



Moving Beyond 20th
Century Education:

Emerging Trends in CTE and Project-based Learning

by Aaron Lauer and Briana Mihok

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Letter from the Co-chairs

The environment in which our students are learning is changing rapidly. We know that many of the jobs that exist today may not exist five, 10, or 20 years into the future. In response, we need to provide today's students with the skills they need to be able to adapt to whatever opportunities are present throughout the course of their careers. Increasingly, educators and other stakeholders are recognizing that, although basic skills such as reading, writing, and math will always be critical, many students will also need skills that have historically been taught in career and technical centers and through project-based learning.

As a result, although the regulations and rules governing career and technical education (CTE) in Pennsylvania have not been materially altered in the past six years, the landscape of CTE has changed significantly since the 2011 release of the Institute of Politics' status report on the governance and funding of CTE in the Commonwealth. Schools have worked independently and with each other to explore new ways of offering programs to improve student engagement and achievement while at the same time preparing them more effectively for unknown or rapidly changing careers. Many schools outside of career and technical centers are starting to offer career-based curricula and integrating project-based learning into all grade levels. This report highlights examples of just a few of the schools in our region—both traditional high schools and career and technical schools—that are taking such steps.

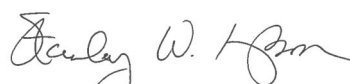
The Institute of Politics is not unique in recognizing the importance of CTE and project-based learning. In just the past couple of years, the Allegheny Conference on Community Development's "Mapping a Pathway: Regional Career and Technical Education for Energy and Manufacturing Occupations" and the Education Policy and Leadership Center's "High School Career and Technical Education: Serving Pennsylvania's Student and Workforce Needs" have provided valuable insight into how CTE and project-based learning can address the education and workforce issues facing our region's students and employers. Additionally, the State Legislature has taken an interest in the issue, and a subcommittee of the House Education Committee recently released findings based on a series of hearings on CTE in the Commonwealth.

Although intended to be an update to the Institute's 2011 report, which was workforce-based, this report attempts to highlight the connections between improving educational achievement and preparing students to take part in the workforce of tomorrow through the new methods of integrating career education and project-based learning that are occurring within our region. It is our desire that this report will showcase these innovations to promote greater understanding of these practices among education and workforce stakeholders.

Sincerely,



The Honorable Rodney D. Ruddock
Commissioner
Indiana County



Dr. Stanley W. Thompson
Education Program Director
The Heinz Endowments



Introduction

In 2011, the University of Pittsburgh Institute of Politics released a status report titled “Governance and Funding Reform for Career and Technical Centers in Pennsylvania,” which outlined the importance of the career and technical education (CTE) system in preparing future workers for participation in an economy that requires a skilled workforce. In order to achieve that goal, the Institute’s Workforce Development Policy Committee, through the report, made the following seven recommendations:

1. Restructuring joint operating committees to include one member from each sending district and representation from companies that employ workers in high-priority occupations
2. Fostering collocation, where possible, of career and technical centers (CTCs) with local community colleges
3. Moving to full-time, comprehensive CTCs with enhanced academic accountability
4. Requiring a competitive admissions process
5. Increasing industry donations to bridge CTCs’ funding gaps
6. Enhancing tax credits for industry donations to CTCs
7. Increasing industry sponsorship of facilities and programs

With the report, the committee remained committed to the long-term viability and success of CTCs in Pennsylvania and expressed an interest in helping CTCs overcome some of the barriers that they experienced in attempting to improve their programming to meet the needs of a 21st-century workforce.

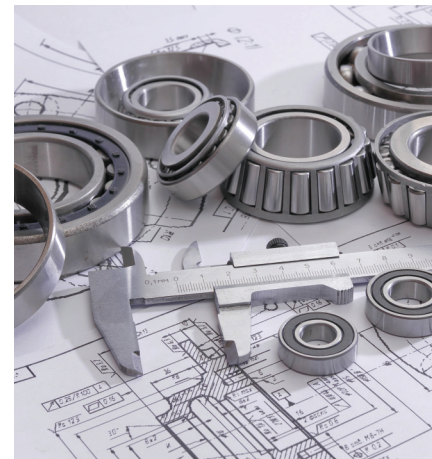
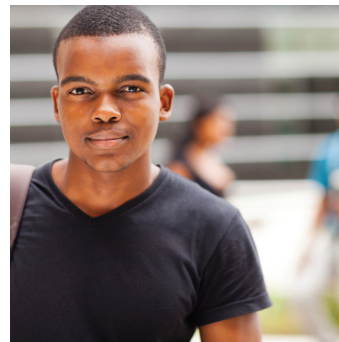
Five years later, the Institute was approached again regarding CTE, this time with the purpose of determining what had changed in the provision of CTE, technical training, and project-based learning in the Commonwealth, particularly in the Institute's footprint of Southwestern Pennsylvania, since the publication of the last report. This report attempts to answer that question and demonstrate that there have been significant changes in the landscape of CTE and project-based learning programs across Pennsylvania. This report will address a number of those changes, including the following:

- Emerging trends in CTE and project-based learning, including but not limited to:
 - The increased use and application of a variety of career pathways within and outside Pennsylvania, including the development of career academies
 - The growth in the provision of technical training, project-based learning, and career exploration at traditional high schools, as well as partnerships that have enabled and/or been a part of that growth
 - The creation of innovative partnerships between CTCs and institutions of higher education
 - The increase in availability of out-of-school, career-related programming, including programs related to the maker learning movement
 - The growth in digital badging
 - An increasing awareness among policymakers, business leaders, school administrators, and other key community stakeholders of the importance of CTE, technical training, and project-based learning to the future economic health of the region and the future success of its residents.

These changes occurred within the context of several federal and state legislative and policy changes:

- The passage of the U.S. Workforce Innovation and Opportunity Act (WIOA)
- The adoption of the national Common Core standards
- The passage of Pennsylvania's Workforce Development Act

This report will also examine new concepts in CTE within and outside the region and identify potential recommendations for moving forward.





Methodology and Terminology

In crafting this report, the Institute relied on interviews with community stakeholders and experts, feedback from the members of the Institute’s Workforce Development and Education policy committees, and data from a variety of reports and sources, including the Pennsylvania and U.S. Departments of Education.

For purposes of this report, the term CTE encompasses educational activities that provide students with academic and technical knowledge and skills needed to prepare for additional postsecondary education or a career. This type of education usually results in technical skill proficiency and industry-recognized credentials. CTE, also historically known as vocational education, can be embedded within traditional high schools or take place at separate CTCs.

This report will also reference project-based learning, which teaches educational content through hands-on projects that allow students to creatively apply academic concepts as well as critical-thinking and problem-solving skills. Project-based learning can occur in a variety of settings, including classrooms, libraries, museums, and at home, and it has been used in recent years especially in support of STEAM (science, technology, engineering, arts, and math) education. Project-based learning also occurs frequently within CTE.

The Current Landscape of CTE in Pennsylvania

CTE affects a significant and growing portion of Pennsylvania's total student body. In 2014–2015, 133,717 students participated in CTE in Pennsylvania, according to the Pennsylvania Department of Education.¹ This included 62,308 secondary students and 71,409 postsecondary students.²

Major Legislative Changes in Workforce Development (2011–2015)

The past five years saw several significant federal and state-level policy changes that affect the way CTE is delivered in the Commonwealth. These efforts work to improve CTE through greater understanding of workforce and skill needs, academic rigor, and engagement with employers.

Workforce Innovation and Opportunity Act

In 2014, the U.S. Congress passed the WIOA, the first major update to the national workforce training structure in 16 years. Although the act provides development opportunities for adults and youth, the primary focus of this overview is on the provisions that pertain to youth. According to the Center for Law and Social Policy, WIOA strengthens workforce training for adults and youth in four ways:³

1. **Increases the focus on serving the most vulnerable workers**, i.e., low-income adults and youth who have limited skills, lack work experience, and face other barriers to economic success
2. **Expands education and training options** to help participants access good jobs and advance in their careers
3. **Helps disadvantaged and unemployed adults and youth** earn while they learn through support services and effective employment-based activities
4. **Aligns planning and accountability policies across core programs** to support more unified approaches to serving low-income, low-skilled individuals

Common Core Standards

The Common Core State Standards are a state-led initiative of the Council of Chief School Officers and the National Governors Association Center for Best Practices to standardize curriculum goals across the United States. As of August 2015, 42 states, the District of Columbia, and four territories had adopted the Common Core.⁴ The initiative attempts to create educational benchmarks based on concepts and skills that students should know rather than specific curricula. New, more rigorous testing standards were developed to assess the proficiency of all students, including those at CTCs, in math and English language arts.

The adoption of Common Core standards in Pennsylvania aligns with an increased focus on career and technical education. According to Pennsylvania's Department of Education, the standards are designed to strengthen the application of skills across disciplines, giving students the ability to:

- Communicate and work more effectively in groups
- Analyze and solve real-world problems through reading comprehension and math
- Develop critical thinking by crafting arguments and critiquing the work of others⁵

¹ U.S. Department of Education. "State Profile-Pennsylvania" Perkins Collaborative Resource Network. <http://cte.ed.gov/profiles/pennsylvania>

² U.S. Department of Education. "State Profile-Pennsylvania" Perkins Collaborative Resource Network. <http://cte.ed.gov/profiles/pennsylvania>

³ Bird, Kisha, Marcie Foster, and Evelyn Ganzglass. "New Opportunities to Improve Economic and Career Success for Low-income Youth and Adults: Key Provisions of the Workforce Innovation and Opportunity Act (WIOA)." Center for Law and Social Policy (CLASP), September 2014. p. 3.

⁴ "Development Process." Common Core State Standards Initiative. <http://www.corestandards.org/about-the-standards/development-process/>

⁵ Pennsylvania Department of Education. "PA Core Standards Fact Sheet for Business and Community." <http://static.pdesas.org/content/documents/PA%20Core%20Standards%20Fact%20Sheet%20for%20Business%20and%20Community%2012.1.2013.pdf>

Pennsylvania Workforce Development Act

In 2011, Pennsylvania amended the Workforce Development Act of 2001 with SB 552. The act allowed for several key advancements in workforce development within Pennsylvania, such as creating industry clusters, providing grant funding for workforce initiatives, and increasing oversight of current and future workforce development programs.

Industry Clusters

Identification of industry clusters through consultation of industry and workforce development boards is based upon the competitiveness of that potential industry cluster and its importance to the Pennsylvanian economy.⁶ The Department of Labor and Industry (DLI) then narrows the potential industry clusters based on importance to the Commonwealth and regional economy, workforce development needs, and career opportunities for employees.⁷

Grant Funding

The act also provides grant funding to industry partnerships to advance the programs identified in the act. Funding is to be used to facilitate collaboration among businesses, workers, labor organizations, and workforce development organizations to identify workforce opportunities and strengthen training opportunities throughout the Commonwealth.⁸

Workforce Development Evaluation

Additionally, DLI is charged with ongoing evaluation of workforce development needs within the Commonwealth. DLI also monitors trends in Pennsylvania's identified industry clusters and continually updates the list of high-priority occupations in the Commonwealth.⁹ It also regularly evaluates and collects information on the Commonwealth's industry partnerships in order to provide annual performance information to key stakeholder groups and the General Assembly.¹⁰



⁶ SB 552 Sec. 1302(a)

⁷ SB 552 Sec. 1302(b)

⁸ SB 522 Sec. 1303(b)(1-9)

⁹ SB 522 Sec. 1308

¹⁰ SB 522 Sec. 1309(2-3)

CTE and Project-based Learning: Benefits for Students

Amid the federal and state changes referenced in the previous section, school districts, CTCs, and other entities have responded to changing workforce demands and new scientific research on student learning. Both CTE and project-based learning have demonstrated benefits to students and to the community at large.

In 2012, the National Academies Committee on a Conceptual Framework for New K–12 Science Education Standards outlined new standards for K–12 science education. In updating the standards, the National Academies sought to highlight “the power of integrating understanding the ideas of science with engagement in the practices of science” as well as “to build students’ proficiency and appreciation for science over multiple years of school.”¹¹ Updating these standards and modernizing K–12 science and math education are especially important, as the United States struggles to keep up with its peers internationally in science and math literacy. On the 2015 Programme for International Student Assessment, the U.S. education system had the 25th highest science literacy and 40th highest math literacy.¹² In order for the American economy and workforce to remain competitive, American students must be better prepared for jobs in STEAM fields.

The framework advocates for the style of practical learning that CTE and project-based learning provide. It says that it is “important for students to explore the practical use of science, given that a singular focus on core ideas of the disciplines would tend to shortchange the importance of applications.”¹³ Additionally, engineering and technology “provide a context in which students can test their own developing scientific knowledge and apply it to practical problems.”¹⁴ CTE and

project-based learning, in line with the framework, allow students to gain knowledge of facts and mastery of skills and also demonstrate the practical application of facts and skills within real-world problems. By providing context to academic knowledge, CTE and project-based learning increase student engagement and build problem-solving skills.

In one study, students’ understanding of scientific concepts through a physical hands-on experiment was compared with their understanding of concepts after viewing a computer model. Students learning through the physical experiment scored 7 percent higher on a follow-up quiz and scored 12 percent higher on more complex assessment questions.¹⁵ The study demonstrated that even brief, meaningful physical experiences enabled students to better understand scientific concepts through physical interaction with the learning tool.¹⁶

CTE and project-based learning also improve student engagement within math and science. Traditionally, K–12 math and science are taught as abstract fields separated from real-world problems, which can lead to boredom when students are unable to see the connection to what they are learning. When asked about what would keep them in school, students preferred teaching methods that provided “opportunities for real-world learning” and that made “classrooms more relevant.”¹⁷ CTE and project-based learning are uniquely poised to address these preferences with an education model created to put students in contact with professionals in the field, tackle projects based on real-world problems, and explore pathways to careers with postsecondary training and education.

¹¹ National Research Council. “A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.” The National Academies Press, 2012, x.

¹² National Research Council. “A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.” The National Academies Press, 2012, 17 & 23.

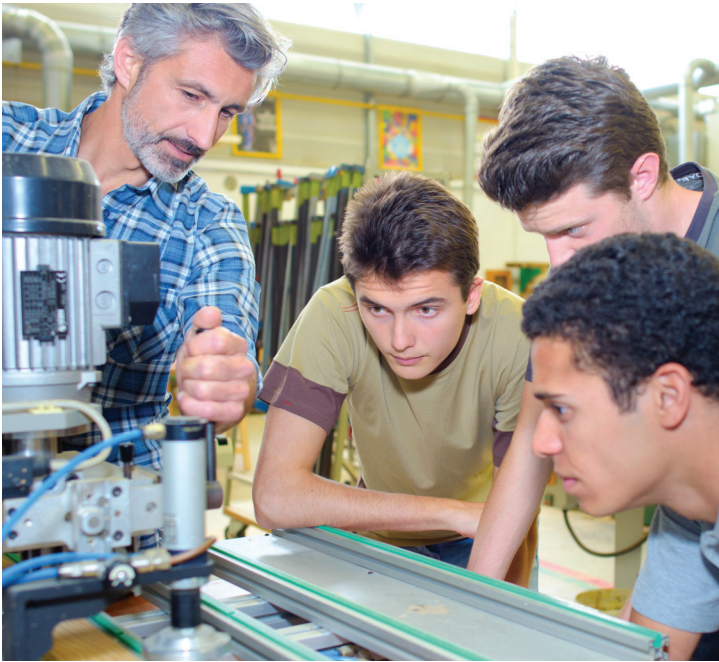
¹³ National Research Council. “A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.” The National Academies Press, 2012, 12.

¹⁴ National Research Council. “A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.” The National Academies Press, 2012, 12.

¹⁵ Kontra, Carly, Daniel J. Lyons, Susan M. Fischer, and Sian L. Beilock. “Physical Experience Enhances Science Learning.” *Psychological Science*, 2015, Vol. 26(6), 745-747.

¹⁶ Kontra, Carly, Daniel J. Lyons, Susan M. Fischer, and Sian L. Beilock. “Physical Experience Enhances Science Learning.” *Psychological Science*, 2015, Vol. 26(6), 748.

¹⁷ Bennett, Dorothy and Peggy Monahan. “NYSCI Design Lab: No Bored Kids.” *Design Make Play: Growing the Next Generation of Stem Innovators*, eds. Margaret Honey and David E. Kanter, Routledge, 2013, 35.



Benefits of CTE

Research on project-based learning is still developing, but CTE has widely recognized and long-standing benefits for students that result in tangible benefits to the greater community. CTE programming is often credited with the ability to keep students engaged in their learning and, as a result, enrolled in school. Studies have found that students are more engaged and more likely to graduate when schools provide opportunities for real-world learning and demonstrate links between finishing school and getting a job.¹⁸

Student preferences for this type of education are evident in the significant impact that CTE has on student dropout rates. For the 2013–2014 school year, CTC students had a graduation rate of 99 percent, which was significantly higher than Pennsylvania’s overall graduation rate, 86 percent.¹⁹ Elizabeth Forward, a traditional high school that has begun nationally recognized career-related programming, described in more detail later in this report, has reported a significant decrease in its drop-out rate since the inception of this innovative hands-on learning programming.

Also, CTE can provide financial benefits to students through dual enrollment, which allows students to earn college credits prior to graduating from high school. With students at Pittsburgh Public Schools and other districts earning up to 24 credits before graduation, cost savings when continuing a college education can be significant. This helps to remove financial barriers to pursuing postsecondary technical certifications or degrees.

¹⁸ Bennett, Dorothy and Peggy Monahan. “NYSCI Design Lab: No Bored Kids.” *Design Make Play: Growing the Next Generation of Stem Innovators*, eds. Margaret Honey and David E. Kanter, Routledge, 2013, 35.

¹⁹ U.S. Department of Education. “Carl D. Perkins Career and Technical Education Act of 2006.” June 2016, 44. https://s3.amazonaws.com/PCRN/uploads/Perkins_RTC_2013-14.pdf

²⁰ Pennsylvania Center for Workforce Information & Analysis. “2016 Pennsylvania High Priority Occupations by Industry.” <http://www.workstats.dli.pa.gov/Documents/High%20Priority%20Occupations/PA%20HPOs.pdf>

CTE and Project-based Learning: Benefits to the Region

Both CTE and project-based learning have benefits beyond the students they seek to reach. In providing students with particular skills, they help to prepare students to participate in the workforce of tomorrow.

A filled pipeline of skilled workers is critical to the regional economy from two perspectives, both based on the same fact: the skilled workforce is fundamentally local. The ability of the region to attract companies that rely heavily on skilled workers is directly related to the availability and skill level of the nonprofessional workforce in the region. Furthermore, the competitiveness of regional companies that rely on a skilled workforce is also directly related to the same pipeline. Without an ample number of well-trained skilled workers and the next generation of workers in the pipeline, regional companies will be at a competitive disadvantage, and the region will not be able to attract new companies.

Additionally, CTE provides training for the increasing level of technical skills demanded of traditional blue-collar jobs. Jobs in coal mining, machining, auto repair, and many other professions have become less about the physical attributes of the worker and more about the worker's ability to operate and even repair complex computerized systems that require significant training to master.

Models that project workforce demand show that businesses in Southwestern Pennsylvania will require skilled workers, many of whom will not require a four-year degree. In fact, 67 percent of high-priority occupations listed in the following chart require either an associate's degree or some level of on-the-job or modest postsecondary training. Almost all of these occupations have a base in information technology skills that can be learned within a CTC.

Education Requirements for Pennsylvania's 2016 High-priority Occupations²⁰

Industry Cluster	Number of Occupations requiring a Bachelor's or greater	Number of Occupations requiring a Less than bachelor's	Total	Percent requiring a bachelor's or greater
Advanced manufacturing	3	20	23	13.0%
Agriculture and food production	0	15	15	0.0%
Biomedical	7	7	14	50.0%
Building and construction	1	15	16	6.3%
Business services	17	18	35	48.6%
Education	2	3	5	40.0%
Energy	0	15	15	0.0%
Health care	10	27	38	26.3%
Hospitality, leisure, and entertainment	1	5	6	16.7%
Logistics and transportation	0	12	12	0.0%
Real estate, finance, and insurance	3	6	9	33.3%
Wood, wood products, and publishing	0	4	4	0.0%
TOTAL	42	151	193	21.8%

Moving Forward: Integrating Career Development in K-12 Education

Although progress in CTE and project-based learning in our region has been significant, other states have models that can offer suggestions for moving forward.

Career Pathways

A “career pathway” is an educational model that sets a clear path for students to receive occupational training in a particular field while still receiving instruction in traditional academic subjects. Career pathways can occur as a discrete program within a traditional high school or in independent schools entirely dedicated to several career pathways, known as career academies. Career pathways have become particularly important given the support by the federal government within the WIOA for the local development of career pathways to satisfy workforce development needs.

Career pathways can take many forms, including the following examples:

- **Career academies** are small learning communities within high schools that prepare students for postsecondary education opportunities through career-themed education. Academies can occur over the course of two to four years. Students can engage with chosen careers through internships, job shadowing, and field trips. The curriculum provides students with the academic training to continue onto postsecondary education opportunities, including college, while also providing career technical courses in a chosen field. Typically, career academy themes are based on local workforce demands such as engineering, construction, energy, and arts. Career academies can be found throughout the country, including in California (partnership academies), Florida, Nashville, and Philadelphia.
- The **Early College High Schools Initiative** was created in 2002 by the Bill & Melinda Gates Foundation, and it partners high schools with local colleges or universities to provide a unique learning experience for secondary students. Students graduating from early colleges have the opportunity to obtain a high school diploma and an associate’s degree or up to two years of college credit. Since 2002, more than 240 early colleges have opened nationwide.²¹
- **Dual enrollment** programs provide high school students with opportunities to earn postsecondary education credits while still enrolled in high school. Often these types of programs are made available through high schools, CTCs, or postsecondary institutions, typically community colleges. Postsecondary credits are subsidized for high school students either partially or fully by their high schools or CTCs. These value opportunities save students money on postsecondary credits, allow them to explore careers, and provide valuable exposure to what full-time postsecondary education is like.

Clearly articulating the education needed to be successful within a career pathway and the potential careers associated with that pathway are important steps in developing a greater level of understanding among students, parents, and school districts about potential career options and their educational requirements.

The following organizations have taken steps to integrate career pathways into their curricula.

²¹ Berger, Andrea, et. al. “Early College, Early Success: Early College High School Initiative Impact Study.” American Institutes for Research. 2013. p. iv.

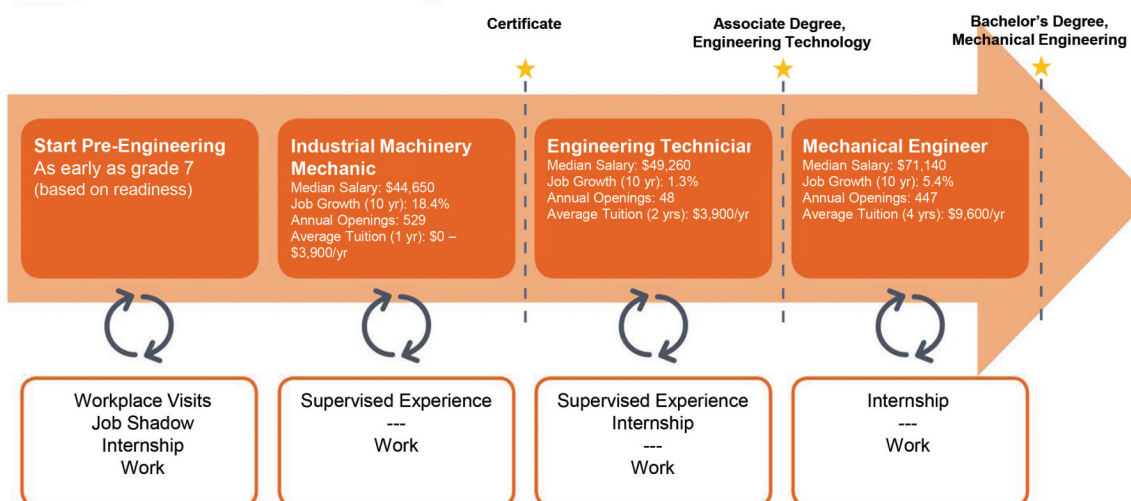
Ohio Department of Education Career Pathways

One example of a statewide response to the need for career pathways can be found in Ohio, where the Department of Education's Career Connections outlined career pathways in order to guide education decisions for students beginning in grade seven. Each identified career pathway includes information on what careers are available with different levels of education, recommended career exploration opportunities (job shadowing and internships), and recommended classes to take in secondary and postsecondary schools. An example of Ohio's career pathway guidance documents for mechanical engineering is shown below.

Ohio Department of Education Career Pathways Worksheet²²



Engineering and Science Technologies Career Pathway



An Example of Courses with Secondary and Postsecondary Credits

Secondary	7 8	English I	Algebra I	Physical Science	Social Studies	Fine Arts	Pre-Engineering Technologies		
	9 10	English II	Algebra II	Biology	World History	Health (.5) PE (.5)	Engineering Principles	Engineering Design	World Languages
	11	English III	Geometry	Chemistry	U.S. History	Manufacturing Operations	Digital Electronics	World Languages	
	12	English IV	Trigonometry/Calculus	Physics	U.S. Government	Robotics	Alternative Energy		
Postsecondary	Year 1 1st Semester	Computer Applications	Technical Math	Intro to Engineering Technology	Manufacturing Materials & Processes	Engineering Graphics			
	Year 1 2nd Semester	English Composition	Statics	Physics	CAD I	Machine Tools Lab			
	Year 2 1st Semester	Interpersonal Communication	Strength of Materials	Basic Mechanisms and Drives	CAD II	Ethics	Motors and Control Logic		
	Year 2 2nd Semester	Technical Writing	Machine Design/CAM	Engineering Statistics	CNC	Robotics	Micro Economics		
High School Career-Technical Education Program Courses									
High School Courses for Postsecondary Credit (Including Apprenticeship Hours) and the Corresponding Postsecondary Courses									
Required Courses									
Recommended Electives									

²² "Mechanical Engineering Career Pathway Worksheet" Ohio Department of Education. <http://education.ohio.gov/Topics/Career-Tech/Career-Connections/Career-Pathways>

California Partnership Academies

California Partnership Academies are themed career pathway-based programs that typically operate within large, traditional high schools. Some high schools using the academy model no longer offer a traditional high school program; instead, they house multiple career pathway programs within a single high school. Each of the more than 500 academies enrolls approximately 150–200 students in one of 15 career themes, which include art, energy, engineering, finance, and manufacturing. Over the course of the three-year program, students receive college prep courses, academic counseling, job internships, and career training.

Academies have been particularly successful in mobilizing local businesses to engage with schools to better secondary education throughout the state. Each academy is required to have an advisory board of representatives from local employers and community partners. California Partnership Academies are funded through a mix of state and local funding and matching employer contributions. In 2009–2010, employers contributed approximately 42 percent of funding to academies. Employers providing matches also typically serve as advisory board members and speakers, as well as provide field trips, mentorships, and internships.

P-TECH

First opened in 2011, P-TECH (Pathways in Technology Early College High School) is a unique opportunity for high school students in New York City. Rather than the four years of education provided by traditional high schools, P-TECH is a six-year program in which students are able to earn both a high school diploma and an associate's degree. Students are able to progress to college-level courses at their own pace through yearly testing. Through a strong partnership with IBM, P-TECH students receive paid internships—and in some cases, job offers from IBM as entry-level employees. More than 80 percent of fourth-year students have completed paid internships with IBM. P-TECH offers open enrollment and has a student population that is mostly low income and minority—96 percent of students are Black or Latino.

Given P-TECH's success, it has developed a replication model for school districts across the county to emulate. By fall 2015, more than 40 schools across the country had adopted P-TECH's model. Each school partners with local businesses

and postsecondary institutions to provide internships, mentoring, and curriculum development. P-TECH schools have partnered with more than 70 small and large companies such as Microsoft, SAP, ConEdison, hospital systems, manufacturing associations, and civil engineering trade groups.

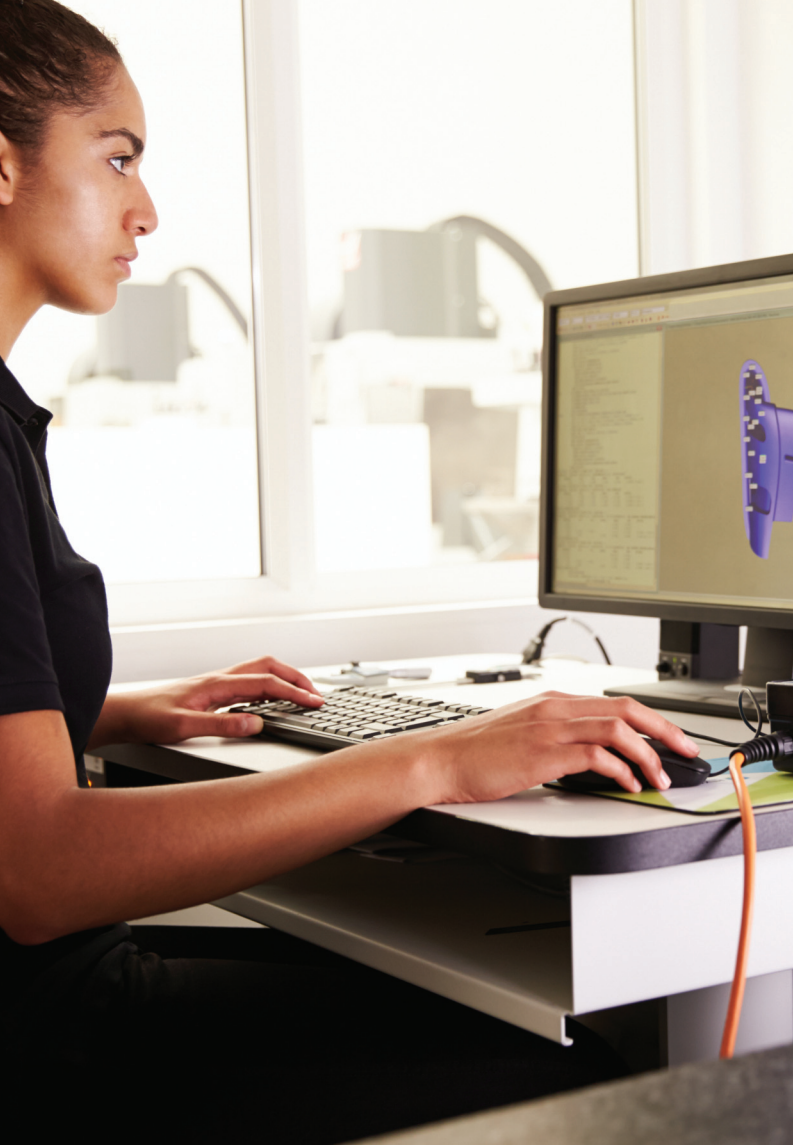
Southern Regional Education Board's Advanced Career Initiative

The Southern Regional Education Board's Advanced Career Initiative combines a rigorous academic core with job-ready technical courses in eight different fields. Courses are designed by secondary, postsecondary, and industry experts to prepare students for postsecondary education and careers. The curriculum is designed to meet Common Core State Standards and integrates academics into traditional CTE courses. In addition, Advanced Career curricula can be embedded within traditional high schools' course offerings.

Each participating state develops a curriculum, which is then shared with the other states. For instance, West Virginia has developed an energy and power curriculum to teach students about the generation, distribution, and use of energy. In addition to learning about the various means of power generation, students also learn about the cost of power generation and its environmental impacts.

Westmoreland County Community College's Advanced Technology Center High School Academy

Westmoreland County Community College's (WCCC's) Advanced Technology Center High School Academy is a partnership between WCCC and four CTCs covering students in Westmoreland, Fayette, and Greene counties. The program allows high school students to earn an industrial technology certificate in one of four programs: machining; heating, ventilation, and air conditioning; welding; or electronics. Each student earns articulated credits in his or her home CTC and completes two college capstone courses. Capstone courses can be completed during the day at the student's home CTC or in the evening at WCCC. In order to implement the program, the WCCC and the four CTCs worked together to align the CTCs' curricula in the four High School Academy programs so that students were able to meet the requirements necessary for college credits from WCCC. Through the High School Academy program, 76 students have taken 433 college credits.



Integrating Project-based Learning into Traditional Schools

As employers, parents, and students are coming to recognize the benefits of and need for STEAM education to prepare students for an increasingly technology-based workplace, technical training and hands-on learning styles have been adopted by STEAM educators to teach concepts and engage students. Students are now learning engineering and programming skills while competing in regional robotics competitions like BotsIQ and the Penn State University Sea, Air, and Land Challenge, a robotics competition for high school students. Through school fabrication labs, students are learning how to use computer-aided design (CAD) software to design and program CNC routers to manufacture student projects. Not only do these lessons and tools engage students effectively in STEAM concepts, but they also often help to prepare students for postsecondary education and job opportunities in high-demand industries.

The following school districts have taken steps to integrate project-based learning and career exploration into their curricula.

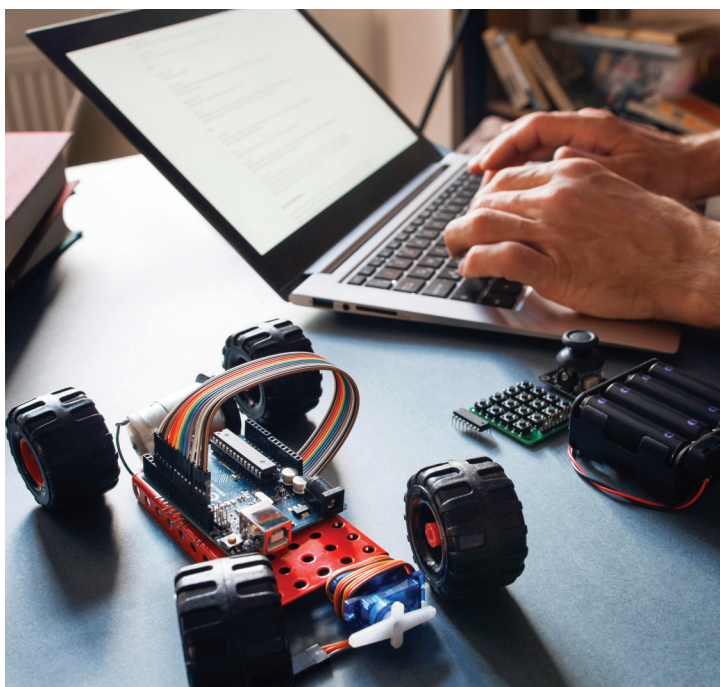
Butler Area School District

In 2013, the Allegheny Intermediate Unit awarded Butler Area School District a \$20,000 STEAM Grant for the development of the Science Math Art Technology (SMArT) Lab. With the grant, Butler Area transformed an unused room into a fabrication lab for students. By filling the room with tools and space to explore, the high school has reinforced learning and expanded educational opportunities, from biology experiments and robotics to screen printing and guitar building. The lab provides a space for students to try new ideas and experiment. Through a partnership with a nearby CTC, Butler Area students can utilize the CTC's faculty expertise and equipment to accomplish student projects beyond the scope of the SMArT Lab. Butler Area High School's students, using skills they developed in the SMArT Lab, won first and second place in the Sea Challenge of the 2015 Penn State University Sea, Air, and Land Challenge. Throughout the competition, students learn real-world engineering processes and skills through the development and construction of unmanned vehicles.



Chartiers Valley High School

Chartiers Valley School District, in conjunction with Project Lead the Way, has developed the Engineering, Applied Engineering, and Technology Path. This curriculum is designed to provide students with the skills and knowledge to succeed in technology-based postsecondary education and careers. The typically three-year program allows students to complete their traditional core classes and take a series of engineering-related courses, all while still on the Chartiers Valley High School campus. The Engineering, Applied Engineering, and Technology Path offers students two program options: the Engineering Academy and four certificate programs. The engineering program is aimed at students seeking a four-year degree and has more extensive course requirements. The certificate programs require students to take four of the engineering and technology course offerings within the certificate field. In 2015, Chartiers Valley was recognized by the Future of Education Technology Conference STEM (science, technology, engineering and mathematics) Advisory Board as one of the top ten STEM programs in the country.



Elizabeth Forward School District

Since 2011, through partnerships with national and regional organizations, Elizabeth Forward School District has infused technology and innovation into its curriculum from elementary through high school. Its iPad learning initiative allows for more personalized, project-based learning for students from grades 1–12. Furthermore, Elizabeth Forward has created fabrication labs in its high school (FABLab) and middle school (Dream Factory) so that students can build and manufacture items using 3D printing, laser cutters, vinyl cutters, and digital fabrication utilizing CNC routers. The school district has extended its CTE capabilities to the community by opening up the high school lab to the community in the evening and to other school districts in the region.

South Fayette Township School District

South Fayette Township School District has been working with national and regional partners to encourage innovation among its students by infusing computational and abstract thinking throughout its new curriculum. Starting in kindergarten, South Fayette students learn the basic logic of programming. As students progress through the program, they are provided with more in-depth coding and robotics training. In the seventh grade, students begin studying mobile app creation, 3D printing, CAD, and robotics. The district has also partnered with schools in distressed communities to allow them access to the tools and equipment South Fayette Township School District has acquired. Many of the district's high school students have been instrumental in this outreach by helping to teach in partnership schools.

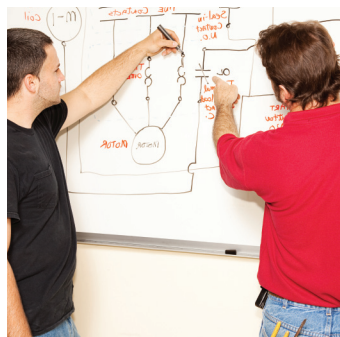


CTC Innovation

Often in spite of governance and funding challenges, CTCs have adapted to become more appealing to a broader range of students. These adaptations include:

- Increasing opportunities for dual enrollment through articulation agreements with postsecondary institutions. Because there is no longer direct funding for dual enrollment from the state, these initiatives are often funded in creative ways, either through grants or sometimes through the postsecondary institutions themselves.
- The increased development and use of educational foundations to attract additional funding from business and industry partners to needed CTE programs. Educational foundations allow CTCs to access additional funding streams to meet existing funding needs and develop new or innovative programming.
- The development of summer camps and other community-based activities. Camps and other programming geared toward students in middle school can help both parents and students learn more about the programming offered at their local CTCs and the types of careers and postsecondary pathways available to students who participate.
- Increased connections with businesses to ensure that students have access to internships and even on-the-job training prior to graduation. For those going directly into the workforce following graduation, this allows for a smooth transition, and for those pursuing postsecondary degrees or certifications, this allows them to view firsthand the multiple career opportunities that may be available at a particular company or within a particular industry.

Also, perhaps because of the increased attention given by the media and others to programs such as STEAM and hands-on maker learning, CTCs have received greater recognition from students, parents, and sending schools as valuable opportunities for career exploration for students, even for those students who plan to pursue college following graduation.



The following examples showcase particular programs in the Southwestern Pennsylvania region.

Pittsburgh Public Schools

Pittsburgh Public Schools (PPS) offers a unique model of CTE in the region through its comprehensive, embedded CTC programs. Similar to the career academy model outlined previously in the report, Pittsburgh Public Schools offers 15 CTC programming options within 6 of its high schools. Each high school has a set of CTE specialties of which students can take advantage. If students have interest in specialties not offered within their neighborhood high schools, they can be bussed or transfer to high schools that offer courses related to their career interest.

As part of this comprehensive regional model, Pittsburgh Public Schools is carving innovative paths for students to follow when striving to reach their career goals.

- By working in conjunction with the Community College of Allegheny County and The Pittsburgh Promise, PPS is able to offer dual enrollment opportunities to students in Culinary Arts, Health Careers, and HVAC which gives them a jump start on their post-secondary education.
- When Pittsburgh Public Schools secured the \$420,000 Innovation Fund grant from the American Federation of Teachers through the Pittsburgh Federation of Teachers, the CTE division worked with the PFT to implement strategies that built awareness of the benefits of CTE for students, families, industry, and local industry as well as develop partnerships with industry and community partners. This grant has allowed PPS to regularly gather local industry, post-secondary, and community stakeholders to discuss the growth of Career and Technical Education in the Pittsburgh region. Additionally, through the AFT/PFT grant, PPS was able to launch a marketing plan that opened access to information on CTE programming through billboard and local publication advertising as well as the development of virtual tour technology used in all CTE classrooms.



Pittsburgh Public Schools *(continued)*

- Through the work of the Innovation Fund grant, PPS created a strong partnership with the City of Pittsburgh. This partnership has enabled the City of Pittsburgh to support the Emergency Response Technology program with the donation of valuable equipment and guidance with curriculum development and implementation. The students that complete this program will have an advantage when applying to become Pittsburgh police, fire, and EMS professionals. This pipeline of trained students will support the city's need for a diverse public safety workforce.
- Through the Pittsburgh Public Schools' partnership with the Greater Allegheny Auto Dealer Owner's Association, students enrolled in the Auto Technology program were able to attend in automotive workshops as well as apply for a scholarship to advance their studies after high school. One student was awarded a full scholarship to CCAC and a gift card for tools.
- In August of 2016, Pittsburgh Public Schools worked with Steeltown Entertainment Project to open a new program that offers students the opportunity to prepare for careers in video and audio production. This partnership has allowed Entertainment Technology students the opportunity to learn from Steeltown Entertainment Project teaching artists while still in high school.

Parkway West CTC

In Allegheny County, Parkway West CTC is partnering with the Energy Innovation Center to develop a project-based curriculum that would allow students to work with businesses and civic organizations to address real-world problems.

Additionally, as part of its dual enrollment programs, Parkway West has partnered with the Community College of Beaver County (CCBC) to launch the Aviation Academy in Allegheny County. Through a location at Parkway West, CCBC instructors will offer courses to 11th- and 12th-graders in preparation for the following careers: professional pilot, aerospace management, air traffic control, and unmanned aerial vehicles. Completion of the two-year program enables students to earn up to a full year of college credit.

A.W. Beattie CTC

A.W. Beattie CTC is working to foster greater CTE awareness among students in its sending schools. A.W. Beattie brings hands-on CTE projects into its sending schools, beginning in the fifth grade, to build upon STEAM curricula and promote CTC career opportunities to the students. Between fifth and ninth grades, students have the opportunity to visit A.W. Beattie to work on classroom projects at the CTC. Additionally, A.W. Beattie offers summer camps within its program areas to more than 150 students in the fifth to ninth grades in order to provide greater exposure to career opportunities and the CTC's offerings.

A.W. Beattie students have also been successful in gaining industry certifications and progressing in their career fields. In 2015, A.W. Beattie students obtained around 500 certifications. Additionally, more than 98 percent of students are in postsecondary education, in the military, or employed a year after graduation.

Beyond the Classroom

Digital Badges

Digital badges are a means of developing learning pathways based on interests and helping others to recognize that learning has occurred. Each badge is a visual symbol that represents a particular skill or disposition. Badges from education entities that record them in Mozilla's Open Badges can be earned in a variety of fields both online and offline and then displayed on websites, Twitter, or LinkedIn to show knowledge of concepts and skills.

Badges offer benefits for students, educational organizations, and employers. They can:

- Illustrate new pathways for students
- Enable program providers to think about real learning outcomes and the assessment system on the micro level
- Store information that can be shared with employers and schools, not only about a student's technical skills but also about soft skills

In Allegheny County, the Sprout Fund has supported creativity and innovation in education by bringing practitioners together to remake learning in the region. The Remaking Learning Network is a group of more than 200 schools, libraries, museums, and after-school programs that share the belief that learning can occur everywhere and at any time, not just in schools.

As part of its work the Sprout Fund has helped organizations across the region and country implement their own digital badges. Within the Pittsburgh region, the Sprout Fund has worked with the Carnegie Library of Pittsburgh, City Charter High School, and Partner4Work to develop badging to signify obtaining competencies from educational offerings by these organizations.²³

Carnegie Library of Pittsburgh

The Carnegie Library is working to provide informal educational opportunities that can help to bridge the equity gap among students in the region. The library has found that mentoring is an effective tool by which to engage children and build on their interests, and it has subsequently developed a mentorship program at several branches. Much of the library's educational programming and mentorship takes place in its labs. These spaces allow students to interact with artists and experts in a variety of fields. An important aspect of the library's educational programming is the use of digital badges that help track learning outcomes for students. The badges give educators and potential employers a better understanding of a student's interests and knowledge base.

Remake Learning Network

Established more than a decade ago by the Grable Foundation and other community partners, the Remake Learning Network is designed to promote interconnectivity among educators and those who seek to promote innovative learning in the region. According to the Remake Learning Playbook, the network seeks to increase productivity in education in the Southwestern Pennsylvania region through the following five elements:

- Learning environments
- Innovation research and development
- Learning scholarship and advocacy
- Commercial and entrepreneurial engagement
- Strategic stewardship

The network operates throughout the year to encourage cooperation, innovation, and project-based learning through a variety of events and professional development opportunities. Remake Learning Days, held each year in May, feature a series of events designed to increase awareness of project-based learning; increase cooperation among students, districts, and other entities; and make connections between schools and the community at large.

²³ "Case Studies of Digital Badges in Action." The Sprout Fund. <https://medium.com/sprout-digital-badges/case-studies-of-digital-badges-in-action-9188b5bac138>

Recommendations

This report highlights a variety of innovations occurring in CTE nationally and locally. The expansion of CTE, technical training, and project-based learning opportunities for all students helps to ensure that more students are able to progress into careers that are both meaningful to them as well as beneficial to the economic vitality of the region. This style of learning could be further strengthened in the region through additional financial and technical support, as well as regulatory changes at the state level.



In the interest of implementing or strengthening the best practices outlined in this report, the following policy options are suggested:

1. Increased use of career pathways
2. Increased advocacy for students earning college credits in high school
3. Greater flexibility in state regulations to allow for CTC programs to respond more quickly to workforce needs
4. Partnerships that would allow districts to share CTE, technical training, and project-based learning resources to increase access and decrease duplication of programming
5. Increased access to job shadowing, internships, and other methods of career exploration at the middle and secondary levels

It is encouraging for the growth of CTE and project-based learning in Southwestern Pennsylvania that the innovations outlined in this report are occurring, mostly through the efforts of strong leaders at the school, district, and community levels. However, additional steps need to be taken by policymakers if they wish to ensure that all students and communities are able to take advantage of these CTE and project-based learning opportunities. Actions they, along with state entities such as intermediate units and regional organizations such as workforce development boards, could take include:

- **Increasing the awareness of CTE, technical training, and project-based learning opportunities and benefits for students, parents, teachers, and administrators.** This requires facilitating conversations and connections between school districts and business leaders to ensure that students, as well as teachers and administrators, have access to additional internships and job shadowing opportunities, which will ultimately provide students and parents with a better understanding of the educational and skill requirements of different career fields. These types of opportunities also will allow students to gain valuable hands-on experience within job fields that will enable them to better understand whether a particular career is what they want to pursue before they spend money and time pursuing a postsecondary education.

Awareness should start early so that students and parents can work to best position students to succeed. Opportunities like early STEAM education, such as South Fayette teaching elementary school students coding principles, provide valuable early understanding and exposure to STEAM careers. Events like Remake Learning Days showcase best practices and demonstrate the benefits of project-based learning. Additionally, alternative career exploration programming—either through outside entities, such as community libraries or business partners, or through schools and CTCs—can provide CTE experiences for students, such as A.W. Beattie CTC’s summer camps or the Carnegie Library of Pittsburgh’s educational programming.

Furthermore, the development or adoption of easy-to-understand and easy-to-use career pathway guides, such as those created by the Ohio Department of Education,

would provide a valuable career decision-making tool for students, parents, teachers, and administrators. These career pathway guides should be promoted early in students’ education, so that students can make decisions early to shape their secondary and postsecondary education to best fit their preferred careers. These pathways should be developed to address immediate workforce needs, while still preparing students to navigate changing workforce demands by obtaining continuing education and translatable credentials.

- **Ensuring that meaningful CTE and career pathway opportunities are available to all students in the region.** These opportunities can be created by sharing unique CTE, technical training, and project-based learning programming, through facilities sharing or by students outside the district participating in telecommunication or in-person courses. Additionally, facilitating meaningful conversations among districts could lead to model replication or program sharing between school districts that have career academies or career exploration programs in place and those that don’t. This could reduce development costs and implementation schedules for lower-income districts.

Additionally, local CTC advisory committees could be shared among neighboring communities to provide CTCs with even stronger committees. Sharing a local advisory committee could result in greater coordination of programming and curriculum development, without forcing larger employers to split their resources among the CTCs in Southwestern Pennsylvania.

CTCs and school districts with project-based learning programs should ensure that students are receiving industry-recognized certifications. These certifications are valuable signifiers of students’ mastery of key skills needed to succeed during postsecondary education and their careers.

- **Providing school districts with flexibility from state policy to allow for programmatic changes that respond to industry demands and engage student interests.** This increased flexibility could occur by facilitating opportunities for pilot programs that demonstrate a quick response to an industry need. The greater flexibility would allow school districts and CTCs to take advantage of new job demand trends or put in place innovative educational opportunities to provide students with the best opportunity to succeed.



Conclusion

Although traditional CTCs still face some of the challenges identified in the Institute’s first report on CTE, the landscape in which they are operating has changed significantly. A growing body of stakeholders are recognizing the need for traditional career and technical education as well as the inclusion of some of the CTE learning principles in other areas of K–12 and postsecondary education. Also, recognizing that those jobs that exist today might well disappear in the future due to automation, technological changes, and other factors, schools must design CTE and project-based learning programs that address current workforce needs as well as prepare students for the lifetime of learning that will be necessary to adapt to labor market changes.

Southwestern Pennsylvania is fortunate to have some outstanding best-practice examples of CTE and project-based learning, too numerous to outline in this report. When done properly and when taken together, these best practices serve as an integral part of a regional strategy that not only helps to ensure that future workforce needs are met, but also provides significant career and learning opportunities to students with greater equity across districts, resulting in lasting benefits for both students and their communities.





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