

Preparing 21st Century Students for a **Global Society**



An Educator's Guide to the "Four Cs"

Letter from Dennis Van Roekel	2
Introduction	3
The Importance of Teaching the "Four Cs"	5
The "Four Cs"	7
1 Critical Thinking and Problem Solving	8
2 Communication	13
3 Collaboration	19
4 Creativity and Innovation	24
Frequently Asked Questions	31
Next Steps and Conclusion	32
Additional Resources	34
References	36
Notes	37



Dear Members and Educators,

As many of you know, NEA is at the forefront of the 21st century education movement in this country. As educators, we are determined to help all students reach their full potential. This is no small challenge, and it is our responsibility to prepare our young people for the unique demands of a 21st century world.

As a founding member of the Partnership for 21st Century Skills, NEA is extraordinarily proud of our partnerships with leaders in education, business, and policy circles to forge a common vision for education that will prepare our young people for college, work, and life.

We all believe that every child should possess strong content mastery, as well as the “Four Cs”: critical thinking, communication, collaboration, and creativity. We designed this guide, *Preparing 21st Century Students for a Global Society: An Educator's Guide to the “Four Cs”*, to clarify this vision for classroom teachers and education support professionals.

This guide includes ideas and resources that will help advance the “Four Cs” in classroom practices. These resources include practical techniques to integrate the “Four Cs” in the classroom setting; tools for developing better proficiency in technology; and methods to ensure that students are learning in a meaningful context. It also offers suggestions for you to encourage your department, school, district, and state to embrace the “Four Cs.”

Though this guide is just a step, it is designed to help you get started with ideas on how to bring the “Four Cs” to life in your classroom. Many of you may have started this process already, but we must all work together to improve our 21st century practices.

It is clear that our school systems need to respond better to a changing world. Franklin D. Roosevelt once said, “We cannot build the future for our youth—but we can build our youth for the future.” It is our duty to do whatever we can to help our students connect learning with real life and to provide them with the necessary skills to prepare them for success.

As our global economy expands, our need to prepare this next generation for new careers becomes even more imperative. If we seize this moment and work together, America’s students will be our most valuable assets to compete in the 21st century.

Join us in this effort. Share with us your views and best practices. Let’s work together tirelessly to bring our students, our schools, our districts and our nation effectively into the 21st century.

Sincerely,

A handwritten signature in black ink that reads "Dennis Van Roekel". The signature is written in a cursive, flowing style.

Dennis Van Roekel
President
National Education Association

Introduction

“Using the ‘Four Cs’ to engage students is imperative. As educators prepare students for this new global society, teaching the core content subjects—math, social studies, the arts—must be enhanced by incorporating critical thinking, communication, collaboration, and creativity. We need new tools to support classroom teachers and education support professionals in their profession, even as they implement new strategies in their classrooms.”

John Stocks

All educators want to help their students succeed in life. What was considered a good education 50 years ago, however, is no longer enough for success in college, career, and citizenship in the 21st century.

The “21st Century Skills” movement is more than a decade old. Yet, educators still pose important questions about how to move 21st century education forward. NEA has been an advocate of the 21st century education movement from its inception and wants to empower educators to move it forward in their own practice.

Ten years ago, NEA helped establish the Partnership for 21st Century Skills (P21) and in 2002 began a two-year journey to develop what became known as a “Framework for 21st Century Learning,” highlighting 18 different skills. In the last eight years, 16 states joined P21 and agreed to build 21st century outcomes into their standards, professional development, and assessments.

Over the years it became clear that the framework was too long and complicated. To resolve this issue, we interviewed leaders of all kinds to determine which of the 21st century skills were the most important for K-12 education. There was near unanimity that four specific skills were the most important. They became known as the “Four Cs”—critical thinking, communication, collaboration, and creativity.

Now the challenge is building the “Four Cs” into K-12 education. Discussions on this topic are pending at the federal and state levels and in many school districts around the country. To encourage more members and leaders to incorporate this policy into their own instruction, NEA developed this guide to introduce educators to the concept, stress the importance of the “Four Cs,” and put 21st century education into classroom practice.

Several other national organizations partnered with NEA to develop this guide. This group includes*:

- ▶ American Council on the Teaching of Foreign Languages (ACTFL)
- ▶ National Association for Music Education (MENC)
- ▶ National Council for Geographic Education (NCGE)
- ▶ National Council for the Social Studies (NCSS)
- ▶ National Council of Teachers of English (NCTE)

- ▶ Mathematical Association of America (MAA)
- ▶ National Council of Teachers of Mathematics (NCTM)
- ▶ National Science Teachers Association (NSTA)

In addition to the contributions of these groups, portions of the guide were derived from materials developed by P21. We want to thank the P21 Board members and staff for their dedication to the cause of 21st century education and to developing this rich set of materials.

We would also like to thank the following members of the NEA leaders, members, and staff who were responsible for reviewing multiple drafts of this document. They include:

- ▶ Daryl Gates, NEA IDEA Resource Cadre, Louisiana Education Association
- ▶ Bobbi Ciriza Houtchens, NEA ELL Culture & Equity Committee, teaching ambassador fellow, U.S. Department of Education, California Teachers Association
- ▶ Jeri Stodola, ESP network engineer and ESPRT member, Illinois Education Association
- ▶ Blake West, president, Kansas National Education Association
- ▶ Peg Dunlap, director, Instructional Advocacy, Kansas National Education Association
- ▶ Roxanne Fonoimoana, Uniserv, Oregon Education Association
- ▶ Anita Maxwell, communication and instructional issues specialist, West Virginia Education Association
- ▶ Larry Wicks, executive director, Ohio Education Association
- ▶ Jessica Brinkley, policy analyst, Education Support Professionals Quality, NEA
- ▶ Mike Kaspar, policy analyst, Education Policy and Practice, NEA
- ▶ Andrea Prejean, associate director, Education Policy and Practice, NEA

We sincerely hope this guide will benefit you and your colleagues as you advance the work of the “Four Cs” and the preparation of your students for the challenges of 21st century lives.

*The full list of partners is listed in the “Additional Resources” section of this guide.

The Importance of Teaching the “Four Cs”

“I’m calling on our nation’s governors and state education chiefs to develop standards and assessments that don’t simply measure whether students can fill in a bubble on a test, but whether they possess 21st century skills like problem-solving and critical thinking and entrepreneurship and creativity.”

President Barack Obama¹

America’s system of education was built for an economy and a society that no longer exists. In the manufacturing and agrarian economies that existed 50 years ago, it was enough to master the “Three Rs” (reading, writing, and arithmetic). In the modern “flat world,” the “Three Rs” simply aren’t enough. If today’s students want to compete in this global society, however, they must also be proficient communicators, creators, critical thinkers, and collaborators (the “Four Cs”).

Students need to master additional subject areas, including foreign languages, the arts, geography, science, and social studies. Educators must complement all of those subjects with the “Four Cs” to prepare young people for citizenship and the global workforce.

Arne Duncan, secretary of the Department of Education, has been a proponent of integrating new skills into classrooms, proclaiming, “I want to develop a system of evaluation that draws on meaningful observations and input from [teachers’] peers, as well as a sophisticated assessment that measures individual student growth, creativity, and critical thinking.”²

Life today is exponentially more complicated and complex than it was 50 years ago. This is true for civic life as much as it is for work life. In the 21st century, citizenship requires levels of information and technological literacy that go far beyond the basic knowledge that was sufficient in the past.

With a host of challenges facing our communities, along with instant connectivity to a global society, civic literacy couldn’t be more relevant or applicable to the curricula in our schools. Global warming, immigration reform, pandemic diseases, and financial meltdowns are just a few of the issues today’s students will be called upon to address. Today’s students must be prepared to solve these challenges.

In addition, workforce skills and demands have changed dramatically in the last 20 years. The rapid decline in “routine” work has been well documented by many researchers and organizations. At the same time, there has been a rapid increase in jobs involving nonroutine, analytic, and interactive communication skills. Today’s job market requires competencies such as critical thinking and the ability to interact with people from many linguistic and cultural backgrounds (cultural competency).

Our ever changing workforce creates a critical need for innovation. Ken Kay, CEO of EdLeader21, remarked, “Today’s students need critical thinking and problem-solving skills not just to solve the problems of their current jobs, but to meet the challenges of adapting to our constantly changing workforce.”

Today, people can expect to have many jobs in multiple fields during their careers. The average person born in the latter years of the baby boom held 11 jobs between the ages of 18 and 44, according to the U.S. Bureau of Labor Statistics.³

The new social contract is different: only people who have the knowledge and skills to negotiate constant change and reinvent themselves for new situations will succeed.⁴

According to a 2010 study — the American Management Association, the AMA 2010 Critical Skills Survey — the “Four Cs” will become even more important to organizations in the future. Three out of four (75.7 percent) executives who responded to the AMA survey said they believe these skills and competencies will become more important to their organizations in the next three to five years, particularly as the economy improves and organizations look to grow in a global marketplace. Additionally, 80 percent of executives believe fusing the “Three Rs” and “Four Cs” would ensure that students are better prepared to enter the workforce. According to these managers, proficiency in reading, writing, and arithmetic is not sufficient if employees are unable to think critically, solve problems, collaborate, or communicate effectively.⁵

It is clear that the “Four Cs” need to be fully integrated into classrooms, schools, and districts around the country to produce citizens and employees adequately prepared for the 21st

century. This guide is intended to help you understand the fundamental aspects of the “Four Cs” and how you can implement them into your instruction.

REFLECTIONS

Throughout this guide, you will be asked to reflect on some key questions that will be useful to your practice. In this introduction, we would like you to reflect on the following questions:

- ▶ What can you do in your classroom to better prepare your students for the challenges of 21st century citizenship?
- ▶ How can educators become more intentional and purposeful about critical thinking, collaboration, communication, and creativity as competencies our young people will fully possess by the time they graduate from their K-12 education?
- ▶ How can educators work collaboratively to improve their students’ performance of the “Four Cs”?

The “Four Cs”

In this section, you will find an overview of each of the “Four Cs”: critical thinking and problem solving, communication, collaboration, and creativity and innovation. Each of the “Four Cs” has a section on:

- ▶ **The Importance of the “C”**
- ▶ **The Definition of the “C”**
- ▶ **How the “C” is Related to Other Skills**
- ▶ **Ways to Integrate the “C” into Your Classroom**
- ▶ **Reflections on the “C”**
- ▶ **Resources on the “C”**

Critical Thinking and Problem Solving

Critical thinking has long been a valued skill in society. Today, every student—not just the academically advanced—needs it. While critical thinking and problem solving used to be the domain of gifted students, now it's a critical domain for every student.

The Importance of Critical Thinking

The link between critical 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.⁶

Teaching critical thinking and problem solving effectively in the classroom is vital for students. Learning critical thinking leads students to develop other skills, such as a higher level of concentration, deeper analytical abilities, and improved thought processing.

Today's citizens must be active critical thinkers if they are to compare evidence, evaluate competing claims, and make sensible decisions. Today's 21st century families must sift through a vast array of information regarding financial, health, civic, even leisure activities to formulate plausible plans of action. The solutions to international problems, such as global warming, require highly developed critical thinking and problem-solving abilities.

In everyday work, employees must employ critical thinking to better serve customers, develop better products, and continuously improve themselves within an ever-changing global economy. Economists Frank Levy and Richard Mundane have described the new world of work in which the most desirable jobs—the ones least likely to be automated or outsourced—are those that require *expert thinking* and *complex communication*.⁷ According to the *AMA 2010 Critical Skills Survey*, 73.3 percent of business executives polled identified critical thinking as a priority for employee development, talent management, and succession planning.⁸

Definition of Critical Thinking

Critical thinking and problem-solving can be defined in many ways, but P21 defines critical thinking as follows:⁹

Reason Effectively

- ▶ Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation

Use Systems Thinking

- ▶ Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Make Judgments and Decisions

- ▶ Effectively analyze and evaluate evidence, arguments, claims, and beliefs
- ▶ Analyze and evaluate major alternative points of view
- ▶ Synthesize and make connections between information and arguments
- ▶ Interpret information and draw conclusions based on the best analysis
- ▶ Reflect critically on learning experiences and processes

Solve Problems

- ▶ Solve different kinds of unfamiliar problems in both conventional and innovative ways
- ▶ Identify and ask significant questions that clarify various points of view and lead to better solutions

(See the “critical thinking rubric” created by the Catalina Foothills School District as an example: http://rubrics.metiri.wikispaces.net/file/view/Catalina_Foothills_Critical_Thinking_Rubric-1.doc)

Related to Other Cs

While the importance of critical thinking is paramount, its connection to the other Cs is equally important. Leading experts on critical thinking stress its connection to creative thinking skills. According to philosophers Richard Paul and Linda Elder, “...sound thinking requires both imagination and intellectual standards.”

When one engages in high-quality thinking, one functions both critically and creatively; one produces and assesses, generates and judges the products of his or her thought.¹⁰

Critical thinking also draws on other skills, such as communication and information literacy, to examine, then analyze, interpret, and evaluate it.

According to educator Thomas Hoerr, the very notion of intelligence has changed. We no longer rely on the limits of our single mind to access the information resources we need to solve problems.¹¹ Problem solving has always involved teamwork and cooperation. Today, however, 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 with other people from a variety of backgrounds.

Ways to Integrate Critical Thinking into Your Classroom

P21 forged alliances with key national organizations that represent the core academic subjects, including social studies, English, science, geography, world languages, mathematics, and the arts. These collaborations resulted in the 21st Century Skills Maps that illustrate the intersection between core subjects and 21st Century Skills. This section includes examples of what critical thinking skills might look like in core academic content classrooms. These examples, drawn primarily from the aforementioned content maps, demonstrate how critical thinking and problem solving can be integrated into classroom teaching and learning across a variety of grade levels and disciplines.

ARTS – 4TH GRADE

Students individually articulate different ways to interpret the same musical passage. Students then compare the various interpretations and determine which one is most effective, taking into account age-appropriate considerations such as the style and genre of the music.

WORLD LANGUAGES – 4TH GRADE

With the job title omitted, students read various job/career advertisements and then match the appropriate job title to the ad. Students are divided into groups. Each group is asked to investigate 3-5 different career/job sites and identify the jobs and careers that are in high demand in a particular city, region, or country. Students present their findings to the class.

SCIENCE – 8TH GRADE

Students research how the physical and chemical properties of different natural and human-designed materials affect their decomposition under various conditions. They compare their findings to the material evidence used by scientists to reconstruct the lives of past cultures, as well as create a map of their classroom as a future archeological site (including written descriptions of artifacts and what they imply about the cultures) discovered by scientists. The students plan and conduct scientific investigations and write detailed explanations based on their evidence. Students compare their explanations to those made by scientists and relate them to their own understandings of the natural and designed worlds.

GEOGRAPHY – 8TH GRADE

Students are assigned to groups to research information about a specific state park (different

amenities at each park, campsites available, recreation opportunities, etc.) along with data about population in the state. Groups develop case studies to advocate for additional culturally and linguistically responsive amenities at their state parks using documentation such as maps, examples from other parks in other states, etc.

ENGLISH – 12TH GRADE

In small groups, students create a plan for involving students in making technology decisions in the school. The process may include gathering student input from surveys, establishing a student advisory committee, using students to help provide tech support or other services to the school, evaluating cost/value ratios, and fundraising proposals to support their recommended strategies. These plans should be used in a presentation to the principal or the school board.

SOCIAL STUDIES – 12TH GRADE

In groups, students explore how selected societies of the past used their natural resources for fuel (e.g., England's use of its forests at the beginning of the Industrial Revolution) and the economic impact of that use. Students use videoconferencing (e.g., www.skype.com) to collect information from relevant government officials about the use of corn for biofuel instead of food and analyze the environmental and economic implications of this use. Students use district-approved wikis to publish the results of their research. Using sound reasoning and relevant examples, students analyze the historical evolution of a contemporary public policy issue, place it within a cultural and historical context, and use a digital publishing tool to report their work.

MATHEMATICS – 12TH GRADE

Students explore the napkin ring problem: if a hole of height “h” is drilled through the center of a sphere, the volume of the portion of the sphere that remains does not depend on the size of the original sphere; it depends only on h. They share and critique their insights into why this is so. Then students explore mathematician Keith Devlin’s 2008 discussion of the problem at www.maa.org/devlin/devlin_04_08.html, where Devlin provides the full computation and explains why some solutions posted online are incorrect. Students explore solutions currently appearing online and assess which solutions are accurate and which are not.

Reflections on Critical Thinking

As you begin to integrate critical thinking into classroom practices, consider the following questions:

- ▶ How can you model critical thinking/problem solving for your students?
- ▶ What kind of learning environment is necessary to emphasize problem solving skills in your classroom?
- ▶ What could you do to make critical thinking and problem solving more intentional and purposeful in your classroom?
- ▶ How can you encourage students to be better critical thinkers and problem solvers?
- ▶ How can you and your colleagues work collectively to prioritize effective higher order thinking pedagogy across classrooms?

Resources on Critical Thinking

The following list of critical thinking resources is divided into “General Resources” and “Classroom Resources.” Use these resources to help generate dialogue and action in your classroom, department, and school.

General Resources**The Foundation for Critical Thinking**

The Foundation and its related entities aim to improve education in all subjects at every level by providing information, research, and resources on critical thinking. This site provides excellent background resources on the subject of critical thinking.

www.criticalthinking.org

Classroom Resources**Catalina Foothills Critical Thinking Rubric**

Catalina Foothills School District created a series of rubrics to assess student critical thinking skills. They measure critical thinking skills such as comparing, classifying, inductive and deductive reasoning, error analysis, and decision making.

<http://tinyurl.com/ydteapw>

Council for Aid to Education’s (CAE’s) Collegiate Learning Assessment (CLA) and College and Work Readiness Assessment (CWRA)

These assessments from CAE measure analytic thinking, critical thinking, problem solving, and written communication skills. The CWRA is available for high school use. Access the scoring rubric at <http://tinyurl.com/2vh3ugo>.

http://www.cae.org/content/pro_collegework.htm

Critical Thinking Lesson Plans – University of North Carolina (UNC)

These lesson plans integrate critical thinking into core academic subjects such as science, English language arts, social studies, geography, and others.

<http://tinyurl.com/3w3a8e8>

FIRST LEGO® League Rubrics

The FIRST LEGO League (FLL) robotics program not only focuses on Science, Technology, Engineering, and Mathematics (STEM), but also stresses teamwork and collaboration, communication skills, creativity, and innovation and critical thinking. There are several rubrics here that help measure the 4C's.

<http://tinyurl.com/3urrave>

Helping Students Learn Critical Thinking Skills

This general purpose, well-organized Web site provides examples of how to help students develop effective inquiry skills, argument structure, reliability, and reasoning skills.

<http://tinyurl.com/3kyqcqn>

Isaksen and Treffinger's Model for Critical and Creative Thinking

Scott Isaksen and Donald Treffinger developed a six-stage, critical and creative thinking model that is outlined in their book, *Creative Problem Solving: The Basic Course* (1985).

Their model is briefly described in this PDF:

<http://tinyurl.com/3wmsc3a>, and in this article:

<http://tinyurl.com/ydv82hz>.

Communication

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. But in the 21st century, these skills have been transformed and are even more important today.

The Importance of Communication

Students must be able to effectively analyze and process the overwhelming amount of communication in their lives today. Which information sources are accurate? Which ones are not? How can they be used or leveraged effectively?

The power of modern media and the ubiquity of communication technologies in all aspects of life make teaching strong communication skills even more important. While education has always emphasized fluent reading, correct speech, and clear writing, there is evidence that students are not mastering these most basic skills. In the report, *Are They Really Ready to Work?*, employers note that although oral and written communication are among the top four skills they seek in new hires, all graduates are lacking in these areas. High school graduates fare the worst, with 72 percent of employers citing this group's deficiency in writing in English, and 81 percent citing their deficiency in written communications. Almost half of employers said employees with two-year degrees were still lacking skills in these two areas, while over a quarter of employers felt four-year graduates continued to lack these skills.¹²

Additionally, there are now “global teams” that work together in business. Linguistically and culturally effective communication is essential to contribute successfully to these teams. And as technology gives rise to global work teams that span time zones, nations, and cultures, it is imperative that tomorrow's graduates communicate clearly and effectively in a variety of languages.

Communication skills are especially critical in the expanding service economy—estimated to be 81 percent of jobs by 2014—where relationships with customers and fellow employees are of vital importance. Linguistically and culturally effective listening, empathy, and effective communication skills are essential skills for every person in the service economy. Economists Levy and Mundane offer further evidence of the importance of communication in today's workplace. Because complex communication involves explanation, negotiation, and other forms of intense human interaction, jobs that require these skills are not as likely to be automated.¹³

Definition of Communication

Communication can be defined in many ways, but P21 defines communication skills as follows:¹⁴

Communicate Clearly

- ▶ Articulate thoughts and ideas effectively using oral, written, and nonverbal communication skills in a variety of forms and contexts
- ▶ Listen effectively to decipher meaning, including knowledge, values, attitudes, and intentions
- ▶ Use communication for a range of purposes (e.g. to inform, instruct, motivate, and persuade)
- ▶ Use multiple media and technologies, and know how to assess impact and their effectiveness a priori
- ▶ Communicate effectively in diverse environments (including multilingual and multicultural)

A “communication rubric,” created by the Amphitheater School District, can be found here: http://www.p21.org/route21/index.php?option=com_jlibrary&view=details&task=download&id=849

Communication and Collaboration

While it is important to emphasize communication skills, it can be difficult to separate them from the other Cs—especially collaboration. As represented in the 21st Century Skills Framework, **communication competencies such as clearly articulating ideas through speaking and writing are closely 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. Communication cannot be effective unless the message is received and understood.

Research backs up the importance—and interconnection—of communication and collaboration as well. In her work with young children, Professor Carol Seefeldt 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.”¹⁵

The communication/collaboration link is just as valid for adults 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.”¹⁶ For Daniel Pink, collaborative, empathic, and social skills—what he calls “high touch” aptitudes—along with the high concept aptitudes listed earlier, represent the “whole mind” that the future will prize.¹⁷ It is important to consider how today’s technologies shape words and images, as we receive many of our messages today through one or more digital devices. Thus, **communication skills are intertwined with information, media, communication, and technology skills.**

Ways to Integrate Communication into Your Classroom

P21 forged alliances with key national organizations that represent the core academic subjects, including social studies, English,

science, geography, world languages, mathematics, and the arts. These collaborations resulted in the 21st Century Skills Maps that illustrate the intersection between core subjects and 21st Century Skills. This section includes examples of what communication skills might look like in core academic content classrooms. These examples, drawn primarily from the aforementioned content maps, demonstrate how communication skills can be integrated into classroom teaching and learning across a variety of grade levels and disciplines.

WORLD LANGUAGES – 12TH GRADE

As part of a unit on community development, students communicate with a Peace Corps volunteer, community activist, or local leader who is fluent in the target language and has field work experience. Students exchange information related to the work/projects being undertaken in that country or locally. Areas of focus may include: agriculture, business, education, health, and the environment. Students in the advanced range can narrate and describe using connected sentences and paragraphs in at least three timeframes when discussing topics of personal, school, and community interest. They can comprehend main ideas and significant details regarding a variety of topics. Students generally reach this proficiency range after participating in a well-articulated standards based K-12 language program.

ARTS – 12TH GRADE

Students research existing site-based choreography to analyze the impact a location makes on the choreographic composition and the messages communicated from both the specific site and movement governed by that site. Students then create their own piece of choreography based on another specific site

that communicates a clear message or point of view about the specific site or environment. The dance is recorded and posted on appropriate Web sites for public view and comment.

GEOGRAPHY – 8TH GRADE

Student groups, adopting various perspectives, research a recent world/local event (hurricane, volcanic eruption, flood, war, famine, mass migration, earthquake, etc.). The perspectives students use could be: an environmentalist, a politician, a relief worker from the U.N., a local journalist, etc. Students create a slideshow of the event from their unique perspective to show to the rest of the class. Students write a journal at the conclusion to synthesize how various perspectives can influence understanding of an event. Students articulate thoughts and ideas clearly and effectively through speaking and writing.

SCIENCE – 8TH GRADE

Students interview local scientists (e.g., university researcher, local television meteorologist, medical technician) about the ways in which computer models inform their work. Students create a digital gallery of images from the different models accompanied by audio files of the interviews. Students are familiar with the use of computational models as tools to describe and predict real-world phenomena.

SOCIAL STUDIES – 4TH GRADE

Working in small groups, students choose an area from their state's history, organize a storyboard on the person/place/event, and use digital tools to create a presentation that teaches their topic to the remainder of the class. Students research, organize, and present historical information in clear, complete, and effective formats.

ENGLISH – 4TH GRADE

Students pose a question about a local issue on a secure, collaborative space such as ed.voicethread.com or galleryofwriting.org. Each student gives a short written or recorded response to the issue and then invites community leaders to add their responses. These students can articulate thoughts clearly and effectively through writing and speaking.

MATHEMATICS – 4TH GRADE

Students work in groups to design a bedroom. One student in the group plays the role of client, and the others act as the design team. The design

team is given building constraints on floor area, wall area, and minimum number of windows. The design team interviews the client for preferences regarding: window and door placement; size and placement of bed, desk, and closets; and size and locations for any wall posters or other decorative items that the client asks to have included. The design team produces a scale drawing of the room with an explanation of why it satisfies the constraints and the wishes of the client. The client checks the design and sends it back for more work if necessary.

Reflections on Communication

As you begin to integrate communication into classroom practices, consider the following questions:

- ▶ How can you model communication skills for your students?
- ▶ How can you emphasize communication skills in general and oral communication skills in particular in your classroom?
- ▶ How can students be encouraged to give oral presentations to varied community audiences?
- ▶ How can you encourage students in your class to be better communicators?
- ▶ How can students be encouraged to use technology and new media to communicate innovatively and effectively?

Resources on Communication

The following list of communication skills resources is divided into “General Resources” and “Classroom Resources.” Use these resources to help generate dialogue and action in your classroom, department, and school.

General Resources**National Council of Teachers of English’s (NCTE’s) 21st Century Curriculum and Assessment Framework**

Twenty-first century readers and writers need to:

- ▶ Develop proficiency with the tools of technology
- ▶ Build relationships with others to pose and solve problems collaboratively and cross-culturally
- ▶ Design and share information for global communities to meet a variety of purposes
- ▶ Manage, analyze, and synthesize multiple streams of simultaneous information
- ▶ Create, critique, analyze, and evaluate multimedia texts

- ▶ Attend to the ethical responsibilities required by these complex environments

<http://www.ncte.org/positions/statements/21stcentframework>

New Literacies Research Lab

Lisa Zawilinski, Donald Leu, and members of the New Literacies Research Lab share additional thoughts on 21st century literacies. Good insights on how digital texts and information is affecting reading, writing and communication skills.

<http://www.ncte.org/magazine/extended>

Classroom Resources

Chapter Five – Procedures for Classroom Talk

Content-Area Conversations by Douglas Fisher, Nancy Frey, and Carol Rothenberg

This chapter includes focus on English Language Learners and discusses the types of classroom talk that can be enhanced (including accountable talk), includes discussion on how to structure effective collaborative discussions and groups with emphasis on communication.

<http://www.ascd.org/publications/books/108035/chapters/Procedures-for-Classroom-Talk.aspx>

Institute for Learning – Accountable Talk Resources

The Institute for Learning at the University of Pittsburgh was founded by Lauren Resnick in 1995. Resnick, an internationally renowned cognitive psychologist, senior scientist at the Learning Research and Development Center of the University of Pittsburgh, and leader in the standards movement, was asked by leading practitioners to help them achieve the goals of

the standards movement—giving all students the opportunity to reach or exceed world-class standards.

The Institute's Web site has numerous resources on Accountable Talk, pioneered by Resnick. She describes Accountable Talk as "talk that is orchestrated by teachers so that students learn to formulate responses to problems, interpretations of text that are correct in disciplinary terms and go beyond what was actually written there....The basic idea is the more you manipulate the pieces of knowledge, the better you understand them, the better you remember them, the more complex your memories become and the smarter you get."

<http://ifl.lrdc.pitt.edu/ifl/>

Video of Resnick describing Accountable Talk

http://ifl.lrdc.pitt.edu/ifl/index.php/resources/ask_the_educator/lauren_resnick

Accountable Talk Sourcebook for Classroom Conversation That Works

Sarah Michaels, Clark University; Mary Catherine O'Connor, Boston University; Megan Williams Hall, University of Pittsburgh, with Lauren B. Resnick University of Pittsburgh

<http://ifl.lrdc.pitt.edu/ifl/index.php/download/ats>

Accountable Talk – General Overview

This clear, concise overview is focused on fourth-sixth graders.

<http://www.scholastic.ca/education/movingupwithliteracyplace/teachingtips.html>

The Reading and Writing Project

K-8 writing samples.

<http://tc.readingandwritingproject.com/resources/student-writing/kindergarten>

CREATIVE COMMUNICATION SKILLS ACTIVITIES FOR HIGH SCHOOL STUDENTS

<http://www.essortment.com/teaching-good-communication-skills-classroom-36140.html>

Collaboration

Collaboration is essential in our classrooms because it is inherent in the nature of how work is accomplished in our civic and workforce lives. Fifty years ago, much work was accomplished by individuals working alone, but not today. Much of all significant work is accomplished in teams, and in many cases, global teams.

The Importance of Collaboration

Sites like Wikipedia highlight how interconnected our world has become and emphasizes the benefits of collaborative work. The resulting products are those to which millions of users have contributed. The comprehensive nature of these articles reflects the collaborative culture of the site and demonstrates how people working together can produce extremely inclusive and valuable resources.

Generally, collaboration has been accepted as a skill that's essential to achieve meaningful and effective results. In the past decade, however, it has become increasingly clear that collaboration is not only important but necessary for students and employees, due to globalization and the rise of technology.

The Global Learning and Observations to Benefit the Environment (GLOBE) Program, a worldwide, hands-on, primary and secondary school-based science and education program, is an example of students collaborating with each other to impact global problems. GLOBE's vision promotes and supports students, teachers, and scientists to collaborate on inquiry-based investigations of the environment and the Earth system working in close partnership with NASA, the National Oceanic and Atmospheric Association (NOAA), and the National Science Foundation (NSF) Earth System Science Projects (ESSP's) in study and research about the dynamics of Earth's environment. Over 1.5 million students have participated in GLOBE, contributing more than 21 million measurements to the GLOBE database for use in their inquiry-based science projects. More projects like GLOBE are needed for students to be prepared for a global, technology-based workforce.¹⁸

Various scholars and authors have emphasized the importance of collaboration. Author James Surowiecki, for example, explains how we use the "wisdom of crowds" in the new economy by saying that "under the right circumstances, groups are remarkably intelligent, and are often smarter than the smartest people in them." Surowiecki underscores the importance of collaboration by remarking that "... a large group of diverse individuals will come up with better and more robust forecasts and make more intelligent decisions than even the most skilled 'decision maker.'"¹⁹ Diversity brings multiple individual and cultural perspectives into the collaboration. Not only does a collaborative effort create more holistic results than individual efforts,

but it also creates knowledge for a greater number of people.

As a result of students working collaboratively, the group can generate more knowledge, making collaboration a key ingredient to student success in today's global society.

Definition of Collaboration

Collaboration can be defined in many ways, but P21 defines collaboration as follows:²⁰

Collaborate with Others

- ▶ Demonstrate ability to work effectively and respectfully with diverse teams
- ▶ Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal
- ▶ Assume shared responsibility for collaborative work, and value the individual contributions made by each team member

A "collaboration rubric," created by the New Technology High School, can be found here: http://www.p21.org/route21/index.php?option=com_jlibrary&view=details&task=download&id=382

Ways to Integrate Collaboration into Your Classroom

P21 forged alliances with key national organizations that represent the core academic subjects, including social studies, English, science, geography, world languages, mathematics, and the arts. These collaborations resulted in the 21st Century Skills Maps that illustrate the intersection between core subjects and 21st Century Skills. This section includes examples of what collaboration skills might

look like in core academic content classrooms. These examples, drawn primarily from the aforementioned content maps, demonstrate how collaboration skills can be integrated into classroom teaching and learning across a variety of grade levels and disciplines.

WORLD LANGUAGES – 4TH GRADE

Students team with another class in a target language country to identify and compare endangered species in both countries. Using basic information in the target language, the students collaborate to produce a multimedia informational presentation for their peers.

ARTS – 4TH GRADE

While rehearsing a piece in music class, students discuss as a group how each individual part (melody, descant, harmonic or rhythmic accompaniment) contributes to the musical effectiveness of the overall performance, and how all musicians must work together to create a satisfying whole. Students also experiment with and discuss how the director (whether student or teacher) communicates with the ensemble (gestures, head movements, facial expressions) to help shape performance.

SCIENCE – 8TH GRADE

Working in collaboration with other classes in the school, students investigate water runoff on their school grounds and use Global Positioning System (GPS) and Geographic Information System (GIS) technologies to create relevant maps. Students are assigned specific interdependent roles based on their interests and talents including background research, data gathering, GPS and GIS use, creating graphics, and communicating findings. Students meet in

their investigation teams. They also meet with students in other classes who share their roles in the project (i.e., GPS operators from each class meet together to discuss their work). Students work collaboratively, either virtually or face-to-face, while participating in scientific discussions and appropriately using claims, evidence, and reasoning.

GEOGRAPHY – 8TH GRADE

After studying an environmental community issue (landfills, water quality, maintaining open space, recycling), students compose email messages appropriate to various local, state, and national officials, stating their opinion and offering alternatives to current methods of dealing with the issue. Encourage students to consider their audience and develop effective ways to create a coordinated and articulate email campaign that will have an impact. Students demonstrate the ability to work effectively with diverse teams.

SOCIAL STUDIES – 12TH GRADE

Working in small groups, students survey favorite forms of recreation among local teens. Students also research the local history of recreational youth facilities for teens and the potential sources of political and economic support. The information is graphed and analyzed, and each group creates a business plan for developing a local recreation center/club for teens. Students present survey results, need, and plan to a community group or civic association using technology tools. Working in small groups, students research a current issue and analyze its historical, political, and economic components, various viewpoints, and potential solutions, and create a digital presentation that clearly describes all sides of the issue.

ENGLISH – 12TH GRADE

Students collaborate with senior citizens in a digital storytelling workshop. The teams bring to life a story from a senior's history as they collaborate on writing and creating the video, including recording the narration and selecting images and music. The students present the finished videos in a community film festival. Each team designs criteria for evaluating their video in advance, and grades their work accordingly. Students demonstrate the ability to work effectively with diverse teams.

MATHEMATICS – 8TH GRADE

Students form investigative teams. Each team is asked to investigate the crime rate in a particular city, represented by the variable "x". Each team then formulates a question about a possible causal variable "y". For example, a team might ask if crime rates are lower in cities with a larger police force, or higher in cities with higher poverty rates. The team then chooses 30 to 40 other cities with which to compare their city's crime rate. By conducting an Internet search, they collect data on x and y. If team members find their data too difficult to access, they consider revising the question. For example, if they are not finding suitable data on poverty rates, team members might decide to investigate the size of the police force in each city instead. Team members analyze the data they have collected, define the relationship between x and y, and discuss questions such as the reliability of the data, its statistical significance, and the validity of the sources. Each team prepares a presentation, explaining the findings and team members' conclusions.

Resources on Collaboration

The following list of collaboration resources is divided into “General Resources” and “Classroom Resources.” Use these resources to help generate dialogue and action in your classroom, department, and school.

General Resources

CORAL

Collaborative Online Research and Learning (CORAL) is a multidisciplinary collaborative task force composed of members at various universities who are dedicated to creating and testing a model to integrate technology with collaborative teaching and learning.

The CORAL group believes classrooms should provide places where students have the opportunity to be learners actively working together on a specific learning objective, a goal endorsed by the Forum on Technology in Education (U.S. Department of Education, 1999) and others (e.g., Dede, 2000). The model developed by the CORAL project uses the Internet as a collaborative tool connecting university-level students in varied disciplines and at distant sites in an effort to complete a joint project.

<http://coral.wcupa.edu/>

The GLOBE Program

The **Global Learning and Observations to Benefit the Environment (GLOBE)** program is a worldwide, hands-on, primary and secondary school-based science and education program. GLOBE’s vision promotes and supports students, teachers, and scientists to collaborate on inquiry-based Earth system and environmental investigations working in close partnership with NASA, NOAA, and NSF Earth System Science Projects (ESSPs).

Introduced in 1994, GLOBE began operations on Earth Day 1995. Today, the international GLOBE network includes representatives from 111 participating countries coordinating GLOBE activities that are integrated into their local and regional communities. Due to their efforts, there are more than 54,000 GLOBE-trained teachers representing over 23,000 schools around the world. Over 1.5 million students have participated in GLOBE, contributing more than 21 million measurements to the GLOBE database for use in their inquiry-based science projects.

<http://globe.gov/about>

Reflections on Collaboration

As you begin to integrate collaboration into classroom practices, consider the following questions:

- ▶ How can you model effective collaboration skills for your students?
- ▶ How can you create a learning environment that emphasizes collaboration skills?
- ▶ How can you provide students substantial opportunities to work in diverse teams?
- ▶ How can you encourage students to be more effective collaborators?
- ▶ How can teachers share/improve their practices for increasing collaboration activities in their classroom practices?

Classroom Resources

Project Based Learning (PBL) Starter Kit: 21st Century Skills Rubrics

The Collaboration Rubric can be used to assess how well a student works as a member of a team during a project. It is designed to assess individual performance, not the group as a whole. The Presentation Rubric guides assessment of an individual or a team presentation to an audience, which may be accompanied by the use of media or visual aides.

http://www.bie.org/images/uploads/useful_stuff/PBL_St_Kit_rubrics.pdf

Using Groups Effectively: 10 Principles

A useful list of ten principles for teaching collaboration effectively in classrooms. Answers questions such as: When are groups effective as means of learning? What tasks are better accomplished collaboratively than individually? How do you structure groups for optimal effectiveness and results?

<http://eduratireview.com/2011/01/using-groups-effectively-10-principles/>

Creating Online Professional Learning Communities and How to Translate Practices to the Virtual Classroom

A beneficial “best practices” list that explains the role of professional learning communities in schools, who joins them, and what they do.

<http://www.elearnmag.org/subpage.cfm?section=articles&article=122-1>

Meta Collab

A discussion of Wikiversity, other collaboration efforts—the wiki on collaboration.

<http://collaboration.wikia.com/wiki/Category:Education>

NoodleTools: Curriculum Collaboration Toolkit

Very helpful Q&A for teachers that provides links to various documents and suggestions on collaboration.

<http://www.noodletools.com/debbie/consult/collab/>

Department of Education—Teacher’s Guide to International Collaboration on the Internet

A list of resources for cross-cultural interaction and project work compiled by the Department of Education.

http://www2.ed.gov/teachers/how/tech/international/guide_pg2.html

Creativity and Innovation

In the past, Americans perceived creativity and innovation as secondary in our national curriculum. Today, creativity and innovation are key drivers in the global economy.

The Importance of Creativity

Author Daniel Pink remarked, "The future belongs to a very different kind of person with a very different kind of mind—creators and empathizers, pattern recognizers and meaning makers. These people...will now reap society's richest rewards and share its greatest joys."²¹ If students leave school without knowing how to continuously create and innovate, they will be underprepared for the challenges of society and the workforce.

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. Sir Kenneth Robinson, a leading thinker and speaker on creativity said, "Creativity is as important in education as literacy and we should treat it with the same status."²²

According to Robert Sternberg of Tufts University, "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."²³ ✓

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 into Harvard Business School.²⁴ Howard Gardner 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."²⁵ Similarly, author Richard Florida stated, "I call the age we are entering the creative age because the key factor propelling us forward is the rise of creativity as the primary mover of our economy."²⁶

Perhaps Pink sums it up best, "In a world enriched by abundance but disrupted by the automation and outsourcing of white-collar work, everyone must cultivate an artistic sensibility. We may not all be Dali or Degas. But today we must all be designers."²⁷

Definition of Creativity and Innovation

Creativity can be defined in many ways, but P21 defines creativity as follows:²⁸

Think Creatively

- ▶ Use a wide range of idea creation techniques (such as brainstorming)
- ▶ Create new and worthwhile ideas (both incremental and radical concepts)
- ▶ Elaborate, refine, analyze, and evaluate original ideas to improve and maximize creative efforts

Work Creatively with Others

- ▶ Develop, implement, and communicate new ideas to others effectively
- ▶ Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work
- ▶ Demonstrate originality and inventiveness in work and understand the real world limits to adopting new ideas
- ▶ View failure as an opportunity to learn; understand that creativity and innovation are part of a long-term, cyclical process of small successes and frequent mistakes

Implement Innovation

- ▶ Act on creative ideas to make a tangible and useful contribution to the field in which the innovation will occur

For another rubric that details creativity, refer to Catalina Foothills' interpretation of the skill in its "Critical and Creative Thinking" rubric, which

can be found here: http://www.p21.org/route21/index.php?option=com_jlibrary&view=details&task=download&id=160

Relationship to Other Cs

Creativity is closely intertwined with some of the other skills previously identified. Innovation today has a social component and requires adaptability, leadership, teamwork, and interpersonal skills. Increasingly, today the capacity to innovate is linked to the ability to connect with others and with a facility for communication and collaboration.

Ways to Integrate Creativity into Your Classroom

P21 forged alliances with key national organizations that represent the core academic subjects, including social studies, English, science, geography, world languages, mathematics, and the arts. These collaborations resulted in the 21st Century Skills Maps that illustrate the intersection between core subjects and 21st Century Skills. This section includes examples of what creativity and innovation skills might look like in core academic content classrooms. These examples, drawn primarily from the aforementioned content maps, demonstrate how creativity and innovation skills can be integrated into classroom teaching and learning across a variety of grade levels and disciplines.

ARTS – 12TH GRADE

After studying a composer's work, students compose a theme, then create variations on that theme in that composer's style. Students notate their compositions using electronic software, orchestrate their compositions using

a variety of sound sources (synthesized or acoustic), and publish their compositions in a class book for other students to check out, listen to, and perform. The students investigate new processes, implement creative ideas, and revisit traditional ideas to create new and reinterpret existing works of visual and performing art.

WORLD LANGUAGES – 12TH GRADE

Students investigate alternative energy projects in a target language country (e.g., Solar

Decathlon Europe) and use ideas gleaned from their investigation to design and explain an original design of an electric car, solar house, or renewable energy alternative specific to their school. Students vote on the best use of renewable energy and defend their choice in an alternative energy publication.

SCIENCE – 8TH GRADE

Student teams design plans for a device that will assist people with disabilities and create 3-D sketches of their device using simple computer-aided design software. The class develops criteria for peer review, and then teams pass their plans to another team that makes recommendations for refinements to improve the original plans.

All teams debrief together on their experience with the engineering/design process and identify the different scientific disciplines they used to create their design (biology, physics, engineering, etc.) and how those disciplines interrelate when applied to solving the design problem. Students also discuss what other expertise they could use to improve their designs—including input from people with the disabilities their designs address. Students are able to describe how science and engineering involve creative processes that include generating and testing ideas, making

observations, and formulating explanations, and can apply these processes in their own investigations.

GEOGRAPHY – 8TH GRADE

After identifying a local issue (i.e., recycling opportunities, congested traffic, excessive litter in a park, noise pollution, water contamination, recreation facilities), students conduct primary research, gather numerical data, and convert it to statistical information (means, trends, correlations). Students present their findings in graphs, charts, and maps, use software to develop community digital data bases, and present a position on the issue. Students prepare an editorial slideshow presentation for a local governing board, or develop a Web site to use in presenting their position, and make a multimedia presentation for local service clubs, such as Kiwanis, Rotary, Library Guild, etc.

SOCIAL STUDIES – 4TH GRADE

Students interview students and/or teachers to identify a problem (e.g., bullying on the playground) and as a group brainstorm creative ways to address the problem (producing a play that examines the issue, hosting a contest for best ideas). Students develop creative solutions to a class or school problem.

ENGLISH – 4TH GRADE

Students collect a variety of newspaper and magazine articles on a social or environmental issue. In small groups, they decide on an issue and a theme and style for a poem. They use words and phrases cut from the articles to create a “found poem” on their topic.

Reflections on Creativity

As you begin to integrate creativity and innovation into classroom practices, consider the following questions:

- ▶ How can you model creativity and innovation skills for your students?
- ▶ How can you encourage creativity and innovation in your classroom?
- ▶ How can you incorporate more creativity and innovation into your lesson plans?
- ▶ How can you encourage students to be more creative and innovative?
- ▶ How can you and your colleagues work together to improve your pedagogical practices involving innovation and creativity?

Resources on Creativity

The following list of resources on creativity are divided into “General Resources” and “Classroom Resources.” Use these resources to help generate dialogue and action in your classroom, department, and school.

General Resources

The Creativity Crisis

This *Newsweek* article by Po Bronson and Ashley Merryman is an excellent background document for strategic conversations around creativity in education. It covers some of the historical and global context of creativity in the classroom and

its importance in the 21st century economy. The piece also details emerging research on cognition and neuroscience and how these new findings are changing how we think about creativity.

<http://www.newsweek.com/2010/07/10/the-creativity-crisis.print.html>

How—and why—to teach innovation in our schools

This *eSchool News* article by Alexander Hiam discusses the “Five I’s”: Imagination, Inquiry, Invention, Implementation, and Initiative.

<http://tinyurl.com/ydv82hz>

It’s Time to Get Serious About Creativity in the Classroom

Jim Moulton’s Edutopia blog post discusses “freedom within a structure”—in other words, making the assignment clear and focused, but allowing real freedom in how the tasks will be accomplished. For example: “Let’s say we bring a group of kids into the art room and tell them they can do whatever they want. Will they become creative? I always thought the answer to this was yes, but turns out the answer is no.”

<http://www.edutopia.org/freedom-structure-balance-classroom>

Classroom Resources

Arts Edge—The Kennedy Center

This rich Web site features lessons, activities, projects, and curriculum guidelines for educators to use to promote creativity in the arts, history, literature, and other humanities disciplines. In addition, there is a wealth of multimedia resources and ideas to encourage the use of technology as a creative educational tool.

<http://artsedge.kennedy-center.org/educators.aspx>

Critical and Creative Thinking—Bloom's Taxonomy

This site addresses key questions such as: What are critical thinking and creative thinking? What's Bloom's taxonomy, and how is it helpful in project planning? How are the domains of learning reflected in technology-rich projects?

<http://eduscapes.com/tap/topic69.htm>

Dan Pink's Right Brain Discussion Guide for Educators

This basic discussion guide encourages educators to consider how their education systems incorporate "right brain" (creative) approaches to teaching and learning. The guide draws from Pink's book, *A Whole New Mind*.

<http://www.danpink.com/PDF/AWNMforeducators.pdf>

Habits of Mind in Math—blog post

This blog post lists ideas that touch on the issue of creativity/"tinkering" in mathematics. These ideas, as well as the comments section, may provide thought-provoking ideas for educators who are interested in exploring inquiry-based approaches to mathematics instruction.

<http://mathteacherorstudent.blogspot.com/2010/09/habits-of-mind.html>

Intel: Visual Ranking, Seeing Reason, and Showing Evidence Tools

These free, online tools are effective ways of bringing idea creation techniques into the classroom. The site also provides tutorials, project examples, and instructional strategies.

<http://www.intel.com/education/teachers/>

Mathematics and the Arts

In this issue of the *Notices* of the American Mathematical Society, the theme is "Mathematics and the Arts." Even in the time of the ancient Greeks it was generally recognized that mathematics and art are inextricably intertwined. The symbiosis has continued through the ages. Today, with computer graphics and many new artistic media, this interplay has taken startling and enlightening new forms. Here are four articles to showcase different aspects of mathematics and art.

<http://www.ams.org/notices/201001/>

Teaching Creativity

Written by an art teacher, this article covers pedagogical approaches to teaching creativity in the classroom: "I write this as an art teacher for other art teachers. However, I think teachers in every area need to reflect on what they are doing that tends to foster or hinder the creative critical thinking that is so essential as a survival and success skill in today's world."

<http://www2.goshen.edu/~marvinpb/arted/tc.html>

The Creative Wisconsin Guide for Local Community Action Planning: A Toolkit for Communities Seeking to Advance the Arts and Creativity in Education

This guide provides valuable tools and processes for local teams—comprised of representatives from area businesses, schools, community groups, and cultural arts organizations—to improve arts and creativity in education in their communities.

<http://www.creative.wisconsin.gov/>

The Marshmallow Challenge

The Marshmallow Challenge is a remarkably fun and instructive design exercise that encourages teams to experience simple but profound lessons in collaboration, innovation, and creativity.

<http://www.marshmallowchallenge.com/Welcome.html>

For a fascinating take on who does this challenge best, see this TED talk:

http://www.ted.com/talks/lang/eng/tom_wujec_build_a_tower.html

While this guide provides a wealth of information on the “Four Cs,” information can sometime raise as many questions as it answers. Here are the answers to 12 of the most frequently asked questions about the “Four Cs.”

Q: Will the focus on the “Four Cs” dilute our commitment to content mastery?

A: Absolutely not. In fact, content learning is enriched when critical thinking, collaboration, communication, and creativity are part of classroom practice.

Q: Are the “Four Cs” just an add-on?

A: No. Integrating the “Four Cs” into teaching and learning is good practice. Critical thinking, collaboration, communication, and creativity are outstanding teaching strategies that should be used every day.

Q: How do the “Four Cs” relate to the new Common Core standards that most states have adopted?

A: The Common Core standards include increased emphasis on critical thinking, reasoning, and communication skills. Therefore, they create a context in which the “Four Cs” are essential. Teachers who want to prepare their students for the Common Core standards will place more emphasis on critical thinking and communication skills.

Q: How do the “Four Cs” relate to the newly updated AP exams?

A: The biology and history AP exams have been redesigned to emphasize critical thinking and problem solving skills. Educators who emphasize

these skills find that their students are better prepared for the new, redesigned AP exams.

Q: How will the “Four Cs” impact curriculum and instruction?

A: Educators must reflect on what changes are required as the Common Core standards and the AP exams deemphasize memorization and more strongly emphasize critical thinking and problem solving. Educators must adopt strategies that accentuate the importance of problem solving. Project-based learning is one of the strategies likely to be helpful in this context.

Q: How will the “Four Cs” impact professional development?

A: Professional development must emphasize how to teach critical thinking, collaboration, communication, and creativity skills. This can be done effectively in professional learning communities where colleagues work collaboratively to improve classroom practices of the “Four Cs.”

Q: Where are we today in the assessment of the “Four Cs”?

A: Assessments are being developed based on the Common Core standards that place more emphasis on critical thinking and communication skills. The AP exams place more emphasis on critical thinking, problem solving, and applied knowledge. This creates a major impetus for

teaching the “Four Cs.” In addition, teachers, schools, and districts should incorporate the assessment of the “Four Cs” into portfolio assessments, performance-based assessments, and capstone projects.

Q: You want us to focus on the “Four Cs,” but what about topics like global competence, financial literacy, and environmental literacy?

A: These additional topics are very important. In fact, some schools and districts have adopted them in addition to the “Four Cs.” Educators must also contemplate teaching the “Four Cs” in the context of these subjects. For example, it is important to engage in global problem solving, global communications, global collaboration, and global innovation. It is most exciting for students when you teach the “Four Cs” in the context of engaging content and challenging problems.

Q: How can technology help support the “Four Cs”?

A: Technology has a crucial role to play in mastering the “Four Cs.” While critical thinking, collaboration, communication, and creativity can all be taught in a low-tech environment, 21st century students need to harness technology to be effective problem solvers, collaborators, communicators, and creators. They must use technology to collaborate with others in communities beyond their own.

Q: How are colleges of education teaching prospective teachers about the “Four Cs”?

A: A growing number of colleges of education are beginning to build the “Four Cs” into their curriculum for preservice teachers. Examples of these practices are included in a paper prepared by AACTE, NCATE, and P21 that outlines what colleges of education should be doing to emphasize the “Four Cs” in their work. (http://www.p21.org/documents/aacte_p21_whitepaper2010.pdf)

Q: How proficient in English must English learners be before they can begin to develop 21st Century Skills?

A: There is no need to wait for students to acquire English fluency before introducing 21st Century Skills into their instruction. In fact, English learners have much to share regarding language and cultural knowledge that may help develop 21st Century Skills for their English-only classmates. In addition, use of 21st Century Skills can enhance the English learners’ language skills in their primary languages, as well as English. Using 21st Century Skills can help make difficult academic content concepts accessible to English learners before they acquire English fluency.

Q: Are the “Four Cs” for all students, including those students with special needs?

A: Yes, all students will need the “Four Cs” to achieve in the new global economy. In fact, the Council for Exceptional Children supports a concept called “Authentic Learning,” which encourages educators to design lessons in which special education students engage in thinking creatively to solve real world problems.

What are the next steps you could take? Hopefully, this guide has inspired you to become more proactive in advancing the “Four Cs” throughout education. Here are some initial suggestions you can use to ensure the “Four Cs” impact education from your classroom to your state capital.

In Your Classroom

This guide has provided some ideas to help you incorporate the “Four Cs” into your own teaching practice. If your content area expertise is covered by one of the P21 content maps mentioned in the introduction, be sure to download the map and read it. Many educators have come to realize that they must engage in more problem- and project-based learning if they are to embed the “Four Cs” into their classroom practices. Specifically, we recommend the materials from the Buck Institute for Education (BIE) (www.bie.org). Last year, they issued the PBL starter kit for 6-12 grade teachers. This year, they issued the PBL kit for K-5 teachers. These are excellent sources to help you increase the use of project-based learning.

In Your Department

In addition to incorporating more of the “Four Cs” in your classroom practices, include discussions about the “Four Cs” in your departmental activities. If there is a P21 content map in your discipline, share it with your department chairs, and urge them to use it as an awareness tool for teachers in the department.

If there are professional learning communities in your department, urge them to focus a significant amount of their time on embedding the “Four Cs” into teacher practice.

In Your School

Adoption of the “Four Cs” will go much more smoothly if your school leaders are fully supportive. Urge your principal to share the “Four Cs” with the department chairs and consider using this strategy as a professional development theme. In addition, urge them to include more project-based learning in all professional development activities.

Consider creating a book club or literature study group around 21st Century Skills reading. You can find examples of 21st Century Skills books in the “Additional Resources” section.

In Your District

While adoption of the “Four Cs” within your specific school is very important, ultimately, implementation of the “Four Cs” won’t happen systematically unless the entire district gets behind it. You should urge your superintendent and leadership team to actively support the “Four Cs” and integrate them into curriculum and instruction, professional development, and assessment in your district.

In addition, many superintendents and district leaders around the country have begun district-wide initiatives supporting the “Four Cs.” Some of them have joined EdLeader21, a professional learning community of district leaders committed to 21st century education (www.edleader21.org). You should suggest that your superintendent and district leaders consider joining EdLeader21.

In Your State

At the time this guide was published, 16 states had formally adopted 21st century education as a strategy for all of their students. Visit the

P21 Web site (www.p21.org) to see your state's status. If yours is a P21 state, you can work with your NEA affiliate to determine who in the state government is responsible for promoting 21st century education. Find out what resources they have that could help your school and district with their 21st century education efforts. If your state is not a P21 state, contact your NEA state affiliate and P21 to find out what you can do to promote state policy that supports 21st century education and the "Four Cs."

Nationally

You can actively promote the "Four Cs" in national policy by working with your NEA affiliate to impress upon your Congressional representatives the importance of including the "Four Cs" in the reauthorization of ESEA. You can also encourage the Obama administration to include the "Four Cs" in their "Blueprint for Reform" for education. Go to www.ed.gov and leave a message telling them to include the "Four Cs" in their proposal.



Conclusion

Over the last decade, an enormous amount of energy has been expended on the need for new federal and state policies around 21st century learning. However, if 21st century education is ever going to make a difference in the lives of students, teachers must have the support they need to do this work in classrooms every day.

The teaching critical thinking and problem solving, communication, collaboration, and creativity and innovation are not new concepts for educators. In fact, they are the basis of great teaching, and most teachers aspire to teach in a manner that incorporates these strategies.

The number of students leaving our K-12 schools and districts with effective critical thinking, communication, collaboration, and creativity skills, however, is very uneven. We now know, based on the work of the 21st Century Skills movement, that **every child needs these skills to be an effective citizen and participant in the new global economy.** Teachers and education support personnel have a huge role to play to ensure that every student is adequately prepared. This guide is intended to help prepare better educators in a new global landscape.

Affiliated National Content Group Associations

SUBJECT	AFFILIATED GROUP	LINK TO MAP
World Languages	American Council on the Teaching of Foreign Languages (ACTFL)	http://www.p21.org/documents/Skills%20Map/p21_worldlanguagesmap.pdf
Arts	National Association for Music Education (MENC)	http://www.p21.org/documents/P21_arts_map_final.pdf
Geography	National Council for Geographic Education (NCGE)	http://www.p21.org/documents/21stskillsmap_geog.pdf
Science	National Science Teachers Association (NSTA)	http://www.p21.org/documents/21stskillsmap_science.pdf
Social Studies	National Council for the Social Studies (NCSS)	http://www.p21.org/documents/ss_map_11_12_08.pdf
English	National Council of Teachers of English (NCTE)	http://www.p21.org/documents/21st_century_skills_english_map.pdf
Mathematics	National Council of Teachers of Mathematics (NCTM)	http://www.p21.org/storage/documents/P21_Math_Map.pdf

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

Some of the language in this guide was derived from “The Intellectual Policy Foundations of the 21st Century Skills Framework,” written by the Partnership for 21st Century Skills in 2007.

The full report, which details the rationale behind of 21st Century Skills, can be found at: http://www.p21.org/route21/images/stories/epapers/skills_foundations_final.pdf

21st Century Skills Books

Below is a list of books that provide more information about 21st Century Skills:

21st Century Skills: Learning for Life in Our Times

by Bernie Trilling and Charles Fadel
Jossey-Bass, 2005

Curriculum 21: Essential Education for a Changing World

by Heidi Jacobs
ASCD, 2010

The Global Achievement Gap: Why Even Our Best Schools Don't Teach the New Survival Skills Our Children Need—And What We Can Do About It

by Tony Wagner
Basic Books, 2008

21st Century Skills: Rethinking How Students Learn

Coedited by James Bellanca and Ron Brandt
Solution Tree Press

The Case for Twenty-First Century Learning

Coedited by Eric Schwarz and Ken Kay
Jossey Bass

Project Based Learning for the 21st Century Starter Kit

http://www.bigge.org/store/item/pbl_starter_kit

Project Based Learning for the 21st Century in the Elementary Grades

http://www.bie.org/store/item/pbl_elementary

Route 21

Route 21, a P21 online database, houses dozens of articles, chapters, classroom tools, and other items related to creativity. The site is a one-stop-shop for 21st century skills-related information, resources, and community tools.

Route 21 link: www.p21.org/route21/

Video 21

P21's video collection is comprised of contributions from educators across the country. What does combining the "Three Rs" and the "Four Cs" look like in your classrooms? What is the importance of 21st century readiness to our youth, our communities and our nation?

Video 21 link:

<https://thepartnershipfor21stcenturyskills238.eduvision.tv/default.aspx>

Teach 21

West Virginia teachers designed Teach 21 to assist colleagues in planning and delivering effective 21st century instruction in West Virginia classrooms. It enables educators to quickly access 21st century content standards, learning skills, and technology tools for West Virginia schools, as well as other resources that exemplify rigorous and relevant instructional design and delivery.

Information is easily accessible for teachers, administrators, parents, and students. Standards-based units, lesson plans, instructional guides and project based learning designs model the integration of content, learning skills and technology standards, research-based instructional strategies, differentiated instruction, and rich classroom assessments, including a culminating performance, product or project with an accompanying rubric.

Student achievement is at the heart of the triangle.. The wealth and depth of resources provided support West Virginia's goal to prepare students to be successful in tomorrow's world.

Teach 21 link:

<http://wvde.state.wv.us/teach21/>

- "About GLOBE." *Globe.gov*. The GLOBE Program. Web. 16 May 2011. <http://globe.gov/about>.
- "AMA 2010 Critical Skills Survey: Executive Summary." *P21.org*. American Management Association, 15 Apr. 2010. Web. 16 May 2011. <http://www.p21.org/documents/Critical%20Skills%20Survey%20Executive%20Summary.pdf>.
- "Are They Really Ready To Work?" *P21.org*. The Conference Board, 29 Sept. 2006. Web. 16 May 2011. http://www.p21.org/documents/FINAL_REPORT_PDF09-29-06.pdf.
- Brown, John Seely, and Paul Duguid. *The Social Life of Information*. Boston: Harvard Business School, 2000. Print.
- "Communication and Collaboration." *P21.org*. Partnership for 21st Century Skills. Web. 16 May 2011. http://www.p21.org/index.php?option=com_content&task=view&id=261&Itemid=120.
- Conley, David T. "Toward a More Comprehensive Conception of College Readiness." Educational Policy Improvement Center, 8 Feb. 2008. Web. 16 May 2011. <http://epiconline.org/files/pdf/Houston%20A+%20Friday%2015-088.pdf>.
- "Creativity and Innovation." *P21.org*. Partnership for 21st Century Skills. Web. 16 May 2011. http://p21.org/index.php?option=com_content&task=view&id=262&Itemid=120.
- "Critical Thinking and Problem Solving." *P21.org*. Partnership for 21st Century Skills. Web. 16 May 2011. http://www.p21.org/index.php?option=com_content&task=view&id=260&Itemid=120.
- Duncan, Arne. "An Open Letter from Arne Duncan to America's Teachers." *U.S. Department of Education*. U.S. Department of Education, 2 May 2011. Web. 16 May 2011. <http://www.ed.gov/blog/2011/05/in-honor-of-teacher-appreciation-week-an-open-letter-from-arne-duncan-to-americas-teachers/>.
- Florida, Richard L. *The Flight of the Creative Class*. New York: HarperBusiness, 2005. Print.
- Gardner, Howard. *Five Minds for the Future*. Boston, MA: Harvard Business School, 2007. Print.
- Hoerr, Thomas. "Distributed Intelligence and Why Schools Need to Foster It." *Independent School* Fall 2003: 76-83. Print.
- Levy, Frank, and Richard J. Mundane. *The New Division of Labor: How Computers Are Creating the next Job Market*. New York: Russell Sage Foundation, 2004. Print.
- "Number of Jobs Held, Labor Market Activity, and Earnings Growth Activity, and Earnings Growth Among the Youngest Baby Boomers: Results from a Longitudinal Survey." *Bureau of Labor Statistics*. U.S. Department of Labor, 10 Sept. 2010. Web. 16 May 2011. <http://www.bls.gov/news.release/pdf/nlsoy.pdf>.
- Obama, Barack. "Obama's Remarks On Education." *Breaking News Headlines: Business, Entertainment & World News - CBS News*. CBS News, 10 Mar. 2009. Web. 16 May 2011. http://www.cbsnews.com/8301-503544_162-4855902-503544.html.
- Paul, Richard, and Linda Elder. "Critical Thinking: The Nature of Critical and Creative Thought." *Journal of Developmental Education* 30.2 (2006): 34-35. Print.
- Pink, Daniel. *A Whole New Mind*. New York: Riverhead, 2006. Print.
- Robinson, Ken. "Ken Robinson Says Schools Kill Creativity." Speech. TED Talks. Long Beach/Palm Springs. 16 May 2011. *TED Talks*. Web. 16 May 2011. http://www.ted.com/talks/ken_robinson_says_schools_kill_creativity.html.
- Seefeldt, Carol. "Helping Children Communicate." *Early Childhood Today*. Scholastic, Sept. 2004. Web. 16 May 2011. <http://www2.scholastic.com/browse/article.jsp?id=3747357>.
- Sternberg, Robert J. *Wisdom, Intelligence, and Creativity Synthesized*. Cambridge: Cambridge UP, 2007. Print.
- Surowiecki, James. *The Wisdom of Crowds*. New York: Anchor, 2005. Print.
- Trilling, Bernie, and Charles Fadel. *21st Century Skills Learning for Life in Our times*. San Francisco, CA: Jossey-Bass, 2009. Print.

- ¹ Obama, Barack. "Obama's Remarks On Education." CBS News. CBS News, 10 Mar. 2009. Web. 16 May 2011. http://www.cbsnews.com/8301-503544_162-4855902-503544.html.
- ² Duncan, Arne. "An Open Letter from Arne Duncan to America's Teachers." U.S. Department of Education. U.S. Department of Education, 2 May 2011. Web. 16 May 2011. <http://www.ed.gov/blog/2011/05/in-honor-of-teacher-appreciation-week-an-open-letter-from-arne-duncan-to-americas-teachers/>.
- ³ "Number of Jobs Held, Labor Market Activity, and Earnings Growth Among the Youngest Baby Boomers: Results from a Longitudinal Survey." Bureau of Labor Statistics. U.S. Department of Labor, 10 Sept. 2010. Web. 16 May 2011. <http://www.bls.gov/news.release/pdf/nlsoy.pdf>.
- ⁴ Trilling, Bernie, and Charles Fadel. *21st Century Skills Learning for Life in Our Times*. San Francisco, CA: Jossey-Bass, 2009. Print.
- ⁵ "AMA 2010 Critical Skills Survey: Executive Summary." P21.org. American Management Association, 15 Apr. 2010. Web. 16 May 2011. <http://www.p21.org/documents/Critical%20Skills%20Survey%20Executive%20Summary.pdf>.
- ⁶ Conley, David T. "Toward a More Comprehensive Conception of College Readiness." Educational Policy Improvement Center, 8 Feb. 2008. Web. 16 May 2011. <http://epiconline.org/files/pdf/Houston%20A+%20Friday%202-15-088.pdf>
- ⁷ Levy, Frank, and Richard J. Murnane. *The New Division of Labor: How Computers Are Creating the Next Job Market*. New York: Russell Sage Foundation, 2004. Print.
- ⁸ "AMA 2010 Critical Skills Survey: Executive Summary."
- ⁹ "Critical Thinking and Problem Solving." P21.org. Partnership for 21st Century Skills. Web. 16 May 2011. http://www.p21.org/index.php?option=com_content&task=view&id=260&Itemid=120.
- ¹⁰ Paul, Richard, and Linda Elder. "Critical Thinking: The Nature of Critical and Creative Thought." *Journal of Developmental Education* 30.2 (2006): 34-35. Print.
- ¹¹ Hoerr, Thomas. "Distributed Intelligence and Why Schools Need to Foster It." *Independent School* Fall 2003: 76-83. Print.
- ¹² "Are They Really Ready To Work?" P21.org. The Conference Board, 29 Sept. 2006. Web. 16 May 2011. http://www.p21.org/documents/FINAL_REPORT_PDF09-29-06.pdf.
- ¹³ Levy, Frank, and Richard J. Murnane.
- ¹⁴ "Communication and Collaboration." P21.org. Partnership for 21st Century Skills. Web. 16 May 2011. http://www.p21.org/index.php?option=com_content&task=view&id=261&Itemid=120.
- ¹⁵ Seefeldt, Carol. "Helping Children Communicate." *Early Childhood Today*. Scholastic, Sept. 2004. Web. 16 May 2011. <http://www2.scholastic.com/browse/article.jsp?id=3747357>.
- ¹⁶ Brown, John Seely, and Paul Duguid. *The Social Life of Information*. Boston: Harvard Business School, 2000. Print.
- ¹⁷ Pink, Daniel. *A Whole New Mind*. New York: Riverhead, 2006. Print.
- ¹⁸ "About GLOBE." *Globe.gov*. The GLOBE Program. Web. 16 May 2011. <http://globe.gov/about>.
- ¹⁹ Surowiecki, James. *The Wisdom of Crowds*. New York: Anchor, 2005. Print.
- ²⁰ "Communication and Collaboration."
- ²¹ Pink, Daniel.
- ²² Robinson, Ken. "Ken Robinson Says Schools Kill Creativity." Speech. TED Talks. Monterey, CA. *TED Talks*. Web. 16 May 2011. http://www.ted.com/talks/ken_robinson_says_schools_kill_creativity.html.
- ²³ Sternberg, Robert J. *Wisdom, Intelligence, and Creativity Synthesized*. Cambridge: Cambridge UP, 2007. Print.
- ²⁴ Pink, Daniel.
- ²⁵ Gardner, Howard. *Five Minds for the Future*. Boston, MA: Harvard Business School, 2007. Print.
- ²⁶ Florida, Richard L. *The Flight of the Creative Class*. New York: HarperBusiness, 2005. Print.
- ²⁷ Pink, Daniel.
- ²⁸ "Creativity and Innovation." P21.org. Partnership for 21st Century Skills. Web. 16 May 2011. http://p21.org/index.php?option=com_content&task=view&id=262&Itemid=120.