Skills for the 21st Century: What Should Students Learn?

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for their contributions.

With sincere thanks for the generous support to the:

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ABOUT THE CENTER FOR CURRICULUM REDESIGN

In the 21st century, humanity is facing severe difficulties at the societal, economic, and personal levels. Societally, we are struggling with greed manifested in financial instability, climate change, and personal privacy invasions, and with intolerance manifested in religious fundamentalism, racial crises, and political absolutism. Economically, globalization and innovation are rapidly changing our paradigms of business. On a personal level we are struggling with finding fulfilling employment opportunities and achieving happiness. Technology’s exponential growth is rapidly compounding the problems via automation and offshoring, which are producing social disruptions. Educational progress is falling behind the curve of technological progress, as it did during the Industrial Revolution, resulting in social pain.

The Center for Curriculum Redesign addresses the fundamental question of "WHAT should students learn for the 21st century?" and openly propagates its recommendations and frameworks on a worldwide basis. The CCR brings together non-governmental organizations, jurisdictions, academic institutions, corporations, and non-profit organizations including foundations.

Knowledge, Skills, Character, and Metacognition

CCR seeks a holistic approach to deeply redesigning the curriculum, by offering a complete framework across the four dimensions of an education: knowledge, skills, character, and metacognition. Knowledge must strike a better balance between traditional and modern subjects, as well as interdisciplinarity. Skills relate to the use of knowledge, and engage in a feedback loop with knowledge. Character qualities describe how one engages with, and behaves in, the world. Metacognition fosters the process of self-reflection and learning how to learn, as well as the building of the other three dimensions.

To learn more about the work and focus of the Center for Curriculum Redesign, please visit our website at www.curriculumredesign.org/about/background
INTRODUCTION

It is becoming increasingly clear that knowledge alone is not enough to prepare students to thrive in the world. Employers are speaking out about their newly hired graduates and their lack of skills in the workplace. In order to truly have expertise, students must learn what to do with the information they learn. Can they use it to create something new? How do they know that it is making a sound argument? Can they communicate their knowledge? Can they work together to construct something greater than any one student? This paper will justify and explore the Skills necessary for a 21st Century Education: Creativity, Critical Thinking, Communication, and Collaboration (“4 C’s”).

Cognitive Science Justification:

Psychological research has shown that an active engagement with learning typically leads to better learning outcomes such as retention, understanding, and active use of knowledge. Instead of just listening, reading, and performing routine exercises, learners investigate, debate, take viewpoints, and so on. Along with active learning, constructivism often emphasizes the social aspect of learning (knowledge is socially constructed), and the creative aspect (knowledge is learned by creating or re-creating it).

In fact, the elusive goal of transfer, shown to be difficult to achieve according to strict behavioral definitions of learning one thing in one context and directly applying it to another, can be reconceptualized based on a constructivist view of learning, as preparation for future learning (PFL). This view defines transfer as the productive use of cognitive tools and motivations, and focuses on students’ abilities to learn in novel, resource-rich environments, much more closely mirroring real-life challenges. Research has shown that educational environments that emphasize the students’ active roles, that enhance students’ self-regulation, which encourage metacognition and communication, and are social and relevant—all successfully enhance transfer.

Knowledge and Skills:

A long-standing debate in education hinges on the false assumption that teaching skills will detract from teaching knowledge. We believe this is a false dichotomy. Studies have shown that when knowledge is learned passively, without skills, it is often only learned at a superficial level (the knowledge may be “troublesome”: ritual, inert, conceptually complex, foreign or tacit), and therefore not readily transferred to

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1 This document contains justification and summaries of the research literature, but excludes assessment. The subject of assessment is a large and important undertaking, which will be addressed more deeply in future work.
6 ibid.
new environments. Deep understanding and actionability for the real-world will occur only by embedding skills within knowledge domains, such that each enhances the other.

To this end, The Partnership for 21st Century Skills (P21) has created a number of “Skills maps” for several traditional knowledge subject areas such as:

- Mathematics
- Science
- Social studies
- Arts
- Geography
- English
- Languages

The maps showcase, at three different grade levels, the correspondence between Knowledge and Skills and how both can be learned in a mutually reinforcing fashion. Below is just one example, on the intersections of Science AND Creativity:

![Image](http://www.p21.org/storage/documents/21stcskillsmap_science.pdf)

Figure 1. Part of the framework offered by the Partnership for 21st Century Skills.

**BUSINESS JUSTIFICATION:**

To respond to the pervasive concern that recent graduates (of high school and college) lack relevant skills for the workforce, many surveys have been conducted asking employers to express their views on what their needs are. For instance: “Are they really ready to work?” by the Conference Board and Partnership for 21st Century Skills,10 “Critical Skills Needs and Resources for the Changing Workforce” by the Society for Human

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Resource Management and The Wall Street Journal\textsuperscript{11}, and “\textit{OECD Skills Outlook}” by the Organisation for Economic Co-operation and Development (OECD)\textsuperscript{12}. The Partnership for 21\textsuperscript{st} Century Skills (P21) synthesized the responses and they were described in the book “\textit{21\textsuperscript{st} Century Skills: Learning for Life in Our Times}”.\textsuperscript{13} They are drawn from a broad global consensus among from industry, and show consistent convergence of views, although different frameworks often use different terminology and groupings. Appendix 1 provides a crosswalk between the most prominent models and highlights their commonalities.

However, feedback\textsuperscript{14} from policymakers in ministries, departments of education, and schools pointed to a \textit{need for simplicity to make the recommendations actionable}, hence the focus on the “4 C’s”. Table 1 provides a comparison between the main frameworks, and highlights the feedback received.

\begin{center}
\begin{tabular}{|l|l|l|l|}
\hline
\textbf{P21.org Skills Framework} & \textbf{ATC21S\textsuperscript{15}} & \textbf{OECD Assessment of Adult Competencies (PIACC)} & \textbf{OECD Programme for International Student Assessment (PISA)} \\
\hline
\textbf{Learning & Innovation} & \textbf{Ways of Thinking} & & \\
\hline
\textbf{Creativity & Innovation} & \textbf{Creativity and innovation} & \textbf{Creative Problem-solving} & \textbf{Creativity} \\
\hline
\textbf{Critical Thinking & Problem Solving} & \textbf{Critical thinking, problem solving, decision making (“Learning to learn” is Metacognition, not skills)} & \textbf{Problem Solving} & \textbf{Critical Thinking} \\
\hline
\textbf{Communication} & \textbf{Communication} & \textbf{(Read Prose-Type Texts Read Document-Type Texts Write Oral Presentation)} & \textbf{Communication} \\
\hline
\end{tabular}
\end{center}

\textsuperscript{11} See the report, http://www.shrm.org/research/surveyfindings/articles/documents/critical%20skills%20needs%20and%20resources%20for%20the%20changing%20workforce%20survey%20report.pdf


\textsuperscript{14} Private communication from Ken Kay, CEO of P21 at the time, with Geoff Garin of Peter Hart Associates (pollster)

\textsuperscript{15} Represented in Binkley http://link.springer.com/chapter/10.1007/978-94-007-2324-5_2#page-1
The following sections examine each skill separately, including its importance and relevant cognitive science and education research, as well as brief thoughts on teaching and assessment. Although we present the skills separately from the knowledge, these skills are meant to be taught through and with the teaching of content knowledge.

**A. CREATIVITY**

Creativity is traditionally considered to be most directly involved with artistic endeavors such as art and music. While this association is rooted in truth, the false equating of creativity *exclusively* with art is misleading and has been described as “art bias.”\(^{16}\) Recently, creativity has been shown to be integral to a wide

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A range of skills, including scientific thinking, entrepreneurship, design thinking, and mathematics. A 2010 IBM study interviewed over 15,000 CEOs from 60 countries and 33 industries and found that creativity was named the most important leadership quality to meet the challenge of increasing complexity and uncertainty in the world. Finally, creativity is an extremely fulfilling activity. According to Mihaly Csikszentmihalyi, “Most of the things that are interesting, important, and human are the results of creativity... When we are involved in [creativity], we feel that we are living more fully than during the rest of life.”

Countries have begun to focus on reformulating education around creativity. In 2008, British secondary-school curricula were revamped to emphasize idea generation, and pilot programs have begun measuring their progress. The European Union designated 2009 as the European Year of Creativity and Innovation, and began holding conferences and funding relevant teacher trainings and problem-based learning curricula. China has begun massive education reform to replace their traditionally rote teaching style with a more problem-based learning approach. Japan has begun to implement educational and economic reforms to address their “creativity problem.”

The dominant model in the research states that creative individuals possess divergent thinking abilities including idea production, fluency, flexibility, and originality. Figure 3 below illustrates each of these qualities and how they relate to sample answers on a test of students’ creativity. This model has inspired a collection of “divergent thinking” tests designed to measure creativity. While there has been some controversy in the literature, a large meta-analysis has found that divergent thinking tasks predict creative achievement more accurately than IQ, although they are correlated to some degree.

Broadly speaking, teaching for creativity is complementary with teaching for content knowledge. Open-ended, problem-based learning is more likely to encourage students to think creatively than paper and pencil exercises in which there is only one right answer. Prompting people to think in a humorous way has also been found to increase creativity, as it cues the brain to think in ways that are not necessarily tied to reality. Play in general is uniquely suited to enhance creative thinking.

In teaching for creativity, it is important to remember it can take place at various levels. The following taxonomy organizes activities according to the creativity involved: from perfect imitation (involving no novelty), to the elusive idea of complete originality (with a high degree of novelty in both form and content).

There are opportunities for creativity in the classroom across all of these levels:

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Table 2: Examples of Creativity at Different Levels

<table>
<thead>
<tr>
<th>Level of Creativity</th>
<th>Definition</th>
<th>Classroom Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imitation</td>
<td>Creation by identical replication. This is a foundational skill, and is often the starting point for more creative tasks.</td>
<td>Memorize an excerpt of a piece of literature and perform it aloud in class.</td>
</tr>
<tr>
<td>Variation</td>
<td>Creation by varying a particular aspect or aspects of the work, and imitating the rest exactly.</td>
<td>Rewrite a sentence from a piece of literature with the same grammatical structure, by changing the subject matter and vocabulary.</td>
</tr>
<tr>
<td>Combination</td>
<td>Mixture of two or more works into one, new work.</td>
<td>Create a Rube Goldberg machine out of the simple machines learned in class.</td>
</tr>
<tr>
<td>Transformation</td>
<td>Translation of an existing work into a different medium or representation.</td>
<td>Create a timeline of historical events based on class notes that separates political, social, and economic threads.</td>
</tr>
<tr>
<td>Original Creation</td>
<td>Creation of a new piece of work that is only very distantly, if at all, related to previous works.</td>
<td>Write a short story.</td>
</tr>
</tbody>
</table>

Although more open-ended assignments demand greater creativity, they are not necessarily more effective. If students haven’t built up the necessary skills, assignments that are too open ended will be overwhelming and ineffective. Teachers should set helpful boundaries within which to innovate, according to the learning outcome they hope to accomplish.

**B. CRITICAL THINKING**

The National Council for Excellence in Critical Thinking defines critical thinking as the “intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.”⁴¹ Although this encompasses a wide range of mental activities, in essence, the “critical” part of “critical thinking” refers to the questioning of claims rather than taking them at face value. Historian William Graham Sumner defines critical thinking as “the examination and test of propositions of any kind which are offered for acceptance, in order to find out whether they correspond to reality or not. The critical faculty is a product of education and training. It is a mental habit and power. It is a prime condition of human welfare that men and women should be trained in it. It is our only guarantee against delusion, deception, superstition, and misapprehension of ourselves and our earthly circumstances.”⁴²

Critical thinking in education can be traced back to the work of Socrates, who used questions to encourage his interlocutors to clarify their assumptions and back up their claims, pushing past ideas that seemed self-
evident and exposing the underlying biases and gaps in reasoning. Now, 2,400 years later, critical thinking remains a top priority for education. Such “habits of mind” as those that comprise critical thinking have been “consistently and emphatically identified by those who teach entry-level college courses as being as important or more important than any specific content knowledge taught in high school.”33 The most famous conceptualization of critical thinking comes from Bloom’s Taxonomy, but many have taken the same ideas and described them differently. Below is a comparison of taxonomies, all illustrating the educational goal of progression from lower level forms of knowledge access to higher levels of comprehension, and into various goals of critical thinking (analysis, synthesis, evaluation, etc.).

<table>
<thead>
<tr>
<th>Taxonomies of Educational Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation</td>
</tr>
<tr>
<td>Synthesis</td>
</tr>
<tr>
<td>Analysis</td>
</tr>
<tr>
<td>Comprehension</td>
</tr>
<tr>
<td>Knowledge</td>
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<td></td>
</tr>
</tbody>
</table>

Table 3. Evolution of Taxonomies.

Teaching critical thinking can come in many different forms, from an explicit curriculum devoted to identifying and practicing the necessary higher order thinking skills, to content-based projects that involve interpreting information, analyzing parts and wholes, evaluating evidence, taking multiple perspectives, discerning patterns, and grasping abstract ideas.34 Teaching critical thinking is often tied closely with developing metacognitive habits of mind, as each can strengthen the other.35 The main challenge is the successful transfer of critical thinking skills to contexts outside the one in which they were learned.

C. Communication

Although only some professions are based on communication at their core (such as therapy and public speaking), all professions require various forms of it (negotiating, giving instructions, advising, building relationships, resolving conflicts, etc.)36 on a regular basis. In fact, the explicit teaching of communication is discussed in research contexts from preschool to medical school.37

Traditional class work such as writing papers and giving presentations is often one-sided, and thus not truly communication; it is inconsequential whether or not the audience successfully understands the information. For this reason, collaborative tasks (discussed in the Collaboration section below) can be an important way to train and measure true communication skills. Another method to train authentic communication is peer tutoring—when students tutor their classmates or younger students. Not only is teaching a great test of

whether the student has really understood the material, but the challenge of communicating it to another student increases the tutor’s effort and the responsibility of the role increases their self-concept.

In today’s digital age, communication skills have become both more important and more varied. Scholars have noted that adding a focus on media literacy to the traditional literacy goals has the potential to “(a) increase learning by making the practices of literacy relevant to students’ home cultures and ways of knowing (b) accommodate diverse learning styles and meet the needs of multicultural learners and (c) develop creativity, self-expression, teamwork, and workplace skills”.

D. Collaboration

In a world of increasing complexity, the best approaches to solving multifaceted problems involve collaboration among people and agencies with different skills and backgrounds. When executed well, collaboration enables a group to make better decisions than any one individual would on his own, since it allows for the consideration of multiple perspectives. On the other hand, if executed poorly, collaborative efforts are subject to “groupthink,” and become less effective than an individual. Studies probing the structure of scientific fields have revealed that while there is specialization, interdisciplinary work is often integral to important advancements in knowledge, and technology.

Simply put, collaboration is the joining together of multiple individuals in service of working towards a common goal. Several tactics have been proven effective in teaching the tenets of collaboration in the classroom. Establishing group agreements and accountability for assigned tasks sets the stage for division of labor and synergy of efforts. Teaching listening skills allows for the creation of a space where ideas can be shared, received, and applied. Teaching the art of asking good questions – particularly, open-ended and thought-provoking inquiries – facilitates expansion of knowledge and aids progress towards optimized solutions. Finally, demonstrating the skills of negotiation – patient listening, flexibility, articulating points of agreement, and maintaining the ability to think clearly under pressure – is paramount in any collaborative situation. In a large meta-analysis of 164 studies of cooperative learning, found that a wide range of pedagogical methods of cooperative learning were all found to be effective in boosting academic achievement.

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Collaborative learning has been shown to increase learning outcomes, enjoyment of the subject matter, self-esteem, and inclusiveness of diversity.\(^{48}\) There are many different pedagogical tools that utilize collaborative learning, and across a meta-analysis, they have been found to be more effective in producing academic achievement than individualistic or competitive learning.\(^{49}\) Students are also more positive about school, subject areas, and teachers, as well as each other when they learn collaboratively.\(^{50}\) It is also synergistic with the other 21\(^{st}\) century skills discussed here, serving as an authentic goal of communication (discussed above), and enhancing critical thinking\(^ {51}\) and creativity.\(^ {52}\)

**Conclusion**

Skills represent “How we use what we know.” They are being demanded by employers, and key to teaching students deep understanding of knowledge and facilitating transfer of that learning to new environments. To that end, they are intrinsically connected to Knowledge, as it is implausible to teach Skills without a supporting content base. The CCR wholeheartedly supports the notion of Knowledge AND Skills developed together in a virtuous cycle, such that the knowledge we engage in our classes becomes the source of creativity, the subject of critical thought and communication, and the impetus for collaboration. In this way, we might engage the substantial challenges of today’s political climate, the new demands of contemporary workplaces, and the paths to personal and societal fulfillment in a modern world.


## Appendix 1: Crosswalk of the 4C’s across several frameworks.
(Source: Charles Fadel & Bernie Trilling)

<table>
<thead>
<tr>
<th>CCR</th>
<th>Creativity</th>
<th>Critical Thinking</th>
<th>Communication</th>
<th>Collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hewlett Foundation Deeper Learning Competencies</td>
<td>Think critically and solve complex problems</td>
<td>Communicate effectively</td>
<td>Work collaboratively</td>
<td></td>
</tr>
<tr>
<td>OECD “Skills for Innovation”</td>
<td>Critical faculties</td>
<td>Persuasion</td>
<td>Collaboration</td>
<td></td>
</tr>
<tr>
<td>OECD “New millennium learners” DeSeCo</td>
<td></td>
<td>Use language, symbols and texts interactively</td>
<td>Relate well to others Co-operate, work in teams Manage and resolve conflicts</td>
<td></td>
</tr>
<tr>
<td>EU Reference Framework Key Competencies</td>
<td></td>
<td>Communication in the mother tongue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNESCO Global Citizenship Education</td>
<td>Think creatively</td>
<td>Think critically and systematically</td>
<td>Communication Networking</td>
<td>Act collaboratively</td>
</tr>
<tr>
<td>Asia Society/CCSSO</td>
<td></td>
<td></td>
<td>Communicate ideas</td>
<td>Act collaboratively</td>
</tr>
<tr>
<td>ACT WorkKeys (WK)-NCRC Plus-CWRC Skills Assessments</td>
<td>Creativity (Talent)</td>
<td><strong>Critical Thinking (WK)</strong> **Problem-solving (WK) Applied Math (WK) **Observation (WK) **Critical Thinking (WK) **Problem-solving (WK) Applied Math (WK) **Observation (WK)</td>
<td>*Reading for Information (WK) **Listening for Understanding (WK) Business Writing (WK)</td>
<td>+Teamwork (Talent)</td>
</tr>
<tr>
<td>CPS Employability Assessment (EA)</td>
<td>Problem Solving</td>
<td>Oratory/Speaking Verbal Communication Active Listening Feedback</td>
<td>Teamwork ≥ 2 People</td>
<td></td>
</tr>
<tr>
<td>AAC&amp;U Essential Learning Outcomes (LEAP)</td>
<td>Creative Thinking</td>
<td>Inquiry &amp; Analysis Critical Thinking Problem Solving Quantitative Literacy</td>
<td>Written &amp; Oral Communication</td>
<td>Teamwork</td>
</tr>
<tr>
<td>CCSSO – Innovation Lab Network (ILN) State Framework</td>
<td>Creativity &amp; Innovation</td>
<td>Critical Thinking Problem Solving</td>
<td>Communicating Effectively</td>
<td>Working Collaboratively</td>
</tr>
<tr>
<td>National Work Readiness Credential</td>
<td>Solve Problems Make Decisions</td>
<td>Read with Understanding</td>
<td>Cooperate with Others Resolve Conflict &amp;</td>
<td></td>
</tr>
<tr>
<td>Solve Problems w. Math</td>
<td>Listen Actively</td>
<td>Negotiate</td>
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<td>------------------------</td>
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<td></td>
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<tr>
<td>Observe Critically</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>CAE College &amp; Work Ready (CWRA) &amp; Collegiate Learning Assessments (CLA)</th>
<th>Critical Thinking</th>
<th>Writing Effectiveness</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Analytic</td>
<td>Writing Mechanics</td>
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<td></td>
<td>Reasoning/Evaluation</td>
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<td></td>
<td>Problem Solving</td>
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</tbody>
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<tr>
<th>EnGauge</th>
<th>Creativity</th>
<th>Higher-Order Thinking and Sound Reasoning</th>
<th>Interactive Communication</th>
<th>Teaming, Collaboration, and Interpersonal Skills</th>
</tr>
</thead>
</table>
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