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Bringing Industry to the Classroom

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Students shouldn’t have to choose between an education that readies them for college and one that prepares them for a career. Pathways provide both.

What if vocational education turned out to be the ugly duckling of high school reform?” So asked Charles Benson nearly two decades ago, when he assumed leadership of the National Center for Research in Vocational Education at the University of California, Berkeley. Although he is no longer with us, Benson would not be surprised by one of the most remarkable, but least remarked upon, trends in U.S. high schools during the past 15 years—the continued popularity of vocational education or, as we now call it, career and technical education.

Data released last year by the U.S. Department of Education (National Center for Education Statistics, 2007) show us that in 2005, high school graduates in the United States took, on average, four Carnegie units of career and technical education (CTE)—as many or more units than in any other subject except English. During a period of unprecedented attention to raising academic achievement, with greater numbers of academic courses required for earning a high school diploma and enormous pressure on schools (and students) to meet goals of annual yearly progress on academic tests, virtually all high school students chose to take at least one CTE course, and more than 60 percent elected to take three or more. CTE courses are electives; few schools require students to take them.

For champions of more academics, the appeal of career and technical education may seem like bad news. But they have much to cheer about. Compared with graduates in 1990, high school graduates in 2005 took 4.3 units of English (up from 4.1); 3.8 units of mathematics (up from 3.2); 4.1 units of social studies (up from 3.5); and 3.4 units of science (up from 2.8). In short, 2005 high school graduates completed a total of 26.8 units, an increase of more than 3 units (the equivalent of one-half year of schooling!) compared with graduates in 1990.

Even more remarkable, a small but rapidly growing number of high school students have discovered what many educators and policymakers still overlook—that it is possible to prepare for both college and career simultaneously. In 2005, fully 8 percent of all high school students completed not only three or more Carnegie units of CTE but also the full complement of college-preparatory courses, including two years of foreign language. This was up from 6 percent in 2000 and up from less than 1 percent in 1990.
For the most part, this increase in the number of students concentrating in both CTE and college-preparatory academics has been happening in spite of high school reform—not because of it. It’s time to change that, to begin fashioning new options for students that connect challenging technical courses with demanding academics. In the career and technical education field, we call these new options multiple pathways.

Multiple Pathways Defined
Pathways are programs of academic and technical study that integrate classroom and real-world learning organized around multiple sectors of industry—fields such as finance and business; health science and medical technology; building and environmental design; and arts, media, and entertainment. Pathways combine college-preparatory curriculums with exceptional career and technical education, motivating students to learn by helping them answer the question, Why do I need to know this?

Organizing Principles
In high schools, pathways can take various forms and be offered through different delivery systems. But whatever their design, each pathway is grounded in four guiding principles.

- **Pathways prepare students for both postsecondary education and a career.** A pathway is always about both objectives; it’s never a choice between the two. Although the Bureau of Labor Statistics projects only modest increases during the next 10 years in the number of occupations requiring a bachelor's degree (Barton, 2006; Mishel, 2007), there is consensus that career success will increasingly depend on the student taking some postsecondary education and completing a formal credential—a certificate, associate's degree, bachelor's degree, or higher credential.

- **Pathways connect academics to real-world applications.** Pathways alter how core academic subjects are taught; they do not lower expectations about what is taught. Through the pathways approach, students are expected to achieve at high levels in mathematics, science, English, social studies, and foreign language. Students master these subjects by tackling authentic problems and situations that are part of the modern workplace.

- **Pathways lead to the full range of postsecondary opportunities.** These include two- and four-year colleges, apprenticeships, formal employment training, and the military. Each pathway represents a broad industry theme that can appeal to a student regardless of his or her prior academic achievement or postsecondary aspirations. Pathways can eliminate current practices that sort and track high school students in ways that limit their options after high school.

- **Pathways improve student achievement.** Pathways are based on accountability. They are designed to produce higher levels of accomplishment in a number of measurable arenas, including grade-level performance on tests of academic achievement, demonstrated mastery of demanding technical knowledge and skill, high school completion, postsecondary transition, and attainment of a formal postsecondary credential. Pathways also contribute—in ways that most conventional academic and CTE curriculums do not—to increased student proficiency in such vital areas as critical thinking, problem solving, media and information literacy, and collaboration. Finally, pathways make an immediate difference, helping young people gain higher earnings right after high school and giving them a leg up in the labor market while they pursue postsecondary education.

Core Components
Multiple pathways offer many strong options for students. Organized around a major industry
sector, each pathway contains four essential ingredients:

- A challenging **academic component**, which typically spans multiple years and places learning in the context of real-world applications. Subjects studied include college-preparatory English, mathematics, science, and social studies.

- A demanding **technical component**, which delivers concrete industry-related knowledge and skills required for high-skill, high-wage employment.

- A **work-based learning component**, which offers students opportunities to learn through intensive internships, virtual apprenticeships, and school-based enterprises.

- **Supplemental services**, which include counseling as well as additional instruction in reading, writing, and mathematics to help students succeed with a challenging program of study.

For example, consider a pathway in Building and Environmental Design. Core academic courses systematically take advantage of the building theme to introduce authentic applications of essential academic knowledge. Geometry classes teach the concepts and skills needed to build roofs and frame walls that can withstand gale force winds. A precalculus class stresses the role of mathematics in designing and building a seismically sound bay bridge. History helps students better understand how the built environment reflects and also helps shape culture, politics, and the economy. An English class not only emphasizes the importance of mastering strong technical reading and writing, but also helps students appreciate relevant literature, such as *House*, the compelling nonfiction account of building the American dream by Pulitzer Prize winner Tracy Kidder.

Technical courses include instruction in carpentry, electricity, and masonry; but they also introduce students to fundamental principles of engineering and design, project and site planning, construction management, and emerging technologies. The work-based component connects 9th and 10th graders to mentors in such fields as architecture, construction, planning, and interior design; in 11th and 12th grade, students engage in more intensive internships, working with professionals who assess their work according to industry standards. Finally, supplemental services provide additional instruction in reading and mathematics and use industry themes to give meaning to the academic content. For example, to help students better understand the Pythagorean theorem, a supplemental mathematics class that is part of a construction technology academy may engage students in using the standard "three-four-five" triangle to ensure plumb construction of wall frames or parallel layout of flooring tile.

On-site learning is integral to the pathway approach. Seniors at Palmdale High School's Health Careers Academy in California spend two mornings each week at Kaiser Permanente learning under the supervision of their classroom teacher, who works side by side with a physician's assistant, nurse, radiology technician, or other medical professional. Students interact with real patients and learn how to conduct electrocardiograms, draw blood, interpret X-rays, set broken bones, and perform a range of other challenging tasks. Back in the classroom in the afternoon, their medical sciences class connects practical work-based experiences to in-depth study of such topics as the human cardiovascular system and the role that electricity plays in regulating the heart. Alternatively, students may dig into nuclear cardiology and the science of injecting isotopes into the blood system to assess the flow of oxygen to the heart.

**Pathways in Practice**

Today, multiple pathways are hardly the norm in U.S. high schools. Yet they are emerging as a fresh, comprehensive, and practical solution to the need for transforming education.

In California, the multiple-pathways approach is practiced in numerous places: at the Construction Technology Academy at Kearny High and at High Tech High School, both in San Diego; at the
Health Careers Academy at Palmdale High School in Palmdale; at the Health Professions High School in Sacramento; at the Manufacturing Production Technology Academy at Laguna Creek High School in Elk Grove; at the Life Academy of Health and Bioscience in Oakland; and at the Media Academy at Grover Cleveland High School in Los Angeles.

Today in California, 296 Partnership Academies (the equivalent of career academies) are organized around the state's 15 major industry sectors; another 300 career academies are in operation. Two or more school districts often join together to create Regional Occupational Centers and Programs to offer more advanced career and technical courses. These programs play an important part in many academies; in other high schools, they innovatively integrate academic and technical education.

For example, at the Center for Advanced Research and Technology, a regional center operated jointly by Clovis and Fresno Unified School Districts in California, 11th and 12th graders undertake projects typically involving a research paper, product development, and a final oral presentation and demonstration of their work. Last year, two students in architecture and engineering undertook an in-depth study of the history of Georgian architecture and its influence on contemporary design. A student enrolled in environmental research and technology designed and built a "fire popper," a forest fire-fighting device that is dropped from an airplane to spread carbon dioxide foam. Still another team of students, in conjunction with their program in psychology and human behavior, developed an electronic role-playing game.

In addition, the National Academy Foundation currently serves more than 50,000 students in 41 states through 500 academies organized around finance, information technology, hospitality and tourism, and engineering. Other organizations—such as the Ford Partnership for Advanced Studies, Project Lead the Way, Acme Animation, the Big Picture Company, Talent Development High Schools, and High Schools That Work—actively support high schools seeking to better engage and teach young people through instruction that connects challenging academic and technical content.

Further supporting these new directions is the States' Career Clusters Initiative established by the National Association of State Directors of Career and Technical Education Consortium. The consortium is working with educators and business partners to develop program specifications, curriculums, and other tools that will help states and high schools design and implement pathways in 16 major industries, including agriculture, food, and natural resources; education and training; manufacturing; and transportation, distribution, and logistics.

Most of these initiatives do not yet embrace all the organizing principles and key components of multiple pathways. Integrating academic and technical curriculums, linking classrooms to robust work-based learning, promoting project-based learning, facilitating effective team teaching among academic and CTE teachers, and engaging postsecondary faculty in the design and delivery of challenging curriculum—none of these tasks is easy, and few schools have mastered them all.

Given the difficulty, why should we persevere to make this kind of education work? Because the multiple-pathways approach offers a credible strategy for helping more young people stay engaged in high school and emerge better prepared for success in postsecondary education and careers.

**The Evidence Base**

Some of the most convincing evidence that a multiple-pathways strategy will improve student outcomes comes from work in cognitive science. Research concludes that many people learn better and faster, and retain information longer, when they are taught concepts in context. One particularly high-quality study (Sticht, 2002; Sticht, Armstrong, Hickey, & Caylor, 1987) found that teaching young soldiers who lacked even basic literacy skills to read in the context of their
daily tasks not only increased their competency in those tasks but also improved their general reading skills—all in a relatively short time period. In fact, the gains in general reading skills were equal to or greater than those produced by the conventional literacy program; gains in job-related reading exceeded the traditional program by a factor of four or five.

Another rigorous and prominent study (Stone, Alfeld, Pearson, Lewis, & Jensen, 2006) offered strong evidence that an integrated academic and technical curriculum leads to higher test scores if implemented well. In this research, career and technical education teachers were paired with mathematics teachers who identified the mathematical content embedded in the CTE teachers’ subjects—agriculture, automotive technology, business and marketing, health, and information technology. The teacher teams then developed lesson plans to teach the math within the occupational context. Students who were taught the integrated curriculum significantly outsored the control group on two tests of math ability.

An integrated curriculum combined with work-based learning and career guidance can lead to higher wages after high school, as well as improvement in other student outcomes. For example, one of the most rigorous recent evaluations found that, five years after completing high school, males who had enrolled in career academies earned $2,500 more than their peers annually (Kemple & Scott-Clayton, 2004).

Along similar lines, a recent examination of data from California’s Partnership Academies found that academy students passed the high school exit exam at much higher rates than other high school students (Bradby, Malloy, Hanna, & Dayton, 2007). Academy students were also much more likely to complete challenging academic courses. Fifty percent of academy seniors met the minimum "A to G" course requirements—the major academic subjects that the University of California and the California State University require for admission—compared with only 37 percent of all seniors statewide.

Even without an integrated curriculum, students taking both academic and technical courses may have lower dropout rates and better achievement gains than other students. In an analysis of the National Education Longitudinal Survey, a large study monitoring student achievement data and other factors for more than a decade, researchers found that the risk of dropping out was four times higher when students took no CTE courses than when they completed a balance of CTE and academic subjects (Plank, DeLuca, & Estacion, 2005).

Finally, postsecondary participation rates may be higher for those enrolled in multiple-pathways programs. In three studies of career academies that followed students beyond high school, two found higher rates of postsecondary participation among academy students compared with their peers, whereas one found no difference (Stern & Stearns, 2007). Research on school-to-work programs in the 1990s also frequently found high rates of postsecondary participation among graduates (Kazis, 2005).

In short, research to date suggests that multiple pathways integrating challenging academics with demanding career and technical education around major industry themes can produce many benefits for students, especially those who have not done well in conventional high school programs. Perhaps just as compelling, none of the studies indicates that students participating in pathways perform less well on key measures than students who elect other high school programs.

**Bringing the Two Together**

Often dismissed as a program for non-college-bound students and largely ignored by the champions of academic excellence in U.S. high schools, career and technical education may, ironically, hold the key to achieving gains on a wide range of student outcomes, including standard academic achievement. We will not realize this potential, however, if we continue to isolate career and technical education from challenging academic instruction. Nor are we likely to reengage many
young people if we squeeze CTE out of the curriculum and promote conventional academic instruction to the exclusion of all else.

By connecting demanding technical education to challenging academics, CTE transforms both domains. Academic subjects acquire authenticity and real-world meaning; technical content becomes grounded in scholarship and intellectual rigor. Students come to understand that both are important, and they are therefore more likely to emerge from high school ready for lasting success in both college and career.

Getting Started on Multiple Pathways

Schools don't need to go it alone in designing and implementing their own industry-focused programs of study. Several resources are available:

- **ConnectEd: The California Center for College and Career** ([www.connectEdCalifornia.org](http://www.connectEdCalifornia.org)). Click on "The Toolkit" for helpful resources in such areas as creating and managing career and technical education at your school, mapping and monitoring curriculum, providing professional development, and making postsecondary and industry connections. Click on "Curriculum Development" for integrated lesson units for academic teachers involved in biomedical and health sciences, engineering, and other sectors.

- **The Career Academy Support Network**, University of California, Berkeley ([http://casn.berkeley.edu](http://casn.berkeley.edu)). The **Planning Guide for Career Academies** explains how to start a career academy. It includes a schedule of tasks, roles and responsibilities of the various stakeholders, stages of evaluation, and related costs and sources of support.

- **The National Academy Foundation**, New York City ([www.naf.org](http://www.naf.org)). Check out NAF's **Academy Planning Guide**. The Academy Development Model can help schools decide whether to introduce or expand the NAF Academy Model in their communities.

- **The Ford Partnership for Advanced Studies** ([www.fordpas.org](http://www.fordpas.org)). Developed by Ford Motor Company Fund as part of its effort to encourage high school students to build careers in business, engineering, and technology, the Ford Partnership offers an inquiry- and project-based program that links learning in traditional academic subjects with the challenges students will face in postsecondary education and careers.

References


College and Career and Career Academy Support Network.


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