**The Intellectual and Policy Foundations
of the
21st Century Skills Framework**

INTRODUCTION

"What we resolve to do in school only makes sense when considered in the broader context of what the society intends to accomplish through its educational investment in the young."
-- Jerome S. Bruner, *The Culture of Education*

In 2007 the Partnership for 21st Century Skills released an updated version of its 21st Century framework which encapsulates the outcomes and support systems needed to prepare students for 21st century life. While the framework's primary focus is forward-looking in identifying the learning needs of the future, it may be less apparent that the framework is bolstered by time-honored learning practice and theory, as well as more recent research on the modern workplace. By tracing the interplay between societal demand and educational response, as well as the implications of advances in learning science and learning technology, this white paper aims to make visible the theory, research and policy antecedents that support the 21st Century Skills Framework.

EDUCATION AND SOCIETY
How do society's needs affect learning?

Agrarian to Industrial Age Education

Throughout human history, education has been shaped by the societal needs of the societies in which it is set. Education, after all, is the attempt to convey from one generation to the next the skills, values, and knowledge that are needed for successful life. For most of humanity's history, and for most of humanity, life took place in a slow-changing agrarian world where few ventured beyond their immediate community and even fewer moved beyond their social class. Education was largely a matter of observing and participating in the work of one's parents, or apprenticing to a local craftsperson. Literacy, for most people, meant the ability to sign one's name or do simple calculations. Any "higher" education was reserved for the elite to prepare them for service in religious vocations or state bureaucracies, the only institutions where literacy much mattered.

The development of the printing press in Europe in the last years of the 15th century was one of the earliest harbingers of the coming industrial age. By vastly increasing the amount of available reading material, printing promoted the growth of literacy, and made possible new forms of societal and economic participation within a growing middle class. But it was not until the industrial revolution in the 18th and 19th centuries that real acceleration of literacy rates occurred in the Western world. Commerce and trade flourished, aided by new forms of transportation and communication. Factories and trading companies, shipping firms and railroads were all dependent on managers who could read and write and calculate.

The United States emerged from its origins as an agrarian British colony into the dawning Industrial Age. Set in this hinge of history, Americans saw in education the means of creating a new society, one in which individual achievement trumped stratified social distinctions and historical privilege. Imbued with Enlightenment ideals, the new country placed its faith in public education, believing that only an educated citizenry could uphold individual freedoms and resist demagoguery. Thomas Jefferson wrote that of all possible reasons for promoting education, "none is more important, none more legitimate, than that of rendering the people safe as they are the ultimate guardians of their own liberty."[1]

Just 100 years later, the United States was on the cusp of becoming the world's largest industrial power. Immigrants flocked to its shores in one of history's greatest population shifts. As the population rapidly expanded, the country's school systems were under intense pressure to develop efficient ways of managing the needs of these new citizens, many of which went beyond the usual academic mission.[2] Not surprisingly, given its success, many school officials looked to industry for models. Elwood P. Cubberly, an influential educator, called for schools to be "factories in which the new materials (children) are to be shaped and fashioned into products to meet the various demands of life."[3]

 John Dewey, perhaps the best-known educator of the 20th century, also responded to the transformations around him. "It is radical conditions which have changed," he wrote, "and only a radical change in education suffices… Knowledge is no longer an immobile solid; it has been liquefied."[4] Unlike

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[1] Thomas Jefferson: Notes on Virginia Q.XIV, 1782. ME 2:206.
http://etext.virginia.edu/jefferson/quotations/jeff1370.htm
[2] Much of the discussion of American educational policy that follows is based on David Tyack and Larry Cuban's now-classic work on the history of American school reform, *Tinkering Toward Utopia: A Century of Public School Reform. (1995)* Cambridge, MA: Harvard University Press.
[3] As quoted in Tyack, D. & Cuban, L. (1995).
[4] Dewey, J. (1980). *The School and Society.* Carbondale, IL: Southern Illinois University Press.

Cubberly, though, Dewey believed the aim of 20th century education was not the production of a labor force, but the enrichment of the individual and society by developing a child's "social power and insight."[5] Dewey advocated learning by doing, and a curriculum that involved the mind, hands, and heart.

Progressive era educators shared a conviction that schools needed to prepare students for a profoundly changed American economy, society, and home life. But they differed in how best to prepare for the new age – whether to focus on core academic subjects or on real-world knowledge and skills, and whether to focus attention on the individual child or on maximizing educational production. These two views would continue to animate American educational policy throughout the rest of the century.

Information Age to the 21st Century Education

The world-wide Depression brought an end to Progressive Era optimism, and with the coming of the Second World War, world attention was fixed on other matters than education. While post-war advances brought unprecedented material comfort to the masses, Americans experienced a new vulnerability in science and technology as a result of the Cold War and the Sputnik crisis. And so the pendulum swung back to a "no-frills" curriculum to prepare children for life in an unstable and contentious world. In the '60s and early '70s, as the U.S. economy soared, educational aims moved yet again from issues of political and economic survival to issues of access and equity. The civil rights and women's movements brought formerly marginalized groups into the educational mainstream, and educational goals once again emphasized real world relevance.

The tide again turned with the oil shocks of the mid '70s and the economic downturns of the '80s. Throughout the world, rising global trade, multinational competition, and geopolitical conflicts created new stresses and strains on national economies. In the U.S., a bipartisan panel of policy makers and business leaders convened to reassess the nation's education system. Their report, *A Nation at Risk*,[6] indulging in some hyperbole, declared the nation's schools so mediocre as to endanger the country's future economic health. In hindsight, it was fortunate the report's dire predictions fell short. But its call for a greater emphasis on metrics, higher standards of excellence, and global competitiveness established accountability as the dominant trend of the American educational agenda, a trend which has continued to this day.

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[5] Dewey, J. (1980).

[6] National Commission on Excellence in Education. (1983). *A Nation at Risk.*

In the 1990s, as a result of the advent of the personal computer and the Internet, virtually every sector of the world economy experienced both profound dislocations and unprecedented opportunities. The fall of the Iron Curtain and the rise of capitalism in China dramatically altered the global workforce, while creating new markets and new trade partners. When these new labor sources were combined with high-speed communications technologies, suddenly many kinds of work could be done round the clock, offsite, or in low wage areas. The era of outsourcing and offshoring had arrived. In response to these economic shifts, in 1991 the U.S. Secretary of Labor convened a blue-ribbon commission of experts and charged it with two tasks: 1) to determine the workplace skills that would be needed in the coming 21st century and 2) to evaluate how well American schools were equipping students with these skills. The Secretary's Commission on Achieving Necessary Skills (SCANS) found that "Despite sincere, well-intentioned efforts to respond, the schools – lacking clear and consistent guidance – continue with the system and methodologies they inherited from a system designed nearly 100 years ago for the needs of business organizations that are now quite different."[7] The industrial model of schooling, a model of progress a century earlier, had now outlived its usefulness.

EDUCATIONAL IMPLICATIONS OF LEARNING SCIENCE
What do we know about human learning?

We've seen that education is profoundly affected by larger society transformations. In this last century, education has also been shaped by our growing understanding of how people learn. The pioneering work of the Russian scientist, Lev Vygotsky, in the 1920s, demonstrated the importance of the social environment to the learning process.[8] Jean Piaget, the Swiss psychologist, showed that cognitive development in children proceeded in a predictable sequence of steps.[9] His work revealed that we learn not so much by acquiring content from outside our minds, but rather by constructing it from within. This theory of learning, known as *constructivism*, had profound implications for the way instruction should be organized. Building from Piaget's work, Bloom formulated his now-famous taxonomy,[10] in which cognitive skills are ordered hierarchically – proceeding from knowledge, comprehension, and application to analysis, synthesis, and evaluation. While

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[7] The Secretary's Commission on Achieving Necessary Skills, U.S. Department of Labor (June 1991). *What Work Requires of Schools: A SCANS Report for America 2000.*

[8] Vygotsky, L. (1978). *Mind in Society: Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.

[9] Piaget, J. (1928). *The Child's Conception of the World.* London: Routledge and Kegan Paul.

[10] Bloom, B.S. (Ed.) *Taxonomy of Educational Objectives: The Classification of Educational Goals.* Susan Fauer Company, Inc. 1956.

traditional education tends to emphasize the lower-order objectives, Bloom's work suggests the importance of mastering the full array of cognitive skills.

These thinkers have deepened our understanding of human learning; Howard Gardner, among others, has expanded it.[11] While Western civilization has traditionally valued intelligence as expressed in the manipulation of abstract symbols, as in reading and mathematics, Gardner's theory invites us to recognize excellence in domains such as interpersonal, intrapersonal, spatial, musical, and kinesthetic. Recent cognitive research also suggests that intelligence is a quality that resides not just within our individual minds, but within the social collective. With the sheer amount of data today, students need help in telling the valid from the spurious, and in using their findings in appropriate and thoughtful ways. Information, as John Seeley Brown has told us, [12] has a social life. In modern life, "know-who" and "know-how" matter as much as "know-what."

Yet for all that has been learned about learning, few schools have been able to fully incorporate this research into their instructional mission. Institutional structures are highly resistant to change and implementation is fraught with difficulty, especially in a system as decentralized as that of the United States. Ideological conflicts and diverse goals further complicate reform. Much of the recent emphasis on accountability in U.S. schools can be seen as an attempt to unite the two principal strands of U.S. educational policy – a quest for both excellence *and* equity – as well as a reliance on large-scale testing to measure progress toward these two worthy aims. To provide an excellent and equitable education for every child, schools must more effectively incorporate advances in learning science into instructional practice.

EDUCATION AND LEARNING TOOLS
How does new technology affect learning?

The prevailing technologies of a particular place and time have always been intimately linked with education, because a society's tools are both the subject and the means of its learning. Today, the fact that technology pervades almost every sphere of life – from home to work to play – results in profound implications for learning, both in schools and throughout life. Students are able to connect – and create – with their peers, and with the wider world, in ways that were unfathomable just a few years ago. Learning tools – media, telecommunication, and networked technologies coupled with

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[11] Gardner, H. (1983). *Frames of Mind: The Theory of Multiple Intelligences.* New York: Basic Books.

[12] Brown, J.S. & Duguid, P. (2000). *The Social Life of Information.* Boston: Harvard Business School Press.

learning science – are rapidly evolving into a powerful support system for acquiring the skills needed for modern life.

These technologies also change our relationship with information and thus, suggest changes in educational goals. With instant access to facts, for instance, schools are able to reconceive the role of memorization, and focus more on higher order skills such as analysis, synthesis, and evaluation. Technologies also change the ways in which learning takes place. High-bandwidth networks, sophisticated simulations, and adaptive software are all creating new opportunities for collaboration and innovation in and among schools and places of work. Software that adapts to the needs of the individual learner may enable teachers to more effectively blend instruction and assessment.

Today's learning technologies give us the means to work smarter and learn more effectively. Schools, though, have not always been able to keep pace with their relentless advance. Too often new digital devices are employed without reference to new approaches to learning. Educators, researchers, and technologists need to continue to work together so that learners of all ages can fully realize the benefits of today's learning tools.

EDUCATION AND THE GLOBAL CONVERGENCE
What learning is needed for the 21st century?

These three themes – education and society, education and learning science, and education and learning tools – are all converging to form a new educational framework – one built around the acquisition of 21st century knowledge and skills.

While today's schools show the influence of industrial and information age models, the 21st century modern school must appropriately employ both individualized and large scale approaches to assessment. It must bring together rigorous content and real world relevance. It must focus on cognitive skills as well as those in affective and aesthetic domains. It must be attentive to the needs of the individual child and to society as a whole. In order to prepare students for 21st century life, we can build on educational goals that have long been a part of our global heritage. At the same time, we can reinvigorate our schools in light of new opportunities in our world, and new understandings of how people learn. By combining the wisdom of the past with the insights and technologies of today, the 21st Century Skills Framework provides schools with a pathway to ensure the promise of tomorrow.

In the sections that follow, we will look at the student outcomes we need our schools to impart, and the educational support systems that will enable them to do so. Although the Framework graphic shows these elements as discrete objects, it should be understood that core subjects, interdisciplinary themes, and other 21st century skills are highly interwoven and interdependent. As researchers Resnick and Hall have stated, "What we know now is that just as facts alone do not constitute true knowledge and thinking power, so thinking processes cannot proceed without something to think about."[13] Indeed, learning, information, and life skills have meaning only in conjunction with core subject knowledge. And core subject knowledge, in turn, is understood more deeply when approached via 21st century skills.

STUDENT OUTCOMES

"School should be less about preparation for life and more about life itself." -- John Dewey

I. CORE SUBJECTS AND INTERDISCIPLINARY THEMES

- English, reading or language arts
- Foreign languages
- Arts
- Mathematics
- Economics
- Science
- Geography
- History
- Government and Civics

The **core subjects** listed above are the keystone of the 21st century skills framework. The Partnership believes that a 21st century education must be founded on the solid ground of content knowledge. But content knowledge doesn't mean storing up a pile of facts. As noted psychologist, Jerome Bruner wrote, "We teach a subject not to produce little living libraries on that subject, but rather to get a student to think mathematically for himself, to consider matters as an historian does, to take part in the process of knowledge-getting. Knowing is a process, not a product."[14]

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[13] Resnick, L., & Hall, M. W. (1998). Learning organizations for sustainable education reform. *Daedalus: The Journal of the American Academy of Arts and Sciences*, 127(4), 89–118.

[14] Bruner, Jerome. (1966). *Toward a Theory of Instruction*. Cambridge, MA: Belknap Press.

Advances in cognitive science suggest that students master core subjects best when their instruction emphasizes depth over breadth of coverage.[15] In his latest book, Howard Gardner, the psychologist renowned for his theory of multiple intelligences, stresses the importance of "the disciplined mind," the mastery of at least one scholarly discipline, craft, or profession. Mastery at this level requires a deep understanding of and extensive time studying the fundamental concepts within a discipline.[16] Yet many of today's content standards emphasize topical coverage, rather than deep understanding of a subject. John Bransford and other noted researchers in their highly regarded review of learning science, *How People Learn*, state that trying to cover too many topics may actually prevent sustained engagement with a discipline's core ideas. – and it is that depth of engagement on which true subject mastery depends.[17]

To cite just one example, Linda Darling-Hammond, a renowned educational researcher, has found that the typical U.S. mathematics curriculum spans far more topics than those in countries that have higher levels of achievement on international tests. While Japanese students study four or five mathematics concepts intensely over a school year, American students typically are expected to master one concept a week. At that pace, true understanding never occurs, and basic topics, like fractions, get repeated year after year, frustrating both teachers and students.[18] This is not to say that that reinforcement and practice of basic skills do not matter – indeed they are essential in learning mathematics – but a better balance between repetition and motivation must be struck.

Modern life also requires students to be able to take what they've learned in school and apply it on the job, at home, in their communities, and in further studies. As John Bransford and the other members of the Committees on Developments in the Science of Learning note, "Transfer from school to the everyday environment is the ultimate purpose of school-based learning."[19] Research indicates that students are more successful at doing this when instruction explicitly emphasizes the process of transfer by using real world context.[20] "Transfer" means just that, the ability to transfer learning from one setting to another. Professional education groups have paid considerable attention to the need to teach for transfer and to incorporate real-world contexts in the curriculum. The

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[15] Bransford , J., Brown, A., & Cocking, R., eds. (2000). *How people learn: Brain, mind, experience, and school.* Washington, D.C.: National Academy Press.
[16] Gardner, H. (2006).
[17] Bransford, et al. (2000).
[18] Darling-Hammond, L. (2002). *Standards, assessments, and educational policy: In pursuit of genuine accountability.* Princeton, NJ: Educational Testing Service Policy Evaluation and Research Center.
[19] Bransford, et al, (2000).
[20] Bransford, et al (2000).

standards guidelines issued by groups such as the National Council of Teachers of Mathematics (NCTM) have reflected the importance of connecting ideas across disciplines and to students' lives. But many researchers feel classroom practice still lags behind.

One way to teach for transfer is to structure learning in the context of a project. Projects enable students to able to make immediate connections between content and application. John W. Thomas, citing years of cognitive research, states that "...learning is maximized if the context for learning resembles the real-life context in which the to-be-learned material will be used."[21] Educator Ted McCain explains why this is so: "Placing course content in the context of a real-world scenario helps a student remember specific details of a lesson because the context gives the information meaning."[22] Their comments reflect the intuitively obvious fact that we remember something better if it is personally meaningful, if we understand its relationship to things that matter to us. Thus, "teaching for transfer," that is instruction that helps students link their learning to the real world, can promote greater understanding of core subjects.

21st Century Themes

- Global Awareness
- Financial, Economic, Business and Entrepreneurial Literacy
- Civic Literacy

Back in 1899, John Dewey wrote, "Relate the school to life, and all studies are of necessity correlated."[23] Over 100 years ago, Dewey was perhaps ahead of his time in understanding the value of **interdisciplinary themes**. In the interconnected 21st century, though, we know that we must draw on multiple knowledge domains to find solutions for many of today's problems. This ability to span multiple domain boundaries is highly valued in the today's competitive workplace. Harvard Business School professor Dorothy Barton Leonard has found that people with "T-shaped skills," that is, those who speak two or more "professional languages" and can "see the world from two or more different

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[21] Thomas, J. W. (2000). *A Review of Research on Project-based Learning.* San Rafael, CA: Autodesk Foundation. Available at http://www.bobpearlman.org/BestPractices/PBL_Research.pdf
[22] McCain, T. (2005). *Teaching for Tomorrow: Teaching Content and Problem-solving Skills.* Thousand Oaks, CA: Corwin Press.
[23] Dewey, J. (1980). *The School and Society.* Carbondale, IL: Southern Illinois University Press.

perspectives" have the cognitive diversity needed to formulate innovative solutions to complex problems.[24]

The Partnership's Framework stresses interdisciplinary topics focused on four themes with special relevance to modern life: Global Awareness; Financial, Economic, Business and Entrepreneurial Literacy; Civic Literacy; and Health Literacy. These themes are not entirely new, as professional educational groups have advocated their introduction into the curriculum over recent decades to better prepare students for the demands of adult life. The Partnership believes interdisciplinary topics are best approached through the core subjects listed above, as their effectiveness, according to curriculum expert Heidi Hayes Jacobs, depends on a solid grounding in the same core disciplines that are linked by these interdisciplinary themes.[25]

Interdisciplinary work often draws on a real world context, because as we all know, real life issues don't restrict themselves to knowledge from just one subject domain. While teaching for transfer helps answer the eternal student question "Why do I need to know this?," interdisciplinary work can help students see the essential connections between bodies of knowledge, and more fluently synthesize disparate domains. Take bridge building, for instance, which involves mathematics, engineering, materials science, and aesthetics. Or putting on a play, which requires dramatic sensibility, artistic expressiveness, and deep knowledge of the text, but also logistical and marketing talents to be a commercial success. Real world problems that draw on multiple forms of expertise enable students to better able to see the relationship between subject knowledge and the world around them. According to researchers Ackerman and Perkins, interdisciplinary work can increase student motivation and, thus, enhance learning.[26] These interdisciplinary themes have practical value, too, according to Ackerman, in helping students develop the "flexible thinking" they need to be effective in their personal, civic, and, professional lives.[27]

II. LEARNING AND INNOVATION SKILLS

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[24] Leonard, D. B. (1998). *The Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation.* Boston: Harvard Business School Press.

[25] Jacobs, H.H. (Ed.) *Interdisciplinary Curriculum: Design and Implementation*. Alexandria, VA: Association for Supervision and Curriculum Development.

[26] Ackerman, D. & Perkins, D. "Integrating Thinking and Learning Skills Across the Curriculum" in Jacobs, H.H. (1989).

[27] Ackerman, D. "Criteria for Successful Curriculum Integration" in Jacobs, H.H. (1989).

"To be playful and serious at the same time is possible, and it defines the ideal mental condition."
> -- John Dewey, *How We Think*

- Critical Thinking and Problem Solving
- Creativity and Innovation
- Communication and Collaboration

We all know that learning doesn't stop when school does, but now more than ever, learning must be a lifelong pursuit. The rapidity of change, the relentless advance of technology, the diminishing half-life of knowledge, the far-reaching effects of globalization – all these factors contribute to a growing conviction that the best thing we can teach our children is how to teach themselves. The Learning and Innovation Skills section of the Framework is focused on the higher order cognitive competencies students need to be effective and self-reliant lifelong learners. By promoting the capacity to learn and grow, **learning and innovation skills** facilitate the mastery of other 21st century skills.

Critical Thinking & Problem Solving

We have long known the value of higher order thinking. Socrates, in 400 B.C., used questions to engage the critical faculties of his students. In 1910, John Dewey stated that it was the business of education to "ingrain into the individual's working habits methods of inquiry and reasoning appropriate to the various problems that present themselves."[28] Closer to our own age, the US Department of Labor's SCANS report[29] identified Thinking Skills as one of three foundational skill sets critical to workplace success. While basic reading and math skills are viewed as "an irreducible minimum," according to the SCANS authors, thinking skills are the "raw materials" that enable mastery of all the other competency domains.[30]

Economists Frank Levy and Richard Murnane[31] have described the new world of work in which the most desirable jobs – and the one least likely to be automated or outsourced – are those that require *expert thinking* and *complex communication*. Expert thinking, for these authors, comprises the skills of critical thinking and problem-solving as articulated in the Partnership's Framework and described in more detail below. (Their notion of

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[28] Dewey, J. (1997). *How We Think.* Mineola, NY: Dover Publications.
[29] US Dept of Labor (1991).
[30] US Dept of Labor (1991).
[31] Levy, F. & Murnane, R. (2004) *The New Division of Labor: How Computers Are Creating the Next Job Market.* Russell Sage Foundation. Princeton, NJ: Princeton University Press.

complex communication closely parallels the skills addressed in the Communication and Collaboration section of the 21st Century Framework which will be examined later in this paper.)

The Partnership, as most educators do, uses the term **critical thinking** to describe the capacity of active investigative thinking. Scholar Diane Halpern has come up with a useful definition "... thinking that is purposeful, reasoned, and goal directed."[32] She notes that "critical thinking also involves "evaluating the thinking process -- the reasoning that went into the conclusion we've arrived at and the kinds of factors considered in making a decision."[33] Other leading experts in the area of critical thinking stress its connection to creative thought. According to philosophers Richard Paul and Linda Elder, "...sound thinking requires both imagination and intellectual standards." [34] When we engage in high-quality thinking, we function both critically and creatively – we produce and assess, generate and judge the products of our thought.

Within these descriptions lie a number of ideas that are important to the 21st century skills framework. Critical thinking is a skill that can be taught, practiced, and mastered. It draws on other skills, such as communication and information literacy, to examine evidence, then analyze, interpret, and evaluate it. Thus, the Partnership's notion of critical thinking draws on a classic learning model, known as Bloom's taxonomy, which classifies intellectual activity into six levels of successively greater cognitive complexity: knowledge, understanding, application, analysis, synthesis, and evaluation.[35]

The link between thinking and education is obvious – one can't learn well without thinking well. Critical thinking contributes to career success – but also to success in higher education. In research conducted for the Bill and Melinda Gates Foundation, University of Oregon professor David T. Conley finds that "habits of mind" such as "analysis, interpretation, precision and accuracy, problem solving, and reasoning" can be as or more important than content knowledge in determining success in college courses.[36]

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[32] Halpern, D. (1996). *Thought and knowledge: An introduction to critical thinking.* Mahwah, NJ: Erlbaum Associates as cited in Petress, K. (2004) Critical thinking: An extended definition. *Education.* 124 (3) 461-6. Spring 2004.

[33] Halpern, D. (1996).

[34] Paul, R. & Elder, L. (2006). Critical thinking: The nature of critical and creative thought. *Journal of Developmental Education.* 30 (2) 34-5 Winter 2006.

[35] Bloom, B. S. (Ed.) (1956). *Taxonomy of Educational Objectives: The Classification of Educational Goals.* Susan Fauer Company, Inc.

[36] Conley, D. (2007). *Toward A More Comprehensive Conception of College Readiness.* Eugene, OR: Educational Policy Improvement Center.

Critical thinking is an essential skill outside the classroom, too. Today's citizens must be active critical thinkers in order to compare evidence, evaluate competing claims, and make sensible decisions.   Twenty-first century families must sift through a vast array of information regarding financial, health, civic, even leisure activities in order to formulate plausible plans of action. And workers, of course, must employ critical thinking to better serve customers, develop better products, and continuously better themselves within an ever-changing economy.

Problem solving is generally understood to be the process of applying scientific and engineering methods of defining and describing a problem, generating potential solutions, and implementing, monitoring, and evaluating the effectiveness of the selected intervention.[37] In the context of the 21st Century Framework, we might productively think of problem solving as the application of learning and innovation skills to a specific area of inquiry. Modern-day problems demand the full range of critical thinking, innovation, and creativity described above. We can no longer afford, as Daniel Pink says, to think with just half our brain.[38] We must approach today's complex boundary-spanning problems with right-brain logical and analytical skills, *and* the creative, spontaneous, and metaphorical capacities that characterize left-brain thinking.

While critical thinking and problem solving have been given considerable research attention for more than two decades, and numerous workshops, conferences, and supplemental materials have been created to support their instruction, recent classroom practice has been dominated by the emphasis on basic skills. It will be important to study the lessons to be learned from these earlier efforts as we strive for renewed emphasis on these important skills.

It's important to see problem-solving as encompassing a set of skills. To successfully solve a problem, we must first be able to formulate it as a problem – that is, understand what makes up its essential elements. Thus, critical thinking skills are key. We must also have a sense of what resources and strategies we need to solve it – this implies skills in information literacy, of being able to sort through data to extract relevant information. We must also able to effectively and efficiently apply appropriate tools and techniques to the problem – and have the persistence and tolerance for ambiguity to keep searching for a solution if our initial attempts are unsuccessful. This suggests that flexibility and self-direction are also critical to problem-solving.

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[37] Canter, A. (2004). A problem-solving model for improving student achievement. *Principal Leadership* (High School Edition) 5 (4) 11-15.
[38] Pink, D. (2007).

Finally, we need to know how to reach out to others to tap their expertise to solve the complex problems we face today.

Advances in cognitive science support the notion that problem solving has a social dimension. As Educator Thomas Hoerr has written, our very notion of intelligence has changed.[39] We no longer rely on the limits of our single mind to access the information resources we need to solve problems. Problem solving has always involved teamwork and cooperation. Today, though, open source programs, wikis, blogs and other web 2.0 technologies enable total strangers divided by space and time to collaborate. Successful problem solving in the 21st century requires us to work effectively and creatively with computers, with vast amounts of information, with ambiguous situations, and also with other people.

Creativity & Innovation

Sir Kenneth Robinson, a leading thinker and speaker on creativity, has said, "We do not grow into creativity, we grow out of it – or rather, we are educated out of it."[40] For ages, traditional education, with its emphasis on rote learning and memorization of static facts, has valued conformity over novelty of thought. But in today's world of global competition and task automation, innovative capacity and a creative spirit are fast becoming requirements for personal and professional success. Robinson says, in fact, that humanity's future depends on our ability to "reconstitute our conception of human capacity" and place creativity and innovation in the forefront of our educational systems.[41]

Robert Sternberg, of Tufts University, has described "successful intelligence" as having three main components: practical, analytical, and creative (plus a fourth "layer" of wisdom). In his view, successful individuals are those who have "creative skills, to produce a vision for how they intend to make the world a better place for everyone; analytical intellectual skills, to assess their vision and those of others; practical intellectual skills, to carry out their vision and persuade people of its value; and wisdom, to ensure that their vision is not a selfish one." [42] Sternberg's conception also reflects Partnership's notions of creativity and innovation. Creativity thrives on freedom and friction and diversity to spark new ideas and gain new perspectives.

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[39] Hoerr, T. (2003). Distributed intelligence and why schools need to foster it. *Independent School*. 63 (4) 76-83. Fall 2003

[40] From a talk by Sir Kenneth Robinson delivered in February 2006 at the TED Conference. Viewed at http://www.ted.com/index.php/talks/view/id/66

[41] Robinson, K. (2006).

[42] Sternberg. R. (2007). "Finding Students Who Are Wise, Practical, and Creative" *The Chronicle of Higher Education,* July 6, 2007.

Innovation keeps the creative spark alive and makes it useful to the wider world by drawing on practical sorts of expertise, such as replication and distribution of, and dissemination of information about the object of creation.

In a world in which good design is increasingly used as a means of differentiating objects of mass production, creative design skills are highly desired in the labor force. As a result, entrance into a topnotch MFA program is now more competitive than getting in Harvard Business School.[43] Howard Gardner, too, cites "the creating mind" as one of the five minds we'll need in the future. To cultivate such a mind, he says, we need an education that features "exploration, challenging problems, and the tolerance, if not active encouragement, of productive mistakes."[44]

Professor Yong Zhao of Michigan State, who has studied the relationship of education and global competitiveness, reminds us that "Would-be education reformers often cite crisis indicators such as poor performance of U.S. students in math and science relative to their international peers, declining interest and enrollment in math and science courses at home, and growing numbers of college graduates abroad. But they seldom mention what until now has been the secret of the U.S. economic advantage – the risk-taking, creative and can-do spirit of its people."[45]

In their report, *Tough Choices or Tough Times*, the New Commission on the Skills of the American Workforce attributes the success of American entertainment business – one of our country's most successful export industries – to its "boundless creativity."[46] Many other business are taking a lesson from the flexibility of the entertainment industry's studio model, in which teams come together for intense short term projects, only to disband and form new work groups when the task at hand changes.

These days, as it always has, creativity requires knowledge, skill, and discipline. But innovation today has a social component, as Gardner points out,[47] and requires the adaptability, leadership, teamwork, and interpersonal skills that will be examined later in the Life and Career Skills section of this white paper. Our capacity to innovate these days is increasingly linked to our ability to connect with others, and with our facility with communication and collaboration – to which we now turn.

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[43] Pink, D. (2005). *A Whole New Mind.* New York: Riverhead Books.

[44] Gardner, H. (2006).

[45] MSU News Bulletin. (2005). *Faculty conversation with Yong Zhao, University Distinguished Professor of Education.* Available at http://newsbulletin.msu.edu/oct2705/zhao.html

[46] National Center on Education and the Economy (2007). *Tough Choices or Tough Times: The Report of the New Commission on the Skills of the American Workforce.* San Francisco: Jossey-Bass.

[47] Gardner, H. (2006).

Communication & Collaboration

Expressing thoughts clearly, crisply articulating opinions, communicating coherent instructions, motivating others through powerful speech – these skills have always been valued in the workplace and in public life. The intellectual tradition of persuasive communication, known as rhetoric, extends back 2500 years to the ancient Greeks. Two millennia ago, the Romans formalized three forms of verbal communication – grammar, dialectic and logic, and rhetoric – into a remarkably durable curriculum known as the trivium that was taught right up to the modern era. More recently, as new forms of mass communication arose, the Canadian critic Marshall McLuhan drew our attention to the effect these modern media had on the messages they carried, and in doing so became one of the most cited cultural commentators of the 20th century.[48]

The power of modern media and the ubiquity of communication technologies in all spheres of life suggest a renewed emphasis on the teaching of **communication and collaboration skills**. While education has always emphasized fluent reading, correct speech, and clear writing, there's evidence that students aren't mastering even these basic skills. In the recent report, *Are They Really Ready to Work?*, employers say that although Oral and Written Communication are among the top 4 skills they seek in new hires, *all* graduates are lacking in these areas. [49] High school graduates fare the worst, with 72% of employers citing this group's deficiency in Writing in English, and 81% citing their deficiency in Written Communications. For two-year graduates, those figures, respectively, almost half of the employer said their skills in these two areas are lacking, while over a quarter of employers felt four year graduates lacked these skills.

Further evidence of the importance of communication and collaboration in today's workplace can be found in the work of economists Frank and Richard Murnane. Because complex communication involves explanation, negotiation, and other forms of intense human interaction, jobs which require these skills are not as likely to be automated.[50] Communication skills are especially critical in the expanding service economy – estimated to be 81% of jobs by 2014 – where relationships with customers and fellow employees are of vital importance. And as technology gives rise to global work teams that span time zones, nations, and cultures, it's more imperative than ever that

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[48] McLuhan, M. (1964). *Understanding Media: The Extensions of Man;* New York: McGraw Hill.

[49] The Conference Board, et al. (2006).

[50] Levy, F. & Murnane, R. (2004) *The New Division of Labor: How Computers Are Creating the Next Job Market.* Russell Sage Foundation. Princeton, NJ: Princeton University Press.

tomorrow's graduates be clear and effective communicators. Leading experts David and Roger Johnson have shown that students who work together cooperatively show dramatic increases in academic achievement, self-esteem, and positive social skills.[51]

As represented in the 21st Century Skills Framework, communication competencies such as clearly articulating ideas through speaking and writing are related to collaboration skills, such as working effectively with diverse teams, making necessary compromises to accomplish a common goal, and assuming shared responsibility for collaborative work. In doing so, the Framework emphasizes the social dimension of communication. We cannot be said to have communicated effectively unless our message is heard by another who responds.

The connection between collaboration and communication may have face-value validity, but learning research backs up the importance – and interconnection – of these skills as well. Professor Carol Seefeldt in her work with young children has found that "Social skills and communication skills go hand in hand. Children who look at the child they are talking with, who understand turn taking when communicating, and who know how to solve verbal conflicts, are those who make and keep friends easily."[52] The communication/collaboration link persists and has value in the adult world as well. John Seeley Brown and Paul Duguid describe effective work teams as those in which "the talk and the work, the communication and the practice are inseparable."[53] For Daniel Pink, collaborative, empathic, and social skills – what he calls "high touch" aptitudes – along with the high concept ones listed earlier, represent the "whole mind" that the future will prize.[54]

We need to also consider how words and images are shaped by today's technologies, as so many of our messages today are mediated by one or more digital devices. Thus, communication skills are intertwined with the Information, Media, and ICT Skills to which we now turn.

III. INFORMATION, MEDIA AND TECHNOLOGY SKILLS

"As we move into the 21st century, our conception of literacy is evolving once again. The prevalence of technology in the everyday lives of the world's

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[51] Johnson, D. W. & Johnson, R. (1989). *Cooperation and Competition: Theory and Research.* Edina, MN: Interaction Book Company, as cited in Fogarty, R. (1995) *Best Practices for the Learner-Centered Classroom.* Palatine, IL: IRI/Skylight Publishing.
[52] Seefeldt, C. (2004). Helping Children Communicate. *Scholastic Early Childhood Today* 19 (1) 36-42.
[53] Brown, J.S. & Duguid, P. (2000).
[54] Pink, D. (2005).

citizens has grown at a rate that many would have found hard to imagine 25 or even 10 years ago. Policy makers, business leaders, and educators have come to expand their notion of a literate populace to include the skills and abilities that will enable citizens to function in an increasingly technological world."

-- The International ICT Literacy Panel, *Digital Transformation*

Information Literacy

Information is doubling every 5.5 years, according to the American Association of School Librarians (AASL), technical information is doubling every 2 years, according to Ian Jukes, a leading media commentator, [55] and the amount of electronic information doubles every hour.[56] At this rate, it is imperative that schools prepare students to learn their way through this through this phenomenon in order to build knowledge. The promotion of information literacy is a hallmark of the AASL, a long-time advocate of traditional literacy in school libraries. The Partnership shares their conviction, recognizing that the worlds of work, higher education, and personal life increasingly demand the ability to 1) *access* information efficiently and effectively, 2) *evaluate* information critically and competently, and 3) *use* information accurately and creatively.[57]

Today's youth are digital natives. They were born into a world rich with technological devices to access, store, and process information. Yet, while they may speak "technology" with greater fluency than their digital immigrant parents, they do not always do so with as much sophistication as they imagine or as much wisdom as their parents would wish. Yet, while they may speak "technology" with greater fluency than their digital immigrant parents, they do not always do so with as much sophistication as they imagine, as much wisdom as their parents would wish, or as much competence as their teachers would like. Take their use of the Internet, for instance. Some students may access misinformation, information that is decidedly inaccurate and laden with content inappropriate for the situation. They may unwittingly cite sources that are highly biased; they may cut and paste together a report, then pass it off as original work.

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[55] Jukes, I. (2007). *From Gutenberg to Gates to Google: Education for an On-line World*. Unpublished handout. http://web.mac.com/iajukes/thecommittedsardine/Handouts_files/fgtgtg.pdf

[56] Oppenheimer, T. (1996). "Reality Bytes: We Listen in on the New-Media Moguls - and They're Nervous." *Columbia Journalism Review* 35.3 (Sept.-Oct. 1996): 40+. And *General Comments*. Library of Congress Cataloging Directorate. (2000). E-mail communications held in connection with the Library of Congress's Bicentennial Conference on Bibliographic Control for the New Millennium, November 15-17, 2000.

[57] American Association of School Librarians and Association for Educational Communications and Technology (1998). *Information Power: Building Partnerships for Learning*. Chicago: AASL.

Information literacy enables them to give meaning and value to the facts, figures, messages, and texts that fill our lives. When they know how to *access* data, they are better able navigate the vast data ocean that surrounds our world. When they know how to *evaluate* that data, they can make sense of it, thus turning it into information.   And by knowing how to effectively *use* information, they are able to convert it into useful knowledge. Thus, information literacy has a truly transformative effect, one that makes possible the acquisition of other skills necessary for 21st century life.

Media Literacy

Children also need to understand the powerful forces that shape the myriad of messages from the broadcast media that surround them in daily life. Thus students today need to develop **media literacy**, which according to the Center for Media Literacy, "provides a framework to access, analyze, evaluate and create messages in a variety of forms, builds an understanding of the role of media in society, as well as essential skills of inquiry and self-expression necessary for citizens of a democracy."[58] A media-literate person is one who uses the process skills of awareness, analysis, reflection and action to understand the nature of media messages. The skills of media analysis and interpretation are well defined in the critical thinking literature as well. Media literacy is not solely limited to interpretation, though; it also encompasses the ability to create messages for self-expression and to influence and inform others.

ICT Literacy

Information communication and technology (ICT) literacy centers on the skillful use of information resources, but it also built around a deep understanding of the "grammar" of technology. Just as a traditionally literate person can fluently incorporate a new vocabulary into her speech, so an ICT-literate person can fluidly master new technologies to enhance her work and personal life. Today's students are immersed in technology, but we adults are not always sure just what they are doing with it.

Jonathan Fanton, president of the John D. and Catherine T. MacArthur Foundation has said that today's digital youth are in the process of creating a new kind of literacy; this evolving skill extends beyond the traditions of reading and writing into a community of expression and problem-solving that

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[58] Thoman, E. and Jolls, T. (2003/5). *Literacy for the 21st Century: An Overview and Orientation Guide to Media Literacy Education.* Los Angeles: Center for Media Literacy. Available at www.medialit.org.

not only is changing their world but ours, too."[59] Today's digital natives edit entries for Wikipedia, create video games, write blogs about their life and times, and instant message each other for help with homework and for support through adolescent crises. Yet with all their immersion in technology, do students know how to use technology to problem solve, analyze, communicate & collaborate effectively?

While we are still learning how technology is shaping today's youth, its influence on the workplace has been undeniable and profound. Anthony Carnevale and Jeffrey Porro have explained that as industries used to be measured on productivity and efficiency, now they are held to a more complex set of performance criteria, including their ability to rapidly and continuously innovate, customize, and adapt, all while maintaining high standards of quality and reliability.[60] Advances in information and communication technologies have been pivotal to realizing these new corporate competencies by reducing routine tasks, enabling the mining of massive amounts of data, and facilitating connections with customers, suppliers, and business partners. This expansion of potential is far from over. As-yet-undiscovered technologies will foster new definitions of workplace excellence in the years to come. It is critical then, that the workers of tomorrow develop the ability to use not just today's technologies, but be skillful enough to learn and adapt to the technologies of tomorrow, in other words, that they be ICT-literate.

 In 2001, the Educational Testing Service convened a panel of experts to study the increasing importance of information and communication technologies in modern life across the globe. Their report, *Digital Transformation,* defines this new kind of literacy as the ability to access, manage, integrate, evaluate, and create information with digital communications and technologies.[61] Every nation, the report advises, must widely cultivate ICT skills in its population, or risk being shut out of today's technology-driven knowledge economy.

There are many obvious linkages among these three forms of literacy – information, media, and ICT. They closely parallel Bloom's taxonomy (see the Thinking and Innovation Skills section above) which maps learning as a series of successively more complex cognitive tasks. All share an emphasis on using progressively higher order cognitive skills to make sense of – while making use of – the information, the media, and the technologies that

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[59] Fanton, J. (2007). New generations, new media challenges. *St. Louis Post-Dispatch,* June 19, 2007.
[60] Carnevale, A. & Porro, J. (1994).*Quality Education: School Reform for the New American Economy.* Washington, D.C: U.S. Department o Education. Office of Educational Research and Improvement. http://eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/15/49/d6.pdf
[61] Educational Testing Service. (2001). *Digital Transformations: A Framework for ICT Literacy. A Report of the International ICT Literacy Pane*l. Princeton, NJ: ETS.

surround us. And once mastered, these literacies, just like traditional forms of literacy, enable the mastery of other academic, professional, and personal competencies needed for 21st century success.

IV. LIFE & CAREER SKILLS

"When the school introduces and trains each child of society into membership within … a little community, saturating him with the spirit of service, and providing him with the means of self-direction we shall have the deepest and best guarantee of a larger society which is worthy, lovely, and harmonious."

-- John Dewey, *The School and Society*

- Flexibility & Adaptability
- Initiative & Self-Direction
- Social & Cross-Cultural Skills
- Productivity & Accountability
- Leadership & Responsibility

The skills listed above under the Life and Career Skills heading reflect the view that academic and cognitive skills, essential as they are, are not all that's necessary for a successful life. In our global technological age, young people also need to work with and learn from diverse groups, be flexible in a variety of work and social settings, and be adaptable to changing times. They need to demonstrate leadership and take responsibility for results, show initiative and resourcefulness, and be productive and accountable for their actions. Indeed, Howard Gardner allots two places to the "the respectful mind" – one that is culturally competent – and "the ethical mind" – one that is responsible and trustworthy – among his five minds for the future.[62]

The drive to promote life and career competencies – often called "soft" or "applied" skills – has been part of American school policy debate for years. The SCANS report of 1991, for instance, listed interpersonal skills, effective management of resources, and personal qualities such as responsibility, self-management, and integrity as essential to successful job performance.[63] Yet some scholars have observed that that the academic accountability push of the 1980s and 1990s so dominated the educational landscape that it overshadowed the skills agenda. Now, though, as fresh concerns surface over global competitiveness, applied skills have once again emerged as a key educational concern. Lauren Resnick, a member of the original SCANS panel,

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[62] Gardner, H. (2006).
[63] U.S. Dept. of Labor (1991).

and now director of the University of Pittsburgh's Learning Research Development Center says, "What really needs to happen is to bring these [two agendas] back together. They never should have been separated in the first place."[64]

We have ample evidence these skills are essential in the workplace. According to the American Diploma Project, professors and employers agree that the abilities to work in teams and to present one's work orally are critical to success.[65] Life and career skills pay off in higher lifetime earnings, according to research conducted by Anthony Carnevale, an economist at Georgetown University.[66] And the Conference Board survey found the applied skills of professionalism/work ethic and team work/collaboration were among the four skills rated most important by employers.[67] So important have these skills become to employers, according to the Conference Board report, "that applied skills on all educational levels trump basic knowledge and skills, such as reading comprehension and mathematics."

Many of the skills in the Life and Career category are encompassed in the concept of Emotional Intelligence, popularized by author and speaker Daniel Goleman. Research on schools that provide emotional literacy programs shows its positive effects on students, such as reductions in violent and disruptive behavior, better self-control, enhanced productivity, and more harmonious interactions among students and teachers. What's especially important here is the finding that emotional intelligence contributes to academic success. [68]

The connection between social skills and cognitive ones should not be surprising. As the research has shown, when students exercise self-control, when they are able to defer short-term gratification for long-term gain, when they empathize with and are helpful to others, and when they take responsibility for their actions – they are able to function at a higher level.[69] And when this effect is multiplied across the classroom, the rising tide lifts all boats. Everyone is able to accomplish more. Thus, life and career skills promote behaviors that lead to deeper learning and greater achievement.

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[64] Gewertz, C. (2007). 'Soft Skills' in Big Demand. In "Ready for What?: Preparing Students for College, Careers, and Life After High School." *EdWeek.* June 12, 2007.

[65] Olson, L. (2007). What Does 'Ready' Mean? In "Ready for What?: Preparing Students for College, Careers, and Life After High School." *EdWeek.* June 12, 2007.

[66] Olson, L. (2007).

[67] The Conference Board, et al. (2006).

[68] Goleman, D. (1994). *Emotional Intelligence: Why It Can Matter More Than IQ.* New York: Bantam.

[69] Goleman, D. (1994).

PARTNERSHIP FOR 21ST CENTURY SKILLS

CONCLUSION

There is ample evidence all around us of the many changes the 21st century has brought to our lives. We live in a more competitive, yet more interdependent world. Our tools and technologies have the potential to either connect or divide us. We know much more about how the human brain functions, but still fall short in using what we know to reach and teach every child.

The Partnership for 21st Century Skills believes that to prepare our children for the world of tomorrow, we must harness appropriate learning tools to the latest learning science to create powerful learning environments for the 21st century. By tracing the intellectual underpinnings of the 21st Century Skills Framework, this paper has shown that the outcomes we want for our children are not new *to* the 21st century. Instead, the Framework reflects knowledge and skills that are essential for life *in* the 21st century. There are some new twists though:

- Recent policy, and the consequent accountability demands, have too often had the unintended effect of reducing the importance, and in many cases, the presence of such skills in the curriculum. We must restore to our schools the skills that future citizens will need to succeed in the worlds of work, higher education, and personal life.

- We now have new learning tools/technologies to help us promote the learning of these skills. The fact that we these tools are so prevalent and essential in modern life is precisely why we must make sure students know how to use them effectively and appropriately. But technology for its own sake is insufficient – it must also connect students with the information, people, and real world contexts that will inspire and engage them throughout the entire curriculum.

- We also know more about the learning process. Current research supports the effectiveness of pedagogical approaches such as cooperative learning, teaching for transfer, project-based learning, and real world teaching contexts -- as well as the importance of educators' lifelong learning through professional development, professional learning communities, mentoring, and the like. Again, these are not necessarily new approaches, but we now have ample evidence they work -- and yet ironically, concerns over test performance have too often pushed these forms of student and

adult learning to the back burner.

Finally, what is unprecedented in this call to action is combining all these goals and supports for the betterment of every student – something no society has ever before attempted. The Partnership for 21st Century Skills is proud to promote an educational framework that reflects time-honored skills, taught via research-proven learning methods, and supported by modern learning tools, processes, and environments. The Partnership's 21st Century Framework unites these elements into a coherent set of educational objectives to ensure that *all* children are prepared for life in the 21st century.