactions or in a social-interactive context.
- ***Personal Responsibility:*** Depth and currency of knowledge about legal and ethical issues related to technology, combined with one's ability to apply this knowledge to achieve balance, integrity, and quality of life as a citizen, a family and community member, a learner, and a worker.
- ***Social and Civic Responsibility:*** The ability to manage technology and govern its use in a way that promotes public good and protects society, the environment, and democratic ideals.
- ***Interactive Communication:*** The generation of meaning through exchanges using a range of contemporary tools, transmissions, and processes.



Teaming and Collaboration

Teaming and collaboration *means cooperative interaction between two or more individuals working together to solve problems, create novel products, or learn and master content.*

Students Who Are Adept at Teaming and Collaboration:

Personally

- Are willing and able to take on different roles and tasks within the group to accomplish shared ends.
- Are open and honest with ideas, concerns, and values.
- Are leaders as well as followers.
- Apply collaborative skills to a variety of situations.
- Reflect on group interactions after collaborative activities; use experiences to make future collaboration more productive.

Interpersonally

- Commit to a shared goal and accept responsibility for group work toward that goal.
- Work to match tasks to team member abilities, expanding team membership when necessary.
- Share personal understandings and resources with other group members.
- Listen respectfully and objectively; offer constructive feedback.
- Iteratively design and redesign solutions through honest debate, disagreement, discussion, research, and development.

Why collaborate and team? Because cooperative interaction is essential for survival in today's fast-paced, complex world.

Increasing levels of complexity require expertise in highly specialized fields. Time itself has become a commodity, and the net result is a flattening of organizational structures—the transfer of high-stakes decision making from high-level executives into the hands of workers on the front lines.

The adage "the whole is greater than the sum of the parts" has never been more true than when applied to a highly functional team operating within the complexity of today's world—whether in the fields of education, medicine, transportation, finance, politics, or any other.

Despite the high stakes, teaming and collaboration are not well understood—in the classroom or in the boardroom. Simply tasking people to work together does not constitute teaming and may not result in collaboration. Highly effective teams have four key elements: (1) a compelling, shared goal or goals; (2) team members with unique competencies that will contribute to successful outcomes; (3) members that operate within a formal structure, with defined roles that facilitate collective/collaborative work; and (4) mutual respect, tolerance, and trust (Schrage, 1989).

Successful collaboration and teaming begins with collective energy and a shared drive among team members to accomplish a shared goal (Schrage, 1989). To help ensure a team's success, organizations—including schools—must pose problems that inspire collaboration and teaming and then create the work-place or classroom norms that both facilitate and reward such work.

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Interpersonal Skills

Interpersonal skills *include the ability to read and manage the emotions, motivations, and behaviors of oneself and others during social interactions or in a social-interactive context.*

Students Who Have Interpersonal Skills:

- Are aware of and able to manage their own emotions, strengths, and limits during both face-to-face and virtual interactions.
- Are able to manage their behavior during social interactions.
- Are able to align their goals to the goals of others during collaborative activities.
- Understand and positively manage the emotions of others in both face-to-face and virtual environments; empathize with others; are sensitive to the needs of others and to the forces that shape the way that others feel and behave; enhance the strengths and abilities of others.
- Manage conflict effectively by devising win-win solutions; constructively influence the behavior of others; use effective communication and persuasive strategies; listen well.

Many have wondered how it happens that persons with high IQs don't always land the top jobs. The answer often lies in interpersonal skills. In fact, emotional intelligence—the capacity to manage emotions well—is twice as important to success in the workplace as IQ and expertise (Goleman, 1998).

The teamwork necessitated by the complexity of today's workplace has placed increased importance on a worker's interpersonal skills. Such teaming often brings together individuals from diverse groups who may not share common norms, values, or vocabularies but who do offer unique expertise, insights, and perspectives.

Interpersonal skills in the Digital Age are somewhat more complex than they have been in the past. E-mail, voice mail, audioconferencing and videoconferencing, and the myriad of other technologies that enable individuals to communicate with each other not only increase the ways in which individuals can interact but also require a heightened sensitivity to the nuances of interpersonal interactions. This idea is particularly true in the worlds of virtual learning and virtual communication, where one cannot yet use hand gestures, facial expressions, or body language to fully express ideas. The challenge to students is to perfect interpersonal skills not only in face-to-face interactions but in virtual interactions as well.

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Personal Responsibility

Personal responsibility *is the ability of an individual to manage and use technology to achieve balance, integrity, and quality of life as a citizen, a family and community member, a learner, and a worker.*

Students Who Are Personally Responsible:

- Acknowledge that access to technology is a privilege, not a right, and as such warrants adherence to protocols and ethics.
- Practice responsible use of technology systems, information, and technology.
- Understand the global implications of personal actions within the World Wide Web system.
- Set, prioritize, and meet personal as well as civic, family, and work-related goals; maintain a focus on important goals in spite of obstacles.
- Balance personal, civic, family, and work demands.

Emerging technologies present individuals with challenges, opportunities—and yes, temptations—like never before. Once the exclusive domain of industry, electronic data is now at our fingertips and on our desktops in the form of digital music, digital video, digital text, digital images, statistics, and business and personal correspondence.

An important component of personal responsibility with electronic media and information is staying current with emergent laws, policy, and practice in this realm (Willard, 2001). The International Society for Technology in Education (2000) defines standards for such decision making in the following areas: (1) the understanding of the ethical and societal issues related to technology; and (2) the practice of responsible use of technology systems, information, and software. Technology can drive values; for that reason, ethics and values must be developed to guide the application of science and technology in society (Uchida et al., 1996).

A further challenge that has arisen as a result of the availability of new communications technology and new levels of global competition is the maintenance of balance between one's professional and personal lives. E-mail, cell phones, and wireless networks have created a level of personal access that, while convenient, also can become intrusive. Although overall hours worked in the United States have declined slightly in the last 25 years, the proportion of those people working more than 49 hours per week has spiked. This proportion approaches 60 percent in higher income brackets (Rones, Gardner, & Ilg, 1997). As a result, the ability to establish priorities that place civic and family responsibilities in a proper perspective may be a key skill in the 21st century.

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Social and Civic Responsibility

Social and civic responsibility *is the ability to manage technology and govern its use in a way that promotes public good and protects society, the environment, and democratic ideals.*

Students Who Are Socially and Civically Responsible:

- Recognize the importance of citizens' access to and use of information in a democratic society.
- Pursue technology-related public policy that promotes ethical behavior, maintains personal privacy, and protects intellectual property as it recognizes and manages the inherent risks and ethical dilemmas raised by innovation.
- Actively engage in public discourse and raise public awareness on ethical issues raised by new, emerging technologies.
- Promote positive technological changes that advance the public good.

Given today's rapid rate of change, technological advances often precede public agreement on the social and civic implications of those advances. People require significant time to discover and evaluate emerging technologies, discarding some and adopting others. In a democratic society, all citizens have a right to access and use information, but they also have a responsibility to use it in ethical ways, weighing such issues as privacy versus security, freedom of electronic speech versus intellectual property, and the impact of particular technologies on current and future generations.

The relative infancy of the World Wide Web is one example of our open window of opportunity for shaping socially and civically responsible norms of technology use. Agreement on what such norms should consist of requires public discourse by informed citizens. Schools, therefore, share a responsibility for ensuring that students have a deep understanding of technology, the historical impact of technology on society, and the roles of individuals and democratic institutions in shaping and maintaining responsible uses of technology.

Besides being socially and civically responsible as individuals, children also need to understand their role in shaping public policy. One policy action aimed at social responsibility is the Children's Internet Protection Act of 2000, which requires all schools and libraries given federal funds for connectivity to use filters that block objectionable materials (Miscellaneous Appropriations Act, 2001). While the need for Internet safety is generally agreed upon, this method of achieving such safety remains controversial.

Truly informed action can come only from knowledgeable, insightful, and shared reflections on practices, policies, and public law. Berson (1996) writes that schools should "promote the development of competent citizens who possess the critical thinking skills necessary to function in a democratic society" (p. 486). Likewise, the National Council for the Social Studies (2002) identifies "citizenship education" as a primary purpose of K–12 education. Even the current No Child Left Behind legislation suggests it is necessary for our education system to "improve the quality of civics and government education," as well as to "foster civic competence and responsibility" (No Child Left Behind Act, Sec. 2342).

In short, students must learn to be informed and active in public policy debates that arise out of technological change.

Resources Used to Develop the Content for Social and Civic Responsibility

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Interactive Communication

Interactive communication *is the generation of meaning through exchanges using a range of contemporary tools, transmissions, and processes.*

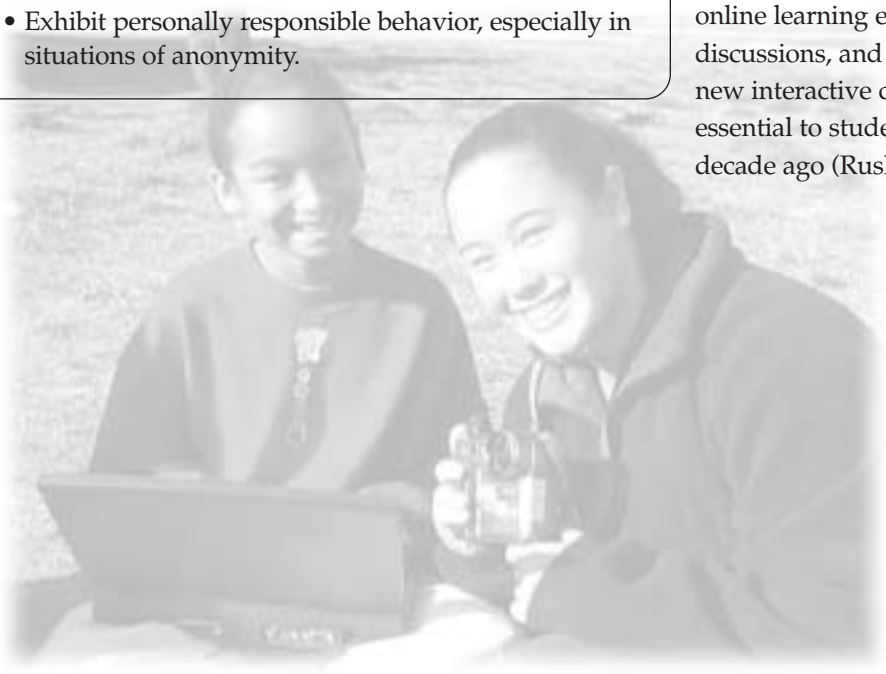
Students Who Are Interactive Communicators:

When Selecting Modes of Interaction

- Consider features, conventions, and etiquette of interactive electronic environments.
- Choose media and processes appropriate to purpose and audience.
- Seek out and interact with virtual communities of interest (formal and informal learning).

During Interaction

- Use a range of expression (such as voice, video, text, and image) to maximize the impact of a medium or online environment.
- In synchronous modes, are comfortable with immediacy of interaction, engaging in appropriate give-and-take, and effectively interpreting and providing emotional cues to enhance electronic communications.
- Manage high-volume electronic communication efficiently and effectively.
- Listen well, seek mutual understanding, welcome full sharing of information, and consider others' views before commenting.
- Exhibit personally responsible behavior, especially in situations of anonymity.



Electronic media create new venues for communication. These new venues change with whom, how, and when communication occurs. They give voice to those formerly silent and breaks the monopolies of those previously in exclusive control. A startling example of these shifts occurred in 1989 at Tiananmen Square, when the government's media repression was thwarted by the electronic communications of individuals with pagers, cell phones, and ham radios.

In today's wired, networked society, it is imperative that students learn to communicate effectively using a range of media, technology, and environments. This includes both asynchronous and synchronous communication, such as person-to-person e-mail correspondence, electronic mailing lists, group interactions in virtual learning spaces, chat rooms, MOOs, MUDs, interactive videoconferencing, phone or audio communications, and interactions through simulations and models. Several of these require knowledge of etiquette unique to their particular environment.

While technology does not alter the fundamental principles of high-quality, interactive communication, it does add new dimensions for enhanced communication through the use of expressive digital visuals, online learning environments, chat rooms, threaded discussions, and e-mail. Expertise in the use of these new interactive communication conventions is as essential to students as expertise with phones was a decade ago (Rushkoff, 1999; Tapscott, 1998).

Resources Used to Develop the Content for Interactive Communication

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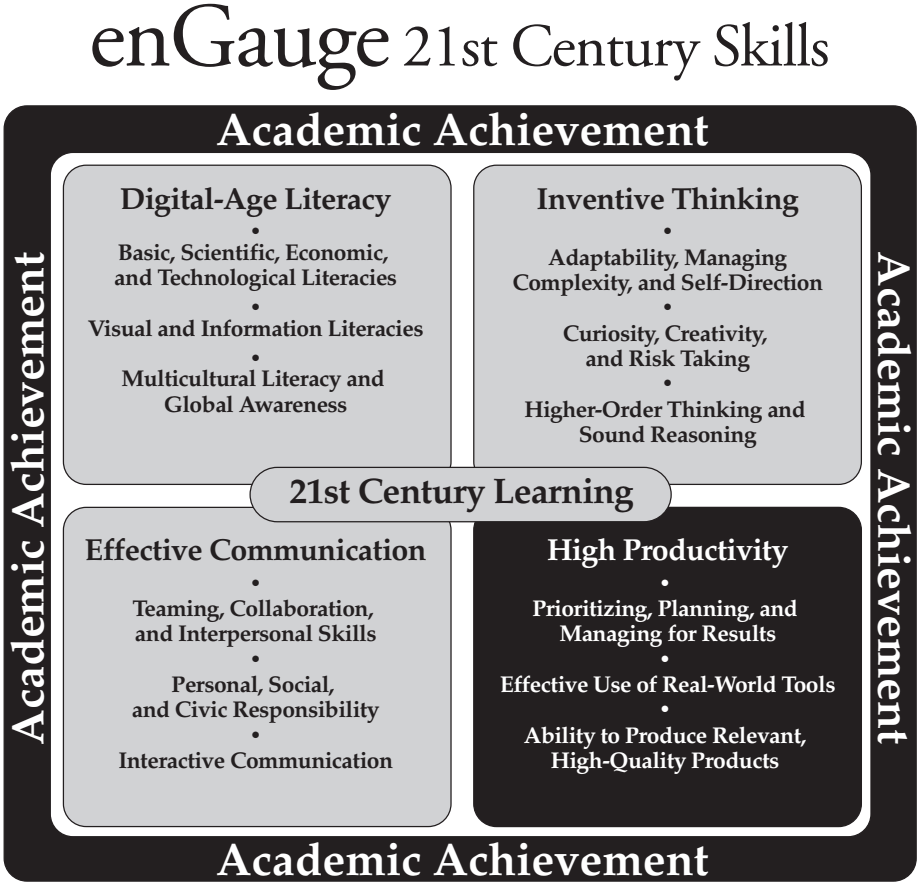
High Productivity

According to leading researchers, caution should be exercised when attempting to link high-stakes testing and high standards to the creation of a productive workforce (Levin, 2001). Levin's studies in the 1990s led him to conclude that how well students do on current tests in no way correlates to how productive they will be in the workforce.

High productivity *currently is not a high-stakes focus of schools, yet the skills involved in this cluster often determine whether a person succeeds or fails in the workforce:*

- ***Prioritizing, Planning, and Managing for Results:*** The ability to organize to efficiently achieve the goals of a specific project or problem.
- ***Effective Use of Real-World Tools:*** The ability to use real-world tools—the hardware, software, networking, and peripheral devices used by information technology (IT) workers to accomplish 21st century work—to communicate, collaborate, solve problems, and accomplish tasks.
- ***Ability to Produce Relevant, High-Quality Products:*** The ability to produce intellectual, informational, or material products that serve authentic purposes and occur as a result of students using real-world tools to solve or communicate about real-world problems. These products include persuasive communications in any media (print, video, the Web, verbal presentation), synthesis of resources into more useable forms (databases, graphics, simulations), or refinement of questions that build upon what is known to advance one's own and others' understanding.



Prioritizing, Planning, and Managing for Results

Prioritizing, planning, and managing for results *involves the ability to organize to achieve the goals of a specific project or problem efficiently and effectively.*

Students Who Prioritize, Plan, and Manage for Results:

- Are able to frame meaningful questions that provide clear direction to planning processes.
- Spend a considerable amount of "up-front" time reflecting on these questions and developing a specific plan that is likely to lead to a solution.
- Anticipate obstacles and plan accordingly, sustaining interest and effort in the face of complexity.
- Exhibit positive leadership traits; cause others to act in accordance with a plan.
- Utilize time and resources efficiently and effectively.
- Monitor progress effectively throughout the implementation of the plan.
- Self-evaluate.

The level of complexity often present in today's society requires workers—and students—to carefully plan and manage their work and to anticipate contingencies. In addition, it requires concentration on the main goals of a project—an ability to keep an eye on the outcomes so as to guide and align all facets of the project toward those goals.

Although this work was the responsibility of managers in the Industrial Age, it is now a basic requirement for the typical knowledge worker of the 21st century.

The 1991 SCANS report supports this concept by including "systems" as one of its five competencies. In that report, *systems* are defined as the understanding of complex interrelationships and the ability to monitor and correct performance. The 1991 SCANS report also includes a fifth competency—"technology"—that emphasizes the selection and application of technology to ensure desired results. In the "personal qualities" section of the foundation, SCANS lists self-management as a desired and necessary trait (SCANS, 1991).

In a recent summary of research on project-based learning, the lack of ability to create and systematically carry out systematic plans to address complex questions was identified as one of the key obstacles to successful implementation (Thomas, 2000). Explicit instruction in planning processes; scaffolds that support planning; and significant opportunities to prioritize, plan, and manage in the course of learning will be needed to build these skills in all students.

Resources Used to Develop the Content for Prioritizing, Planning, and Managing for Results

Huitt, W. (1997, April 18). *The SCANS report revisited*. Paper delivered at the Fifth Annual Gulf South Business and Vocational Education Conference, Valdosta State University, Valdosta, GA.

Rohn, J. (2001, September 25). *Jim Rohn's weekly e-zine*, No. 101. Retrieved April 11, 2003, from http://www.jimrohn.com/ps.dll?s=jimrohn&a=&b=1343951&p=0&@ses_ID=1560 0414125269&@msg_2779900_415178521=1&@obj_ ID=124987

Thomas, J. (2000). Executive summary. *A review of research on project-based learning*. San Rafael, CA: Autodesk Foundation. Retrieved April 11, 2003, from http://www.k12reform.org/foundation/pbl/research/

Effective Use of Real-World Tools

Effective use of real-world tools *(e.g., the hardware, software, networking, and peripheral devices used by information technology workers to accomplish 21st century work) is using these tools to communicate, collaborate, solve problems, and accomplish tasks.*

Students Who Effectively Use Real-World Tools:

- Understand the value of tools for a particular field and are comfortable using these tools.
- Enhance their learning about content areas through both general technology tools and those specific to a field of study.
- Use the real-world tools of field practitioners as a bridge between the theory and practice.
- Document their resultant products and, when appropriate, write technical manuals to guide use and possibly continued development of the work by others.

Bill Gates' 12th rule for "business at the speed of thought" is to "use digital tools to help customers solve problems for themselves" (Gates, 1999, p. 82). This idea is dependent on ubiquitous, networked communication.

According to the standard for "technology productivity tools" of the International Society for Technology in Education (2000), choosing appropriate tools for the task and applying them to real-world situations in ways that add significant value results in increased collaboration, promotion of creativity, construction of models, and the preparation of publications and other creative works.

Resources Used to Develop the Content for Effective Use of Real-World Tools

International Society for Technology in Education. (2000). *National educational technology standards for students: Connecting curriculum and technology*. Eugene, OR: Author. Retrieved April 11, 2003, from http://cnets.iste.org/students/s_book.html

National Workforce Center for Emerging Technologies. (n.d.). *National Workforce Center for Emerging Technologies Web Site*. Retrieved April 11, 2003, from http://www.nwcet.org/

Online Internet Institute. (2002). *Online Internet Institute* Web site. Retrieved April 11, 2003, from http://oii.org/index.html

Serim, F. (2001). *From computers to community: Unlocking the potential of the wired classroom*. New York: Centrinity.

Thurow, L. (1999). Building wealth: The new rules for individuals, companies, and nations. *The Atlantic Monthly*, *283*(6), 57-69. Retrieved April 11, 2003, from http://www.theatlantic.com/issues/99jun/9906thurow.htm

21st Century Workforce Commission. (2000). *A nation of opportunity: Strategies for building tomorrow's 21st century workforce*. Washington, DC: U.S. Department of Labor.

Ability to Produce Relevant, High-Quality Products

The ability to produce relevant, high-quality products *relates to intellectual, informational, or material products that serve authentic purposes and result from student use of real-world tools to solve or communicate about real-world problems.*

Students Who Generate Relevant, High-Quality Products:

- Ensure that content is accurate, balanced, carefully researched, and well-documented (application of information literacy).
- Strategically use a variety of media (text, video, audio) and technology tools to add value to their products.
- Skillfully integrate and apply technological, information, and visual literacies to generate "knowledge products."
- Create "knowledge products" that have significance beyond the classroom walls.
- Understand both the utility of the products created and the way they meet the needs or demands of the original problem.
- Have internal standards for high-quality products, and routinely use these standards to test and evaluate products and the processes that led to them.

Research by Newmann (1996) suggests that students who engage in intellectually stimulating work learn more. Newmann's three criteria include knowledge construction, disciplined inquiry, and value beyond the school. Effective use of real-world tools can advance each of these criteria to bring excitement, motivation, and real-world value to the study of the academics. Such work can provide a bridge between the theoretical, conceptual study of academics and the application of theory into practice in the field.

Under the heading "technology problem-solving and decision-making tools," the International Society for Technology in Education (2000) includes the use of technology for making informed decisions and for problem solving in the real world. Likewise, the National Research Council's Committee on Information Technology Literacy (1999) identified a tripartite approach to being fluent with technology—a combination of capabilities, concepts, and skills. This combination is critical, for without the practical aspect of the skills, the capabilities and concepts would remain abstract, unable to exert influence the real world.

Researchers are finding learning benefits for students who build authentic products involving the creation of meaningful products (Newmann et al., 2001). Such experiences can provide students with deep insights into whatever domain of knowledge they pursue and whatever tools they use.

Resources Used to Develop the Content for Ability to Produce Relevant, High-Quality Products

Committee on Information Technology Literacy & National Research Council. (1999). *Being fluent with information technology*. Washington, DC: National Academy Press. Retrieved April 11, 2003, from http://www.nap.edu/html/beingfluent

International Society for Technology in Education. (2000). *National educational technology standards for students: Connecting curriculum and technology*. Eugene, OR: Author. Retrieved April 11, 2003, from http://cnets.iste.org/students/s_book.html

Newmann, F. (1996). *Authentic achievement: Restructuring schools for intellectual quality*. San Francisco: Jossey-Bass.

Newmann, F. M., Bryk, A. S., & Nagaoka, J. K. (2001). *Authentic intellectual work and standardized tests: Conflict or coexistence*. Retrieved April 11, 2003, from http://www.consortium-chicago.org/publications/p0a02.html

North Central Regional Technology in Educational Consortium, Porter, B., & Education Technology Planners. (2000). *Scoring guide for student products*. Retrieved April 11, 2003, from http://www.ncrtec.org/tl/sgsp/index.html

National Workforce Center for Emerging Technologies. (2001). *National Workforce Center for Emerging Technologies* Web site. Retrieved April 11, 2003, from http://www.nwcet.org/

Online Internet Institute. (2001). *Online Internet Institute* Web site. Retrieved April 11, 2003, from http://oii.org/index.html

Schlechty, P. (1997). *Inventing better schools: An action plan for educational reform*. San Francisco: Jossey-Bass.

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Thurow, L. (1999). Building wealth: The new rules for individuals, companies, and nations. *The Atlantic Monthly*, *283*(6), 57-69. Retrieved April 11, 2003, from http://www.theatlantic.com/issues/99jun/9906thurow.htm

21st Century Workforce Commission. (2000). *A nation of opportunity: Strategies for building tomorrow's 21st century workforce*. Washington, DC: U.S. Department of Labor.

Glimpses Into 21st Century Classrooms

The programs highlighted on the following pages tell the stories of real students who are developing 21st century skills in the context of rigorous, content-based, academic study. Learn how these teachers are engaging their students in authentic, intellectually stimulating and challenging work that motivates them to work hard, collaborate in meaningful ways, build a variety of skills, and conduct research to accomplish their goals.

Each of the four examples addresses multiple 21st century skills:

	Grades 1–2 Kristi Rennebohm Franz's Classroom	**Grades 4–12** WISE Science	**Grades 9–12** Geometry in the Real World	**Grades 9–12** Electric Soup
Digital-Age Literacy				
• Basic Literacy	X*			X
• Scientific Literacy		X*	X	
• Economic Literacy		X	X	
• Technological Literacy	X	X	X	X
• Visual Literacy			X	X
• Information Literacy		X		X
• Multicultural Literacy	X			
• Global Awareness	X*			
Inventive Thinking				
• Adaptability and Managing Complexity		X	X	
• Self-Direction		X	X	X*
• Curiosity	X	X		
• Creativity			X*	X
• Risk Taking	X	X	X	X*
• Higher-Order Thinking and Sound Reasoning		X*	X	
Effective Communication				
• Teaming and Collaboration	X	X	X*	
• Interpersonal Skills	X	X	X	
• Personal Responsibility				X
• Social and Civic Responsibility	X	X		
• Interactive Communication	X*	X	X	X
High Productivity				
• Prioritizing, Planning, and Managing for Results		X*	X	X
• Effective Use of Real-World Tools		X	X	X*
• Ability to Produce Relevant, High-Quality Products			X*	

**Indicates a primary 21st century skill addressed by this project.*

As you peruse the classroom stories, note how naturally these teachers have incorporated the 21st century skills into their student learning activities.

Kristi Rennebohm Franz's Primary Classroom

Printed with permission from Dr. Rennebohm Franz, Sunnyside Elementary, Pullman, WA

Level: Primary, Grades 1–2

Content Areas: Reading, Writing, and Social Studies

Article: (*enGauge*)

Web site: www.psd267.wednet.edu/~kfranz/index.htm

When Jane McLane first mentioned her upcoming sabbatical to bicycle around the world to Kristi Rennebohm Franz, a fellow teacher at Sunnyside Elementary in Pullman, Washington, she never dreamed she'd end up with 25 virtual companions. But somehow she did—Kristi's first and second graders! By carrying a digital camera and a small computer, Jane was able to communicate on a daily basis with Kristi and her students. Along the way, Kristi's students leaned to write, read, and communicate as they interacted with Jane about world languages, cultures, geography, art, time zones, and architecture.

The 6- and 7-year-olds in Kristi's class are energized by these kinds of learning activities. While technology takes up only a minor part of their day, it adds tremendous value to their learning. Kristi is a master teacher and a technology risk-taker. She likes—and builds upon—her children's energy levels, suggesting that "the tempo learning at this age matches the current tempo of technology." She respects her children's ingenuity, intelligence, and curiosity, and uses technology in ways that extend and enrich their learning.

In 1993, she started using the Internet by reading and writing simple text e-mail messages with local to global I*EARN students and teachers. Today, she and her students have added Web site publishing, videotape production, and live video conferencing—all focused on exploring curricular topics. Kristi discovered early in this journey that by having children share their classroom curricular experiences through local to global telecommunications, their learning took on energy and inquiry beyond what she had ever imagined. The classroom became a place of "turbocharged" teaching and learning due to being connected to the real-world experiences of others who shared a passion for learning.

Using e-mail, Web sites, video, and video conferencing, Kristi's students learn to write, read, and communicate with global peers about water habitats, world languages, culture, art, and much more. The kids not only build critical thinking and problems solving skills, they build friendships as well. Their interaction allows them to identify and share their cultures with one another in ways that both affirm commonalties and uncover a world of diversity, giving them positive opportunities to comprehend the world in new ways. They use new technologies as tools for knowing themselves in the process of knowing and understanding others.

The immediacy of e-mail and Web site publishing enables Kristi's students to gain a cognitive hold on the connection between the ideas they send and the ideas embedded in other students' replies. Learning to read and write in this social context enables them to share what they think and know with global peers, just as it provides the essential ingredients for developing literacy skills. These students write for a purpose and with the expectation of learning more through collaborative communication.

The simultaneous use of text and digital images in both e-mail and Web site publishing provide powerful, developmentally appropriate realms for building technology, visual, and information literacies. Videoconferencing uses real-world tools to bring students face to face with distant peers, building multicultural literacy and global awareness, and promoting a vision for taking positive action with what they learn from one another.

WISE: Web-based Integrated Science Environment

Printed with permission from the College of Education, University of California, Berkeley.

Level: Grades 4–12

Content Areas: Science, Mathematics, and Social Sciences

Web site: http://wise.berkeley.edu

The Web-based Inquiry Science Environment (WISE) is a free, online, project-based learning environment supported by the National Science Foundation for students in Grades 4–12. In WISE, students work collaboratively on real-world topics like malaria, genetically modified foods, earthquakes, water quality, and the mystery of deformed frogs. They learn about and respond in socially responsible ways to contemporary scientific controversies through designing, debating, and critiquing solutions using "evidence" Web pages that promote information literacy, as well as other real-world tools that support data visualization, causal modeling, simulations, online discussions, and assessment.

In the real world, problem solving requires specific skills: collaboration, risk-taking, the ability to manage complexity when evaluating conflicting evidence, using data to back up a point of view, prioritizing, planning, and managing for results. WISE software includes a large—and growing—suite of special features that help develop exactly these skills.

Additional offline activities, such as experiments or class debates, also play an integral role. In the Plants in Space Project, for example, students (Grades 4–8) construct a small hydroponic garden in their classroom, analyze factors responsible for plant growth (e.g., light, water, and soil), compare earth plants and Wisconsin Fast Plants (referred to as "NASA space plants"), and analyze what factors are important for plant growth in a space station environment. The Plants in Space Project was designed by a partnership that included NASA scientists, research biologists, teachers, educational researchers, and technology specialists. Web-based materials bring the space station to life and raise questions relevant to students (e.g., Can we grow plants with no dirt whatsoever?).

WISE projects are centered on the following four key goals, all aimed at developing scientific literacy:

1. **Making Science Accessible:** Science is made accessible when students are given opportunities to explore a personally relevant problem and investigate their own ideas about it (e.g., "Do plants eat dirt?"). Effective instruction provides opportunities for students to evaluate scientific evidence according to their own personal understanding, to articulate their own theories and explanations, and participate actively in science learning.

2. **Making Thinking Visible:** To help students connect science instruction to their own understanding, their thinking needs to be made visible. The Plants in Space project, for example, includes online graphing so students can represent plant growth.

3. **Learning from Each Other:** Science learning is rarely performed in isolation from one's peers; rather, peer exchange is often vital to learning. This is true of real-world scientists and should also be true of classroom learning. WISE technology is designed to capitalize on the social nature of learning. Students work in pairs, and activities often call upon students to explain evidence to one another. Finally, online communities have been developed to link to additional resources, peers, and mentors in the field.

4. **Promoting Autonomy:** Science instruction should prepare students for self-directed, lifelong learning. To do this, WISE presents students with accessible, independent activities that require sustained reasoning. WISE activities like critique, comparison, and design are chosen because they will be important to students throughout their lives.

Geometry in the Real World

Printed with permission from the George Lucas Educational Foundation.

Level: Grades 9–12

Content Areas: Mathematics, Science, and Social Sciences

Article: George Lucas Foundation: http://www.glef.org/EdutopiaPDF/Fall01.pdf (pp. 10-11).

Each spring at Mountlake Terrace High School in Washington, Eeva Reeder presents her geometry students with both a challenge and an opportunity: Become members of two- to four-person architectural teams from the year 2050, competing for a contract to design a state-of-the-art high school. The designs must meet the learning needs of students in the year 2050, must accommodate 2,000 students, and must make use of the natural benefits of the given site, preserving at least half of its existing wetland. One team will be awarded the contract based upon presentations of the designs to a panel of professional architects.

Over a frenzied—and exciting—six-week period, the teams research architectural design elements on the Web and through interactions with professionals in the field. They then develop site plans (using CAD), scale models, floor plans, perspective drawings, cost estimates, and written proposals that model those of existing companies—all while making use of mathematical and technological concepts. They maintain design files of all their working drawings, notes, and group contracts, such as the Team Operating Agreement (adapted from a similar form at the Boeing Company), in which team members come to consensus on items such as expectations of themselves and each other, how decisions will be made, how misunderstandings will be prevented, and how conflicts will be resolved.

Eeva Reeder is passionate about the importance of this sort of hands-on, real-life application of abstract mathematical concepts, as well as the value of working as a team to produce relevant, high-quality products. "The ability to work collaboratively is a learned skill," she says. "Students need repeated opportunities to practice it within a complex, high-stakes context—similar to the one they'll encounter in the workplace and in the world."

For students, she continues, having an audience other than the teacher is a powerful motivator to produce work of the highest possible quality. Students seem to care more about their work and take it upon themselves to revise and edit it in ways they rarely do for traditional classroom assignments. The external audience also enables them to celebrate and value learning in ways that a single grade from a teacher cannot.

This problem-solving process provides students with plenty of opportunity for learning and improving life skills. Beyond teaming and collaboration, this includes interactive communication, self-direction, sound reasoning, the ability to manage complexity, and using real-world tools to develop high-quality products. Learning like this blurs the distinction between schoolwork and life outside the classroom, blending academic rigor with real-life relevance.

Assessments of the projects are also grounded in real life. During the project's initial phase, students are given a scoring rubric by which their work will be measured; each project artifact is evaluated on quality and accuracy, clarity and presentation, and concept. Teamwork (participation, level of involvement, and quality of work as a team member) is assessed during the course of the project and at the end.

When their designs are complete, the teams present to a panel of architects, who also formally assess the work. Students and professionals discuss the evaluations during a follow-up field trip to the architects' offices. They work together to identify the projects' strengths based on concept, site planning, educational vision, technology use, environmental impact, and teamwork during the presentation. Finally, students have the opportunity to ask specific questions of these field-based professionals, often developing lasting and interactive relationships with them. In some cases, the architects have even incorporated student ideas into their own school designs!

Electric Soup

Printed with permission from Electric Soup, National Edition Project: Grant supported by SchoolCity.com

Level: Grades 7–12

Content Areas: English Language Arts and Visual Arts

Article: *Education Week:* www.edweek.org/sreports/tc99/articles/t-profile.htm

Web site: http://homer.hcrhs.k12.nj.us/esoup/

In Florence McGinn's 11th and 12th grade Imaginative Process class at Hunterdon Central Regional High School (HCRHS) in New Jersey, students reflect on artistic creativity through literary classics like *Oedipus Rex* and the stories of Henry James.

But it's the students' own creative projects—visual imagery, poems, and "free writes"—that really make the course resonate. In fact, these projects almost never stop at the classroom door; students add their best work to class Web sites, electronic portfolios, and the Web-based *Electric Soup*, a highly acclaimed, student-run literary magazine now receiving international offers of peer-level partnerships. "Fascination is the key," the Chinese-American high school teacher says of her teaching philosophy. "You can establish the wonder, and once you do that, everything else follows." In addition, giving students the tools to create and publish their work, said McGinn in an interview with *Education Week*, "intensifies the learning process. Learning is not isolated—and that's very important to me."

> ***When you go to sleep, your subconscious enters the wild world of Dreamland. What the dreamer sees at night can be put into words. So why not turn your dream into a poem? Or a story?***
>
> *(From Dreams, on the Electric Soup Web site)*

Just as important is exploring technology to enhance that learning. For that reason, *Electric Soup* is multifaceted. On one part of the site, students practice literary skills of observation and description by digitizing pictures of themselves, writing stories and poems based on interviews with family members, and creating multimedia collages about their childhoods. In another, Microsoft® PowerPoint®, Multimedia® Flash®, and other software applications are used to maximum effect by student writers to create artistic images representing their emotions. *Virtual Art* explores a world of creative possibility that arises when students combine technology with artistic imagery in the 21st century, while in *Interviews*, students interact with accomplished professionals from an exciting range of fields, gaining insight into the lesser-known aspects of the world of work. *Young Writers* invites elementary and middle school students to experience seeing their names in print, at the same time giving high school editors the chance to practice and refine valuable, real-world skills while collaborating across time and distance.

Electric Soup and Florence McGinn's award-winning educational concepts have been part of presentations and demonstrations for groups as diverse as PBS, the Smithsonian Institute, China's President Jiang Zemin, Disney's Celebration Team, the New Jersey Commission on Holocaust Education, and many others in the United States and abroad. There's even a new National Edition—a collaboration between HCRHS and SchoolCity.com that redefines the original material into thematic editions in an interpretative, student-designed Web format. The National Edition is selected, collated, and designed by student editors from Hunterdon Central.

Getting There From Here

After reading this publication, it will seem obvious that schools need to embrace 21st century skills. Yet the very nature of institutions such as schools is to maintain the status quo. Don't be surprised when others don't immediately see the urgency of incorporating the new thinking reflected here.

Consider using the process on the following page as a way to bring 21st century skills into your school. As you do:

Don't expect teachers to make individual decisions to incorporate 21st century skills into their classrooms until the school district has made a formal commitment to doing so!

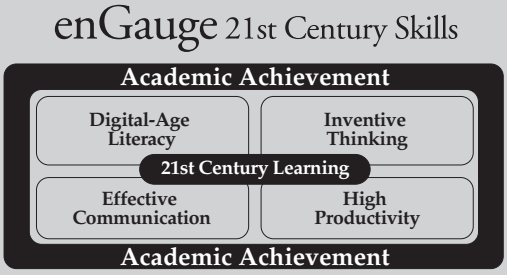
- **Stay Focused:** Remember, the goal is to ensure that our students are able to thrive in the Digital Age. Getting there from here will take commitment, perseverance, hard work, and careful analysis of whether your strategies and tactics are contributing to that goal.
- **Take on Something Doable:** Don't try to implement all of the 21st century skills at once. Bring them into the mainstream of standards-based learning and academic achievement, cluster-by-cluster, skill-by-skill. Identify a couple of skills that you know will resonate with your school and community. Build from there.
- **Build Bridges:** Advocate the use of common sense, logic, statistics, insights from the business community, humor, and other tactics to create a sense of urgency for your 21st century skills. In this age of high-stakes assessment, it will be necessary to build a bridge between the 21st century skills and the high academic achievement that is first and foremost in teachers' and administrators' minds. Do your homework. Build a strong bridge—convince others that the 21st century skills can add to students' viability in this knowledge-based, global society.
- **Honor and Extend Existing Work:** Chances are some, if not all, of the 21st century skills are being at least partially addressed by innovative teachers in your school or community. Build on that work by helping those educators to be more explicit and purposeful in addressing such skills, adding missing components such as assessments. Where the 21st century skills are not being addressed, help teachers to build them—along with effective uses of technology—into existing lessons. Go slowly—appeal to teachers' natural inclination to do what is right for students.
- **Make Decisions at the System Level:** Don't expect teachers to make individual decisions to incorporate 21st century skills into their classrooms until the school district has made a formal commitment to doing so. In this high-stakes testing environment, it is just too risky for individual teachers to dedicate instructional time to ideas not yet sanctioned by the school system. Commit to the concept at the system level; collaboratively build and align curriculum, instruction, and assessment to the 21st century skills; and create a culture of openness, support, and reward work toward that innovation.

Bring 21st century skills into the mainstream of standards-based learning and academic achievement.

A Process for Bringing 21st Century Skills Into Your Schools

1. Learn

Investigate the rationale and history behind the 21st century skills. Research, reflect, discuss, debate, and argue. Why are these skills important? Who says so? What would happen if we did nothing? What's the fit with standards-based reform and high-stakes testing? How do I communicate this?



2. Advocate

Set a goal worth striving for.
Engage the leadership team. Create a sense of urgency and understanding about key 21st century skills. Be unified and clear on what skills are worth going after and why. Identify and focus on skills that matter to your community—skills that will advance learning goals and your school district's vision.

3. Focus

Find the fit for your schools.
Engage your community, teachers, parents, and business leaders. Facilitate discussions and consider viewpoints, but only after everyone understands what the skills are and what it looks like when kids master them. Highlight the pioneering work already taking place, and link 21st century skills to that important work. Prototype new ideas.

Make the commitment.
Based on research, discussions, and feedback, make a formal decision to invest resources, time, and money into achieving the goal of getting students ready to thrive in the Digital Age. Identify and commit to a specific set of 21st century skills.

4. Activate

Try things!
Simultaneously seed classroom pilots and districtwide, content-specific research. Collect stories and artifacts of successful practices. Keep everyone informed. Publish findings, using them to drive change and develop "solutions that work."

Make necessary system changes.
At the district level, formally align curricula, instruction, and assessment in content areas based on your findings. Make changes in policy and practice.

Get everyone ready.
Build ongoing professional development, resources acquisition, curriculum development, and leadership around research and best practices for each of the target skills. Identify the key characteristics of successful practice and keep it simple!

5. Impact

Implement with integrity.
Thoughtful staging should smooth the way for effective implementation! Establish a support system to ensure that schools have what they need to be successful. Continue the professional development, formative assessment, and continuous evolution of curriculum, instruction, and assessment necessary to help ensure that students will be ready to thrive in the Digital Age.

Cross-Match to National Models

National Educational Technology Standards (NETS) for Students (2000)

By the International Society for Technology in Education (ISTE): **cnets.iste.org/students/s_book.html.**

First released in 1998 after five years of development and extensive input from educators across the nation, the National Educational Technology Standards for Students (NETS) are the de facto standard for most schools today. ISTE has since built extensive curriculum guides and teacher standards based on these standards.

Compared to *enGauge* 21st Century Skills, the ISTE standards do not specifically address Visual Literacy, Global Awareness, Adaptability/Managing Complexity, Curiosity, or Risk-Taking.

ISTE NETS	*enGauge* 21st Century Skills
1. Basic Operations and Concepts	
• Students demonstrate a sound understanding of the nature and operation of technology systems.	• Technological Literacy
• Students are proficient in the use of technology.	• Technological Literacy
2. Social, Ethical, and Human Issues	
• Students understand the ethical, cultural, and societal issues related to technology.	• Multicultural Literacy • Social and Civic Responsibility
• Students practice responsible use of technology systems, information, and software.	• Personal Responsibility • Social and Civic Responsibility
• Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.	• Teaming and Collaboration • Effective Use of Real-World Tools
3. Technology Productivity Tools	
• Students use technology tools to enhance learning, increase productivity, and promote creativity.	• Information Literacy • Creativity
• Students use productivity tools to collaborate in constructing technology-enhanced models, preparing publications, and producing other creative works.	• Relevant, High-Quality Products • Prioritizing, Planning, and Managing for Results • Teaming and Collaboration
4. Technology Communications Tools	
• Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.	• Interactive Communications
• Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.	• Information Literacy • Interactive Communication
5. Technology Research Tools	
• Students use technology to locate, evaluate, and collect information from a variety of sources.	• Information Literacy • Economic Literacy
• Students use technology tools to process data and report results.	• Scientific Literacy • Information Literacy • Economic Literacy
• Students evaluate and select new information resources and technological innovations based on the appropriateness to specific tasks.	• Information Literacy • Effective Use of Real-World Tools
6. Technology Problem-Solving and Decision-Making Tools	
• Students use technology resources for solving problems and making informed decisions.	• Higher-Order Thinking and Sound Reasoning
• Students employ technology in the development of strategies for solving problems in the real world.	• Economic Literacy • Higher-Order Thinking and Sound Reasoning • Effective Use of Real-World Tools

International Society for Technology in Education. (2000). *National educational technology standards for students: Connecting curriculum and technology*. Eugene, OR: Author.

What Work Requires of Schools (1991)

By the U.S. Department of Labor: **http://wdr.doleta.gov/SCANS/whatwork/whatwork.html.**

In 1991 the Secretary's Commission on Achieving Necessary Skills (SCANS) published skills that were required to enter the workplace successfully. SCANS identified workplace know-how that defined effective job performance. The list had two elements: five competencies and a three-part foundation of skills and personal qualities.

Compared to *enGauge* 21st Century Skills, the SCANS proficiencies do not explicitly address Multicultural Literacy, Global Awareness, aspects of Interactive Communication and Visual Literacy, or High-Quality Results.

SCANS		*enGauge* 21st Century Skills
Five Competencies		
• Resources: Identifies, organizes, plans and allocates resources	A. Time B. Money C. Material and Facilities D. Human Resources	• Adaptability/Managing Complexity • Economic Literacy
• Interpersonal: Works with others	A. Participates as Member of a Team B. Teaches Others New Skills C. Serves Clients/Customers D. Exercises Leadership E. Negotiates F. Works with Diversity	• Teaming and Collaboration • Self-Direction • Multicultural Literacy
• Information: Acquires and uses information	A. Acquires and Evaluates Information B. Organizes and Maintains Information C. Interprets and Communicates Information D. Uses Computers to Process Information	• Information Literacy • Economic Literacy • Interactive Communication
• Systems: Understands complex inter-relationships	A. Understands Systems B. Monitors and Corrects Performance C. Improves or Designs Systems	• Scientific Literacy • Economic Literacy • Adaptability/Managing Complexity • Prioritizing, Planning, and Managing for Results
• Technology: Works with a variety of technologies	A. Selects Technology B. Applies Technology to Task C. Maintains and Troubleshoots Equipment	• Effective Use of Real-World Tools • Technological Literacy
A Three-Part Foundation		
• Basics Skills: Reads, writes, performs arithmetic and mathematical operations, listens, and speaks	A. Reading B. Writing C. Arithmetic/Mathematics D. Listening E. Speaking	• Basic Literacy • Scientific Literacy
• Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn, and reasons	A. Creative Thinking B. Decision Making C. Problem Solving D. Seeing Things in the Mind's Eye E. Knowing How to Learn F. Reasoning	• Higher-Order Thinking and Sound Reasoning • Visual Literacy • Curiosity • Creativity
• Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty	A. Responsibility B. Self-Esteem C. Sociability D. Self-Management E. Integrity/Honesty	• Teaming and Collaboration • Self-Direction • Personal Responsibility • Social and Civic Responsibility

Secretary's Commission on Achieving Necessary Skills. (1991). *What work requires of schools: A SCANS report for America: 2000*. Washington, DC: U.S. Department of Labor.

Information Literacy Standards for Student Learning (1998)

By the American Association of School Librarians and the Association for Educational Communications and Technology: **www.ala.org/aasl/ip_nine.html**

The Information Literacy Standards were developed as a foundation upon which to base lifelong learning. Prepared by the American Association of School Librarians (AASL) and the Association for Educational Communications and Technology (AECT), they have been widely promoted by the American Library Association. The nine standards fall into three categories: information literacy, independent learning, and social responsibility.

Compared to the *enGauge* 21st Century Skills, the AASL and AECT standards address student skills from the perspective of a library media specialist. The *enGauge* 21st Century Skills are broader in scope, including such areas as Scientific Literacy, Visual Literacy, Multicultural Literacy, Global Awareness, Interactive Communication, Risk-Taking, and High-Quality Results.

Information Literacy Standards	*enGauge* 21st Century Skills
Information Literacy	
• Standard 1: The student who is information literate accesses information efficiently and effectively.	• Basic and Information Literacy
• Standard 2: The student who is information literate evaluates information critically and competently.	• Information Literacy • Economic Literacy • Higher-Order Thinking and Sound Reasoning
• Standard 3: The student who is information literate uses information accurately and creatively.	• Information Literacy • Creativity • Effective Use of Real-World Tools
Independent Learning	
• Standard 4: The student who is an independent learner is information literate and pursues information related to personal interests.	• Information Literacy • Self-Direction • Curiosity
• Standard 5: The student who is an independent learner is information literate and appreciates literature and other creative expressions of information.	• Visual Literacy • Information Literacy
• Standard 6: The student who is an independent learner is information literate and strives for excellence in information seeking and knowledge generation.	• Information Literacy • Effective Use of Real-World Tools • Relevant, High-Quality Products
Social Responsibility	
• Standard 7: The student who contributes positively to the learning community and to society is information literate and recognizes the importance of information to a democratic society.	• Social and Civic Responsibility • Technological Literacy • Economic Literacy
• Standard 8: The student who contributes positively to the learning community and to society is information literate and practices ethical behavior in regard to information and information technology.	• Information Literacy • Personal Responsibility • Social and Civic Responsibility • Technological Literacy
• Standard 9: The student who contributes positively to the learning community and to society is information literate and participates effectively in groups to pursue and generate information.	• Information Literacy • Teaming and Collaboration • Social and Civic Responsibility • Prioritizing, Planning, and Managing for Results

American Association of School Librarians & Association for Educational Communications and Technology. (1998). *Information literacy standards for student learning*. Chicago: American Library Association.

Technically Speaking: Why All Americans Need to Know More About Technology (2002)

By the National Academy of Engineering (NAE) and the National Research Council (NRC): **www.nap.edu/books/0309082625/html/.**

This Committee for Technological Literacy was charged with developing a vision for technological literacy in the United States and recommending ways to achieve that vision. The project was funded by the National Science Foundation (NSF) and the Battelle Memorial Institute.

Compared to *enGauge* 21st Century Skills, the focus for this committee's work is on Technological Literacy, just one of the skills included in the *enGauge* 21st Century Skill set. Nevertheless, the following match can be made:

Technically Speaking	***enGauge* 21st Century Skills**
Characteristics of a Technologically Literate Citizen	
Knowledge	
• Recognizes the pervasive presence of technology in everyday life.	• Technological Literacy
• Understands basic engineering concepts and terms, such as systems, constraints, and trade-offs.	• Scientific Literacy
• Is familiar with the nature and limitations of the engineering design process	• Scientific Literacy
• Knows some of the ways technology shapes human history and people shape technology	• Multicultural Literacy
• Knows that all technologies entail risk, some that can be anticipated and some that cannot.	• Prioritizing, Planning, and Managing for Results
• Appreciates that the development and use of technology involving trade-offs and a balance of costs and benefits.	• Economic Literacy • Prioritizing, Planning, and Managing for Results
• Understands that technology reflects the values and culture of society.	• Multicultural Literacy
Ways of Thinking and Acting	
• Asks pertinent questions, of self and others, regarding the benefits and risks of technology.	• Self-Direction • Technological Literacy • Economic Literacy
• Seeks information about new technologies.	• Curiosity • Technological Literacy
• Participates, when appropriate, in decisions about the development and use of technology.	• Social and Civic Responsibility
Capabilities	
• Has a range of hands-on skills, such as using a computer for word processing and surfing the Internet and operating a variety of home and office appliances.	• Technological Literacy
• Can identify and fix simple mechanical or technological problems at home or work.	• Technological Literacy
• Can apply basic mathematical concepts related to probability, scale, and estimation to make informed judgments about technological risks and benefits.	• Scientific Literacy

National Academy of Engineering: Committee on Technological Literacy. (2002). *Technically speaking: Why all Americans need to know more about technology*. Washington, DC: National Academy Press.

Standards for Technological Literacy (2000)

By the International Technology Education Association (ITEA): **www.iteawww.org/TAA/PDFs/xstnd.pdf.**

These standards were developed by the Technology for All Americans Project to promote the study of technology and technological literacy. Compared to the *enGauge* 21st Century Skills, these skills focus on classes specializing in the study of technology as a topic. Nevertheless, the following match can be made:

Technological Literacy	*enGauge* 21st Century Skills
The Nature of Technology	
• Standard 1: Students will develop an understanding of the characteristics and scope of technology.	• Technological Literacy • Scientific Literacy
• Standard 2: Students will develop an understanding of the core concepts of technology.	
• Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.	
Technology and Society	
• Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.	• Multicultural Literacy • Technological Literacy • Economic Literacy
• Standard 5: Students will develop an understanding of the effects of technology on the environment.	• Scientific Literacy • Social and Civic Responsibility
• Standard 6: Students will develop an understanding of the role of society in the development and use of technology.	• Technological Literacy • Social and Civic Responsibility
• Standard 7: Students will develop an understanding of the influence of technology on history.	• Technological Literacy
Design	
• Standard 8: Students will develop an understanding of the attributes of design.	• Relevant, High-Quality Products
• Standard 9: Students will develop an understanding of engineering design.	• Scientific Literacy
• Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.	• Higher-Order Thinking and Sound Reasoning • Creativity
Abilities for a Technological World	
• Standard 11: Students will develop abilities to apply the design process.	• Effective Use of Real-World Tools
• Standard 12: Students will develop abilities to use and maintain technological products and systems.	• Technological Literacy
• Standard 13: Students will develop abilities to assess the impact of products and systems.	• Relevant, High-Quality Products
The Designed World	
• Standard 14: Students will develop an understanding of and be able to select and use medical technologies.	• Technological Literacy • Effective Use of Real-World Tools • Scientific Literacy • Economic Literacy • Interactive Communication • Social and Civic Responsibility
• Standard 15: Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.	
• Standard 16: Students will develop an understanding of and be able to select and use energy and power technologies.	
• Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.	
• Standard 18: Students will develop an understanding of and be able to select and use transportation technologies.	
• Standard 19: Students will develop an understanding of and be able to select and use manufacturing technologies.	
• Standard 20: Students will develop an understanding of and be able to select and use construction technologies.	

International Technology Education Association (2000). *Standards for technological literacy: Content for the study of technology*. Reston, VA: Author. Available at: **www.iteawww.org/TAA/PDFs/xstnd.pdf.**

	NETS ISTE	What Work Requires SCANS	Information Literacy AASL and AECT	Technically Speaking NAE/NRC	Technological Literacy ITEA
Digital-Age Literacy					
• Basic Literacy		X	X		
• Scientific Literacy		X		X	X
• Technological Literacy	X	X	X	X	X
• Economic Literacy	X	X	X	X	X
• Visual Literacy		X	X		
• Information Literacy	X	X	X		
• Multicultural Literacy	X	X		X	X
• Global Awareness					
Inventive Thinking					
• Adaptability and Managing Complexity		X			
• Self-Direction		X	X	X	
• Curiosity		X		X	
• Creativity	X	X	X		X
• Risk Taking					
• Higher-Order Thinking and Sound Reasoning	X	X	X		X
Effective Communication					
• Teaming and Collaboration	X	X	X		
• Interpersonal Skills		X			
• Personal Responsibility	X	X	X		
• Social and Civic Responsibility	X	X	X	X	
• Interactive Communication	X	X			X
High Productivity					
• Prioritizing, Planning, and Managing for Results	X	X	X	X	
• Effective Use of Real-World Tools	X	X	X	X	
• Ability to Produce Relevant, High-Quality Products	X		X		X

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Notes: