CTE | Career & Technical Education RESEARCH NETWORK

CTE Programs and the COVID-19 Pandemic

Responses, Innovations, and Implications for Future Research

SEPTEMBER 2021

Tara Smith | Lisa Soricone
JFF

Acknowledgments
The authors wish to thank the administrators and staff of the CTE programs who participated in this research, and we wish them an easier school year in 2021–22. We also wish to acknowledge the helpful feedback and support of Katherine Hughes and Kelly Reese, American Institutes for Research; Shaun Dougherty, Vanderbilt University; and Corinne Alfeld, Institute of Education Sciences, U.S. Department of Education. Any errors are the sole responsibility of the authors.

The work of the CTE Research Network Lead is supported by the Institute of Education Sciences at the U.S. Department of Education with funds provided under the *Carl D. Perkins Career and Technical Education Act* through Grant R305N180005 to the American Institutes for Research (AIR). The work of the Network member projects is supported by the Institute. The opinions expressed are those of the authors and do not represent the views of the Institute or the U.S. Department of Education.

Contents

Page

Introduction 1

CTE Program Overview 1

How Did the CTE Programs Respond to the Pandemic? 3
- Spring 2020 program delivery 3
- Academic year 2020–21 program delivery 4
- Technology 5

What Changed in CTE Programs During the Pandemic Period? 7
- Learning activities 7
- Teacher professional development 11
- Employer engagement 11

How Did Students Respond to the Pandemic? 12
- Student participation 12
- Student outcomes 13

What Changes Are Likely to Extend Beyond the Pandemic? 16

What Questions Do Researchers Need to Ask? 17
- Understanding how programs responded 17
- Understanding what changed 18
- Understanding outcomes and data reporting issues 18

Conclusions 19

Reference 20

Appendix. Summary of CTE Programs in This Study 21

Exhibits

Page

Exhibits 1–4. Characteristics of Interviewed CTE Programs.....2

Exhibits 5–6. CTE Program Delivery Format.....3

Exhibits 7–9. Technology Challenges CTE Programs Faced in the Pandemic Period 5

Exhibit 10. Certification Examination Options During the Pandemic Period 15

Introduction

Although the COVID-19 pandemic affected all education programs in the United States, career and technical education (CTE) programs in particular faced significant challenges given the hands-on and team-based nature of many CTE courses. This report presents findings from interviews with 22 programs to learn about their responses to the conditions presented by the pandemic. The programs were initially studied for the CTE Research Network's evaluability assessment (Hughes et al., 2021).[1] Recognizing the significant impact of COVID-19 on CTE programs, the Network developed a follow-up study to update the program profiles and identify how program offerings and student participation differed from normal operations. We conducted 22 interviews between November 2020 and February 2021. CTE teachers, administrators, and curriculum developers identified the challenges they faced and key lessons learned, as well as the innovations they developed that will carry into future work. This report highlights those findings and describes considerations for CTE researchers to recognize when studying education during the COVID-19 pandemic period.

CTE Program Overview

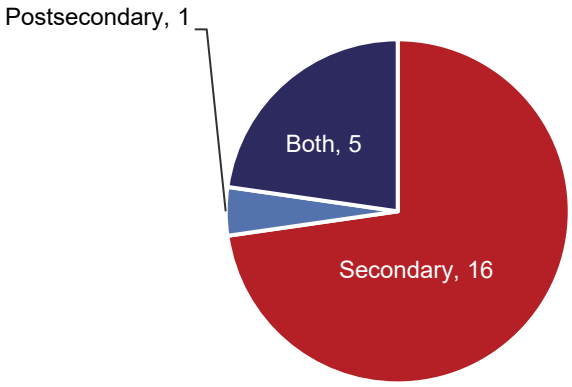
The 22 CTE programs included in this follow-up study met one or more established criteria for consideration in the Network's evaluability study.[2] Exhibits 1–4 illustrate the key characteristics of these programs. Sixteen of the 22 programs interviewed served students at the secondary level, and seventeen programs operated in multiple schools. Geographically, the interview set included four national programs and programs operating in 14 states. Thirteen programs offered multiple CTE pathways of study; the remaining nine programs offered single programs spanning from traditional CTE options such as automotive, health care, and skilled trades to more recent pathways in animation and gaming plus entrepreneurship.

[1] Given the dearth of causal evidence on the effectiveness of various types of CTE programs, the U.S. Department of Education directed the Network to conduct an evaluability assessment that could point education researchers to CTE programs and models prescreened for the elements needed for a causal evaluation. The evaluability study was carried out between January 2019 and April 2020, and 112 programs were nominated. The final report includes a set of profiles documenting how screened programs in high schools, technical centers, and community colleges operated prior to the pandemic.

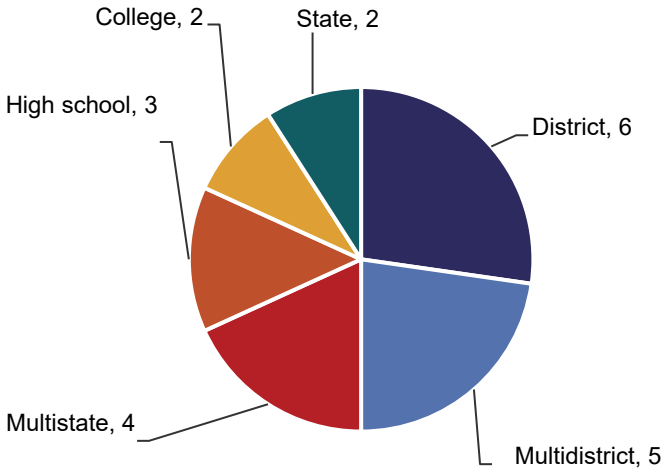
[2] The criteria included the following: (a) serving more than 500 students annually or with 500 or more students completing the program in the last 3 years; (b) using a lottery to admit students; or (c) incorporating at least 10 program components considered by the field to likely indicate quality: a blended curriculum with academic and technical courses; shared planning between academic and technical instructors; career advising or guidance system, process, and/or supports; industry participation; review of labor market data; work-based learning (exploration, experience, and/or immersion) opportunities; credential opportunities; a direct link to postsecondary through dual enrollment, articulation agreements, or other; and available career and technical student organizations (CTSOs) or industry competitions.

Exhibits 1–4. Characteristics of Interviewed CTE Programs

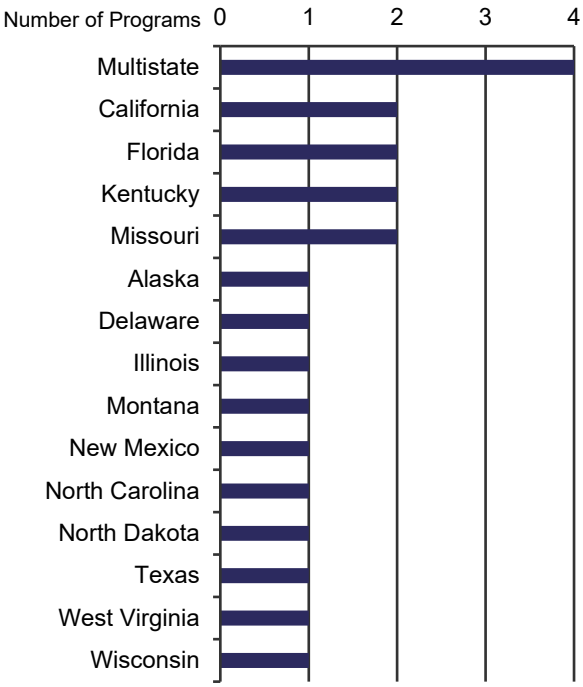
CTE Program Level



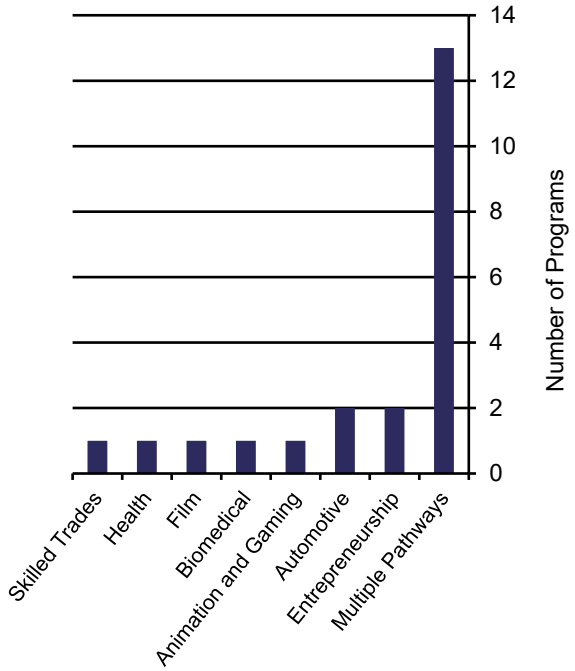
CTE Program Scale



CTE Program Location



CTE Program Pathways



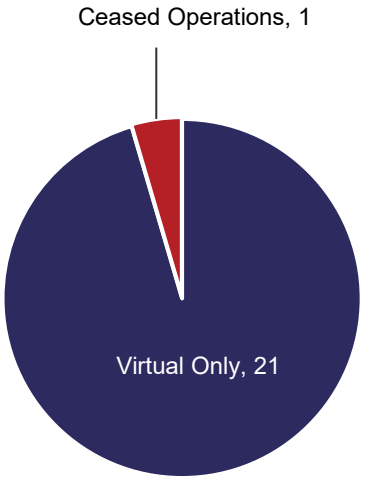
NOTE: For Figure 4, programs offering multiple pathways often included a mix of health care, skilled trades, information technology, culinary, welding, and other career options. See the appendix for more detail.
SOURCE: All four figures represent JFF analysis of the study data.

How Did the CTE Programs Respond to the Pandemic?

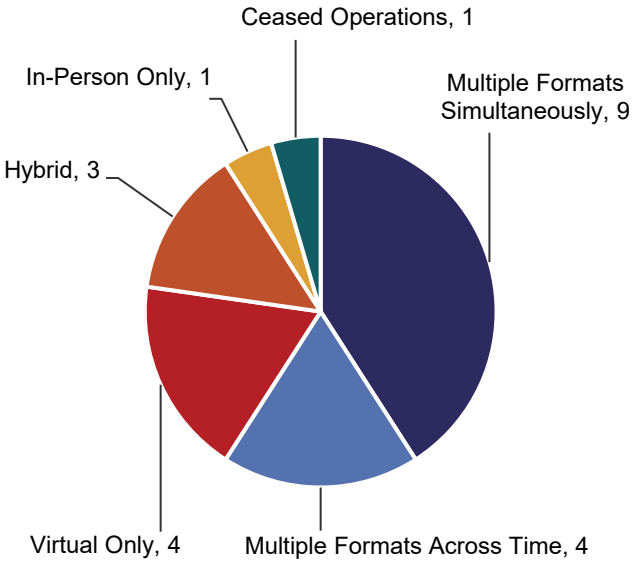
Most of the CTE programs we interviewed shared a common response to the pandemic in spring 2020: ceasing in-person classes and other activities in March and remaining virtual through the end of the academic year. Program responses for the 2020–21 academic year, however, varied widely and were complex. One program, Introduction to the Skilled Trades in Fairbanks, Alaska, ceased operations in spring 2020 and had not yet reopened at the time of the interview in winter 2021 because of pandemic-related restrictions. In contrast, Franklin Technology Center in Joplin, Missouri, had fully reopened for in-person classes starting with the first day of school in August 2020. Between those two responses, the other programs we interviewed described the 2020–21 academic year with significant changes to virtual classrooms and instruction; restructured spaces and processes for those programs offering in-person classes; and engaged in a back and forth between virtual, in-person, and hybrid approaches (combining both virtual and in-person schedules) during the year. Exhibits 5 and 6 illustrate the variety and complexity of CTE program delivery formats in this phase of the pandemic, with more than half of the programs operating in multiple formats either simultaneously or across time.

Exhibits 5–6. CTE Program Delivery Format

Spring 2020



Fall–Winter 2020–21



Spring 2020 program delivery

Program administrators and staff emphasized that the curriculum and core learning objectives for their CTE courses largely did not change during the spring 2020 through winter 2021 period. The biggest change was in the program delivery format. In spring 2020, 21 of the 22 programs in the study shifted to fully remote (i.e., primarily online) instruction, with some also offering paper packets to address internet access and technology challenges. Few programs had offered remote or virtual classes or components prior to the pandemic. Two notable exceptions were the Central Regional Area Career and Technical Center in North Dakota, which normally operates as a “virtual-hybrid” program with students

participating in virtual instruction at their home school coupled with periodic in-person, hands-on labs at the technical center campus; and the William S. Hart Union High School District College and Career Readiness Program in California, which normally operates as a hybrid program with students participating in both online and in-person hours each week. Jessamine Career and Technology Center in Kentucky had previously established a "nontraditional instruction" process, using predistributed paper packets and online instruction through Google Classroom for bad weather days. These three programs reported that this prior experience and planning helped ease the transition to all-virtual instruction in March 2020.

The interviewees often described spring 2020 as a trial (or trial-by-fire) period, with both teachers and students figuring out how to work in a fully virtual environment. Virtual programs were both synchronous and asynchronous, sometimes combining both elements during a school day or week. A few programs used, or at least started with, a "virtual mirror" approach that closely resembled the regular school day with fully synchronous classes and few adjustments to the learning expectations. Other programs provided primarily asynchronous lessons through weekly plans or daily postings, with teachers available for office hours at designated times. However, several schools changed their approach during the spring semester after recognizing that students were either "hitting the wall" from being in online classes for 7–8 hours per day or disengaging and falling behind in the asynchronous environment. This report describes the specific ways in which CTE programs pivoted during the COVID-19 pandemic.

Academic year 2020–21 program delivery

At the time of our late fall 2020 and winter 2021 interviews, one program was not operating, and four programs remained fully virtual.[3] The remaining 17 programs changed their delivery format for the 2020–21 academic year. As mentioned earlier, one program returned fully to in-person instruction as of the first day of the new academic year. Others offered hybrid or multiple (fully in-person and fully virtual; hybrid and fully virtual) formats for students based on state and local guidance and input from families. Some programs shifted their delivery format as the year progressed in response to local COVID-19 rates and changing state or local mandates. These shifts made it difficult for teachers and programs to plan for instruction and resulted in some program enrichment elements being dropped to focus on more basic or core learning objectives.

The term "hybrid" was frequently used to describe a program delivery format that required defined groups of students to attend in-person on certain days and virtually on others, alternating with other defined groups to allow for increased social distancing in classrooms. The various programs defined the alternating period differently: for some, students alternated between in-person and virtual instruction within the same school day, others alternated by days of the week, and still others alternated in a 2–3-week period. In some programs, teachers taught both in-person and virtual students in the same class synchronously, whereas other teachers taught in-person and virtual students in separate periods. One program assigned separate teachers to online and in-person classes to help reduce the heavy workload that teachers faced.

[3] Although the Introduction to the Trades program did not restart operations through winter 2021, the program and its partners were planning for an intensive 2-week course in summer 2021 for students to build job readiness and apply for apprenticeship opportunities.

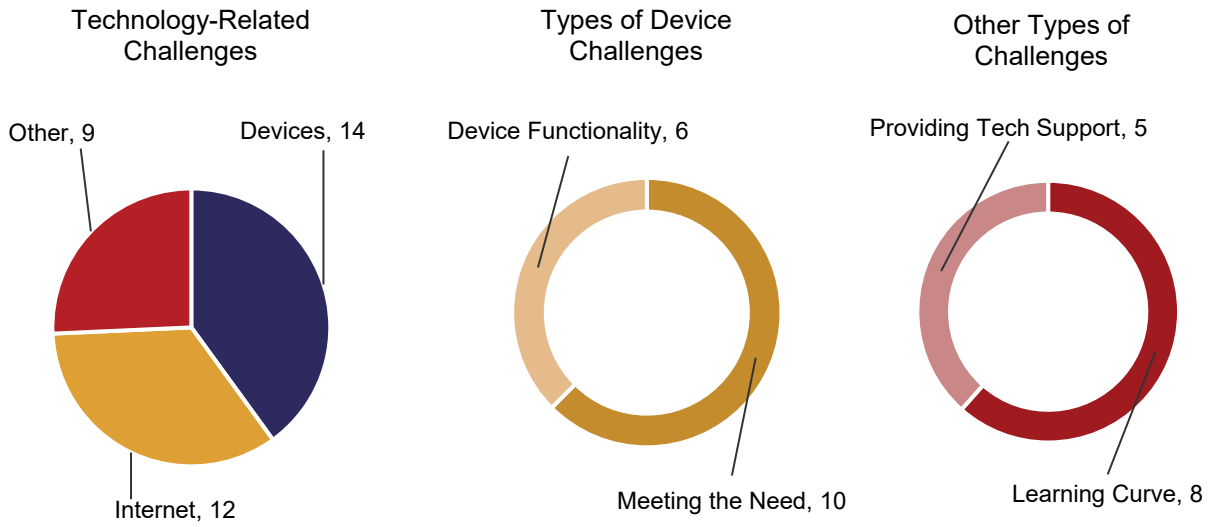
Two programs—the Missoula County Public Schools District Automotive Program in Montana and the Evanston Township High School CTE Department in Illinois—implemented block scheduling in 2020–21, a change that was previously under consideration or was in development prior to the pandemic.[4] Staff reported that this positive change helped both teachers and students better manage the workload of hybrid or virtual programs. Instructors often included a mix of synchronous and asynchronous elements in a block period, providing flexibility for working with smaller groups of students or providing additional support to individual students as needed. Staff at both programs hope that block scheduling will continue beyond the pandemic.

- Researchers considering "CTE dosage"—the amount of instructional and learning time provided—will need to gather data on how CTE program delivery formats and lesson length changed from spring 2020 through the 2020–21 academic year (and perhaps beyond).
- Researchers should ask questions about how changes to CTE dosage resulted in adjustments to program components and enrichment activities during this period.

Technology

Underlying the abrupt shift to virtual delivery was the availability (or lack) of technology infrastructure. Eighteen of the 22 programs defined spring 2020 by the technology challenges faced and overcome. Schools and programs that had previously implemented a one-to-one approach, which provided or required each student to have their own technology device (often a Chromebook), reported that the shift to virtual learning in 2020 was easier than for schools or programs that did not have that structure in place. Exhibits 7–9 show the various technology-related challenges that programs faced during the pandemic period.

Exhibits 7–9. Technology Challenges CTE Programs Faced in the Pandemic Period



NOTE: Some programs identified multiple challenges.

[4] Block scheduling involves longer class times to allow for deeper engagement with the course materials. With block scheduling, students do not typically receive instruction in every subject every day.

Devices and functionality

Fourteen programs highlighted that at least some of their students had no access to a technology device (i.e., computer, laptop, or tablet) when school buildings closed in spring 2020. Staff and administrators for these programs shared a variety of solutions to meet that need, including distributing school-owned devices to students, leasing equipment from local companies, refurbishing older laptops and tablets donated by state agencies, and partnering with local libraries and foundations for funding and device donations.

Beyond device access, other challenges were related to device functionality for a given CTE program. For example, programs in graphic design, animation, and film production often reported that industry-standard software and applications were not compatible with Chromebooks or iPads. Some school IT departments developed virtual desktop systems that allowed students to tap into campus-based computer labs, whereas other programs worked to identify alternate software or modified the lessons to adjust to technical limitations.

Internet access

More than half of the programs reported that the lack of broadband internet access was a challenge for at least some of their students. CTE staff and administrators shared that in many parts of the United States, including in both rural areas and large urban environments, families could not access reliable or affordable internet service. To address connectivity challenges, school systems, state and local leaders, and community and business partners contributed to solutions. Some schools distributed mobile hot spots to families, paid for with Coronavirus Aid, Relief, and Economic Security (CARES) Act funding; in others, local churches and nonprofit organizations opened access to their networks and allowed families to sit in their parking lots and use the internet. For some families, particularly in spring 2020, paper packets were the only viable option. Perquimans County Schools decided to discontinue paper options for 2020–21 and worked throughout the summer to meet the technology needs of those families, including providing hot spots for those without internet service. To further address connectivity issues in fall 2021, Perquimans County Schools used a hybrid model open space on campus for students on scheduled remote days.

Other technology challenges

CTE programs also highlighted significant challenges that fall under the umbrella of technical support. With the sudden shift to remote learning, both teachers and students faced difficulties in setting up and using new technology tools, including devices, webcams, and more. Another challenge for CTE centers related to the broad diversity of technology platforms and resources being leveraged by schools and programs. For centers that shared students with multiple school districts, access restrictions and compatibility issues created initial barriers to student participation. For example, a school or district may have chosen Google Classroom as its learning platform and thus restricted access to Zoom on its network, without knowing that a partnering technology center used only Zoom for its CTE classes. In some programs, IT administrators could address these compatibility challenges; in other programs, technical centers developed work-around strategies, such as providing a separate mobile hot spot to circumvent internet access restrictions.

Several programs noted that CTE instructors accustomed to working in a lab or classroom setting, where every station used the same devices and software, were suddenly trying to support students on a variety of devices using different programs and applications. Instructors themselves provided additional tech support and also relied more heavily on their school's IT staff to find solutions to individual challenges. The people we interviewed noted that their IT departments and the IT help desk staff rose to the challenge of the moment, sourcing equipment, providing training, troubleshooting, delivering remote support, and more to ensure that instruction could continue during this period.

Finally, and perhaps most importantly, CTE teachers and students alike faced a significant learning curve in developing skills and confidence with the technology tools being used in virtual learning. In spring 2020, that learning curve was a priority focus of CTE programs, and significant time was spent in and out of class to address technology challenges or build technology skills.

- Researchers should consider differences in the solutions to technology challenges implemented during this period as a factor in identifying appropriate comparison groups for a causal study.
- The abrupt shift to virtual learning created significant inequities in school access. Researchers should probe schools and programs to identify how technology challenges were addressed and gather information on how the shares of students affected changed across time. Researchers also should explore how inequities in student access affected student outcomes during this period and whether any of the effects are long term.

What Changed in CTE Programs During the Pandemic Period?

In addition to understanding how program delivery changed during the pandemic period, CTE researchers also need to understand the significant changes that occurred within programs. From learning activities to teacher professional development and employer engagement, CTE often looked very different during this time compared with normal, prepandemic operations. This section summarizes the types of changes that programs implemented and highlights issues that CTE researchers should explore.

Learning activities

Although the learning objectives for CTE programs were mostly unchanged, the pandemic significantly altered learning activities in CTE pathways. Several programs noted that the pandemic slowed the pacing of their curricula, with some recognizing that students are 3–6 months behind where they would otherwise have been. Shifting program delivery formats also had the effect of modifying the types of CTE learning activities that students engaged in during this period. Hands-on components, such as labs and clinicals, were the most commonly affected across the study period, along with work-based learning experiences either during the school year or in the summer. Disruptions with other activities, such as career and technical student organizations (CTSOs), also occurred, with many activities shutting down completely in spring 2020 and some returning only with virtual programming or restrictions in 2020–21. Most programs introduced new resources and materials, through regular curriculum providers and other sources, to support the shift to virtual instruction. In addition, some programs developed new modules or

components for CTE courses, and a few even launched new programs or pathways during this time. This section presents some program experiences in these areas.

Hands-on opportunities

The loss of hands-on learning opportunities was one of the most significant differences for students in the pandemic period. In spring 2020, most hands-on activities were canceled following school building closures. In 2020–21, fewer hands-on opportunities were available, and those that were available often looked very different from a typical year. Several programs operating virtually, including automotive and welding programs, reported adjusting curricula to shift theory and lecture to the first half of the academic year, hoping that schools would reopen with in-person opportunities at a later date. Other virtual programs, including culinary and health pathways, reported sending home kits with equipment and supplies so that students could still get some hands-on experience. CTE teachers and school staff took on the logistics of ordering, assembling, and distributing equipment and supply kits for various CTE courses, and purchases through grocery delivery services (e.g., Walmart) ensured that culinary students had the food ingredients necessary for each lesson.

Programs offering hybrid delivery often structured class time so that lecture and theory components happened while students were in virtual sessions and applied work happened when students were in person. These in-person opportunities often were sharply limited in terms of the number of students who could participate at one time and the availability of personal protective equipment or resources to disinfect equipment between uses. The CTE program at Union Grove High School in Wisconsin, however, highlighted a benefit of hybrid programming: with the smaller group size engaged in hands-on activities, students had more opportunities to use the equipment and get one-on-one attention from the teacher than would have been possible in a normal classroom setting. In Delaware Pathways programs, CTE teachers developed “reverse field trips” to allow students to attend labs in person on days they were scheduled to be remote. This strategy was particularly for seniors who needed to meet lab or other hands-on requirements for certification examinations. Looking ahead, staff and instructors noted that students who were only or primarily virtual in 2020–21 will have had limited hands-on experience and will need additional time and support to build applied skills.

- CTE researchers interested in understanding program quality elements will need to document the structure of hands-on components during the pandemic period—if offered at all—including differences in sequencing, frequency, location, and equipment access.
- Programs that sent kits home reported that they used Perkins and CARES Act funding, or flexible state funds, to cover the costs of equipment and supplies. Future researchers conducting cost studies should specifically ask for details on if and how programs used additional or supplemental funding during this period.

Work-based learning opportunities

Although most programs reported that work-based learning opportunities, including internships, were lost or reduced because of the pandemic, some programs pivoted their operations. For example, approximately 2,000 students from Miami-Dade County Public Schools participated in paid, virtual summer 2020 internships with the school district and other local employers. Other programs, such as

NAF and Virtual Enterprises, implemented virtual internships in summer 2020 that created opportunities for work-based learning experiences that had not previously been available to students in rural or remote settings.

For the 2020–21 academic year, most programs reported that work-based learning opportunities continued to be unavailable or were sharply reduced. Many programs reported using tools such as Nepris and other online platforms to provide students with virtual job shadowing opportunities, connect with industry mentors, and bring speakers from business and industry into the virtual classroom.[5] One program that offered in-person work-based learning in spring 2021 was the Health Sciences Pathway at Rockcastle County Area Technology Center in Kentucky. In partnership with area hospitals, the program developed protocols to allow Medicaid nurse aide students to build workplace experience in long-term and acute care facilities. Another program, the Franklin Technology Center at Joplin School District, reported that although work-based learning opportunities were not available in most pathways, students in the early childhood education pathway could participate in internships—while observing stringent masking and glove requirements—because child care was designated an essential service by the state.

- CTE researchers exploring the impact of work-based learning should ask programs about the introduction and use of virtual work-based learning activities, including internships, during the pandemic period.
- While an administrative record may indicate whether a student participated in work-based learning, researchers should also probe to understand what type of work-based learning was offered and how student participation and learning objectives were defined.

New resources and materials

With the shift to virtual and hybrid learning, CTE programs faced a significant need for relevant online tools and resources. The programs we interviewed reported that most CTE vendors and curriculum developers offered additional resources, often free, including online textbooks, videos, web-based activities, and virtual examinations in spring 2020. For the 2020–21 academic year, many programs reported purchasing online curricula and supporting materials, as well as cameras and other equipment for teachers to record demonstrations and lessons. Many programs had to renegotiate software licenses to allow students access to programs that previously were available in classrooms or campus computer labs. Funding for these purchases often came through the CARES Act, although some programs used Perkins funds or other state or local resources to cover the associated costs. In Delaware, the state provided two flexible funding allocations to schools to help them meet the changing circumstances encountered.

The national programs we interviewed all identified “a sprint” to shift their content to work online, developing additional modules and activities to help teachers engage students and providing significant teacher training and support. NAF moved its catalog of academy curricula, resources, and toolkits from behind a paywall to support existing partner schools and connect with schools outside the NAF network that had not previously engaged with the organization. The Switch Lab, an engineering and automotive

[5] Nepris is an online platform for connecting teachers and students with industry professionals.

curriculum designed around students building an electric vehicle, helped teachers implement more lessons on computer-aided design and testing and ramped up development of interactive online curricula. The program also developed circuit and battery assembly kits that could be sent home or rotated among students to provide hands-on opportunities. Both Virtual Enterprises International and Uncharted Learning's INCubatoredu, national programs focused on entrepreneurship, developed dynamic videos, self-guided content, and modules to support students working collaboratively in the virtual setting.

- Given all the changes in curricula, materials, and resources, researchers examining CTE programs during the pandemic period should examine the differences in the breadth and depth of student learning opportunities, along with the trade-offs potentially made because of cost or other constraints.
- National programs expressed facing a challenge in understanding how the implementation of their curricula may have changed during this period, both within and across schools. They anticipate that these changes may have repercussions for future assessments and program development. Future CTE researchers should probe program changes and modifications following the COVID-19 period to identify the ongoing influence of pandemic-era experiences.

New components, programs, and pathways

CTE programs also developed new content or modules to replace components that did not translate to the virtual format. For example, at Evanston Township High School in Illinois, the welding class became a metal sculpture class to keep students engaged with some of the tools and materials they would have used in a normal class. The Central Regional Area Career and Technical Center in North Dakota developed lessons on career-ready practices (responsibility, communications, technical skills) that broadly applied to multiple CTE pathways. The Northwest ISD Biomedical Sciences Academy in Fort Worth, Texas, implemented a new unit on COVID-19 developed by Project Lead the Way to help students better understand the virus. The unit included a project in which students designed safety protocols and drafted facility plans based on their understanding of the virus. This project had a side benefit of helping students recognize the purpose and importance of campus COVID-19 protocols and helped ease concerns about returning to school in person.

Others reported launching new programs or pathways in 2020–21, typically because of longer term planning and implementation efforts that were already in motion prior to the pandemic. Miami-Dade County Public Schools in Florida launched a new pilot pathway in agriculture technology, and the Central Orange County CTE Partnership in California piloted a new manufacturing entrepreneurship pathway. The Hart Union High School District Career and College Readiness Program launched a new dual enrollment welding pathway in partnership with the local community college; that pathway started with theory, mathematics, and blueprint reading classes, which were well suited for virtual delivery.

- Implementation of new materials, components, and programs is a significant feature of the pandemic period. Future researchers should carefully document these changes when exploring how CTE program curricula and activities impact student outcomes. Researchers also should consider how further use of these new pieces may change after the pandemic ends.

- Researchers should recognize that, despite the challenges of the 2020–21 academic year, CTE programs launched new components and pathways during this period. Researchers should ask about any needed implementation issues or modifications to meet pandemic-related circumstances.

Teacher professional development

One way that CTE programs responded to the pandemic was to connect teachers and support staff to professional development opportunities. Many schools and programs offered initial training in virtual platforms (e.g., Google Classroom, Teams, and Zoom) to support the abrupt shift to online learning in spring 2020. The state education agencies in Delaware and West Virginia partnered with the Southern Regional Education Board (SREB) to provide virtual professional development sessions on high-quality online instruction and other related topics. The postsecondary CTE programs in the study reported that their colleges granted institutional waivers for instructors to teach online courses in spring 2020 but required certification in online teaching methodologies and student engagement to be allowed to teach in fall 2020. Certification classes were primarily existing offerings available through the professional development departments at each college.

The programs we interviewed also reported that curriculum developers, textbook publishers, and CTE professional associations all offered professional development, teacher peer learning opportunities, and other supports beginning in spring 2020 and continuing through the summer and into the 2020–21 academic year. Several programs reported that traditional professional development opportunities offered by state associations or curriculum partners shifted to online and more frequent connections that engaged more teachers than they might typically have reached.

Noting the toll of the pandemic on teacher's mental health and the exhaustion that teachers reported from the additional workload of delivering content online, West Virginia worked with SREB to build a professional development session for instructors on emotional wellness and self-care.

- Future CTE researchers may want to identify required and available teacher professional development opportunities during this time period to understand how instructional practices and supports changed and how those may relate to the student experience, participation, and outcomes.
- Researchers also may want to explore if CTE teachers retired or left the profession in greater numbers during or after the COVID-19 period, perhaps resulting from the pandemic's toll on mental health or because of high labor market demand for certain skills (e.g., welding, nursing).

Employer engagement

Despite the clear impact of the pandemic on traditional internship and job shadowing opportunities, many programs reported that employer engagement continued—and sometimes became stronger—during this period. Administrators shared that it was easier for employers to be a guest speaker in a class or participate in a program advisory board meeting when they could be online rather than leave their workplace and drive across town or across the state to participate in person. An employer partner of the Hart Union High School District Career and College Readiness Program in Santa Clarita,

California, developed an online platform to host the program's annual manufacturing day event virtually. The Hart program also implemented a new "adopt-a-pathway" initiative to match business partners one-on-one with pathway teachers and lead staff. In Illinois, the Evanston Township High School CTE Department implemented a "career pathway of the month" initiative to showcase area employers and help connect students with information about career pathways and labor market opportunities. The Miami Animation & Gaming International Complex (MAGIC) program at Miami Dade College in Florida developed a virtual career fair platform to help graduating students connect with industry employers. The platform, which allowed employers access to student portfolios and résumés, is an example of an innovation that will continue beyond the pandemic.

Several programs reported that business leaders in their regions were eager to connect with and support CTE programs. In Alaska, the director of the Introduction to the Trades program was invited to present to the local Chamber of Commerce about the impact of the pandemic. Employers there had concerns about student preparation for entering the workforce and eager to discuss ways in which they could be of assistance. Similarly, the Central Orange County (California) CTE Partnership reported that employers there also had concerns about the talent pipeline and wanted to know how they could help.

- Because employer engagement and industry partnerships are critical to high-quality CTE programs, researchers should document how employer engagement changed during the pandemic period. Asking questions about how employers engaged and where employers focused their efforts may be particularly important for understanding student participation in work-based learning and employment outcomes.

How Did Students Respond to the Pandemic?

Beyond documenting the pandemic's impact on how CTE programs operated, it will be important for future researchers to account for how students and families responded during this period, including their participation in CTE courses and related outcomes. Most programs reported that students struggled academically, mentally, and/or socially during the pandemic period, and student engagement was a significant challenge both in spring 2020 and through the 2020–21 academic year. Although CTE classes typically are more engaging than standard academic classes, few CTE programs reported that student engagement in CTE during this period was better than their engagement in academic classes overall.

Student participation

Secondary staff and administrators flagged participation and engagement challenges according to students' grade levels at the time of the pandemic disruption. High school seniors may have lost the opportunity to take industry certification examinations or complete credential requirements, high school juniors and sophomores may have missed or delayed skill development opportunities, and freshman students may have experienced lower levels of engagement and ultimately decided not to persist in a pathway.

Programs regularly reported that student recruitment and enrollment for 2020–21 was completed before school buildings closed in March 2020. Although a few noted that actual participation in fall 2020 was

lower than expected or that students stopped out of CTE programs, others reported that participation was strong and even growing. Looking ahead, most interviewees believed that recruitment for the 2021–22 academic year would be negatively impacted by the loss of student site visits, open house nights, and student peer interactions that often generate interest among students considering CTE programs and pathways.

For many CTE students, participation was a challenge given all the changes forced by the pandemic. Staff at CTE centers noted that students struggled to balance the workload of their home school or core subjects with CTE classes that focused more on theory than the hands-on learning they originally expected. Another participation issue surfaced related to student organizations. Although many CTSOs shifted to virtual meeting and competition formats, programs typically reported that student engagement and participation was down sharply in 2020–21. Without the same leadership and travel opportunities that CTSOs normally offer, few students saw the value of participating in yet another online meeting.

Many schools reported challenges and fresh approaches to communicating with students and parents. Secondary administrators often noted that communications with parents were much more frequent than in a typical year, a change that some hoped would continue in the future. The MAGIC program at Miami Dade College in Florida shared that instructors and staff discovered during the pandemic that Discord is an effective platform for reaching and communicating with students who do not answer emails or respond through other channels.[6] The MAGIC program had been working to address this problem for several years without success, and the program felt fortunate to have found a solution when needed the most.

A few programs identified some positive aspects of student participation. Some reported that students appreciated the opportunity to manage their own time and pacing through the content that virtual learning allowed. Others noted that online curricula provided teachers with engagement and progress metrics that were useful in identifying students who needed outreach or additional support.

- Researchers should be aware that the impacts of the pandemic on student recruitment, participation, and engagement may have a ripple effect for several years, including disruptions to CTE skill-building and demonstration experiences that typically supplement academic programs.

Student outcomes

CTE administrators and staff identified significant student outcomes differences beginning in spring 2020 that future CTE researchers will need to account for in longitudinal research and in research specifically looking at the effects of the pandemic period. These differences include changes to grading measures and examination requirements, limited or lost opportunities to earn credentials, and disruptions to data collection and reporting.

[6] Discord is an instant messaging and digital distribution platform for creating communities.

Grading and completion

Some CTE programs revised their grading measures and definitions or extended grading and completion periods in recognition of the significant disruptions that the abrupt shift to virtual learning in spring 2020 created. For example, South Technical High School in the Special School District of St. Louis County, Missouri, implemented a "hold harmless" policy that meant a student's final spring 2020 grades could not be lower than their grades from the third grading period. Programs in Kentucky noted that the state paused end-of-course accountability examinations in spring 2020 and planned to test only seniors in spring 2021.

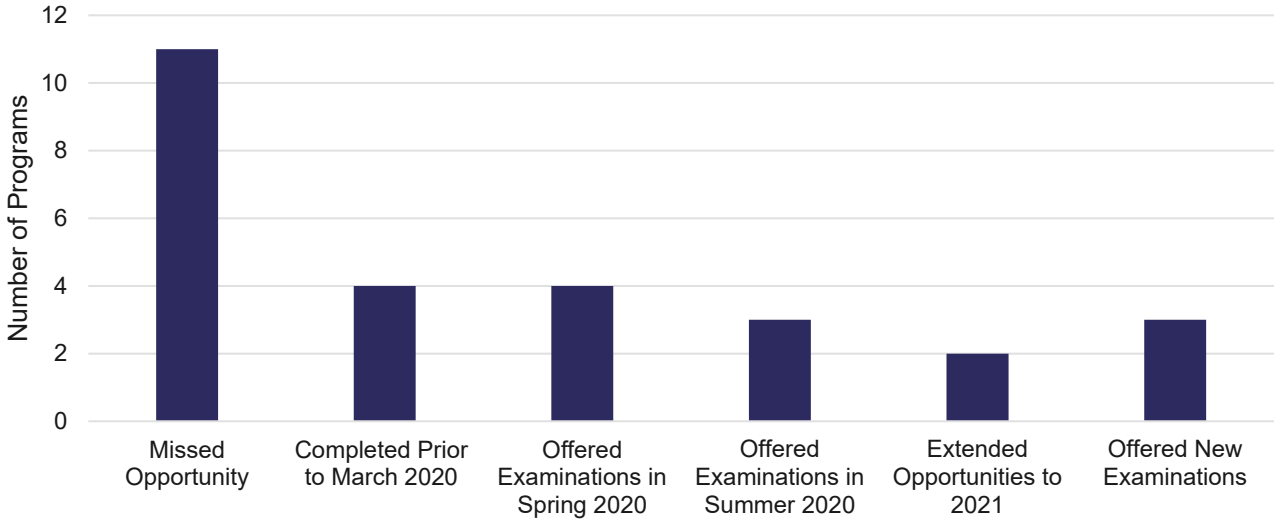
The Film Technician Program at Central New Mexico Community College marked students in classes with lab- or production-based equipment requirements and classes that required in-person collaborations "incomplete" for the spring 2020 semester. Students received an extended opportunity to complete course requirements once the campus reopened at a reduced capacity in 2021. Miami Dade College did not offer some MAGIC program classes in 2020–21 because of COVID-19 restrictions on student interactions—a decision that may lead to student progress and completion delays.

- Researchers conducting longitudinal studies of CTE programs or examining the effects of the pandemic period will need to ask about any changes to completion or grading standards and policies from spring 2020 through spring 2021 to understand credit accumulation, promotion, and other student outcome data.
- Because decisions to change standards may have been made by campus, local, and/or state education authorities, researchers should ask about the set of changes that may factor into student outcomes during this period.

Certification examinations

For many students, the pandemic resulted in a missed opportunity to earn industry and/or academic credentials. Exhibit 10 summarizes how the programs addressed examination options during this period. Only four programs reported that students had completed licensure or certification examinations before March 2020. Most noted that examinations were postponed or canceled altogether. In some cases, state regulatory agencies or industry certification standards did not allow for adjustments to the circumstances, for example, requiring in-person testing or a set number of practical hours to qualify for the examination. Programs that provided testing opportunities in spring or summer 2020 saw fewer students choose to take the examinations than expected. Staff shared that local COVID-19 rates and safety concerns likely reduced students' participation in the extended examination window, resulting in further missed opportunities.

Exhibit 10. Certification Examination Options During the Pandemic Period



NOTE: Programs could identify multiple examination options.

High school seniors were one of the groups significantly impacted by school building closures in spring 2020 and the resulting disruption of examination and certification opportunities. Timing was the critical factor for seniors because many programs cannot provide services to students after their graduation date in May or June 2020.

For programs with postponed examinations, staff and administrators set up testing opportunities during the summer for individuals or small groups to come into a school building or central office to complete applied skills tests and sit for proctored written examinations. Some programs noted that students earned lower proficiency ratings or had higher failure rates than in a normal year, and most reported that the numbers of students earning certifications were down sharply from recent years. Several programs anticipated limited or no availability of examinations and certifications in the 2020–21 academic year because of virtual instruction and restricted hands-on opportunities.

In West Virginia, the state board created a “virtual CTE completer” certificate that provided recognition that a 2020 high school graduate completed all the class time requirements but lacked the clinical or lab hours normally required for a credential in their program of study. Virtual completers would have up to 1 year to finish the required hands-on hours and any associated examinations to earn their intended completion credential. A few other programs reported adding certification opportunities that students could complete online, including certifications in Microsoft Essentials and Excel, as well as more pathway-focused credentials developed or provided by industry partners. For example, in the Orange County (California) CTE Partnership, an employer partner developed a data analytics curriculum with two embedded certifications that could be offered as an asynchronous workshop opportunity for students. In Montana, the Missoula County Public Schools District Automotive program added Ford Technical Training online certifications through its strong partnership in the Ford Automotive Career Exploration program.

- Researchers should catalog CTE certification examination opportunities and take-up rates, beginning with March 2020 and continuing through 2020–21, to identify the impact of pandemic-related disruptions on student outcome measures.

Data collection and reporting

Another issue for understanding student (and program) outcomes in spring 2020 is that data collection for measures of completion and credential attainment often occurs in the last quarter of the academic year. In some schools and districts, data collection and reporting stopped in March 2020, so records may be incomplete. NAF, with academies in 392 schools nationally, changed its reporting requirements in spring 2020, modifying the certification standards and reducing the number of internship hours required. NAF also allowed schools to extend their prior year's academy quality ratings through 2020–21 to reduce logistical and reporting burdens for schools.

- Researchers using student and program outcome data from this period should ask for additional information about the context, conditions, timing, and potential disruptions to data collection, as well as information on changes to definitions, threshold ratings, and other measurement standards.

What Changes Are Likely to Extend Beyond the Pandemic?

Although many aspects of CTE programs and how students participated were changed to address the challenges of the moment, program staff, teachers, and administrators all noted innovative and impactful change elements that will likely continue after the pandemic ends. Many administrators and program developers felt that the pandemic forced teachers to "level-up" their proficiency with technology, including in CTE programs. One teacher shared that the opportunity to try something new and record lessons meant that students in all periods got the same great lesson, whereas in the past she may have been working out the kinks of a new lesson in first and second period before finally hitting on the right approach later in the day. The Central Orange County (California) CTE Partnership noted that the process of ideation—the creative process of generating, testing, and refining new ideas—had become a commonplace practice for teachers during the pandemic as they learned to leverage technology tools for collaboration and human-centered design.

Others reported that teachers in pathways from automotive to health care realized the value of well-recorded hands-on demonstrations that gave every student the same close-up view rather than just the few students who gathered closest to an engine or patient. Several programs highlighted the fact that although the shift to virtual instruction has been a significant lift for teachers, the newly developed virtual content and online tools will extend beyond the pandemic and benefit future classes. Staff with Uncharted Learning's INCubatoredu program highlighted a new volunteer engagement approach for facilitating virtual mentorships with industry professionals as one of those innovations.

Virtual engagement with employers is a change that most likely will extend beyond the pandemic. Programs shared that employer engagement would likely incorporate more virtual opportunities in the future. Teachers and employers recognized how easily classroom visits, mentoring, and other activities

could be conducted through Zoom and other virtual platforms. Many programs also noted that virtual platforms facilitated attendance and participation in advisory board meetings.

CTE programs also shared that their communications with students and families were stronger than they had ever been because of the multiple channels available for connection. YouTube, Twitter, Facebook, Discord, and other technologies created opportunities to connect with students and parents "where they were." Other schools found that old-fashioned home visits were still important in the modern era, especially for students and families who lacked technology devices or broadband access. In areas where technology barriers had been overcome, a handful of programs believed that virtual and hybrid learning opportunities would become a lasting feature for schools in the future, even if just to support students with health issues that prevented attending school in-person or to keep students on-track during bad weather days.

- CTE researchers who are looking at the postpandemic period should recognize the lasting impact of pandemic-era changes. The "new normal" is unlikely to be a return to how the program looked prior to March 2020 and may have implications for understanding program implementation and impacts across time.

What Questions Do Researchers Need to Ask?

As shared throughout this report, CTE researchers will need to account for multiple topics as they study program and student outcomes during and after the pandemic. Much of this context, though critical for study design, the determination of measures and counterfactuals, and analysis, is unlikely to be captured in administrative data. In this section, we summarize those issues and suggest additional areas of focus. Answers to these questions will be especially important for researchers, CTE practitioners, and policymakers as they work to identify best practices for CTE, develop new approaches and systemic reforms leading to more impactful CTE programs, and increase student achievement.

Understanding how programs responded

- How did program delivery formats change in spring 2020 and for the 2020–21 academic year? How did delivery formats change within a semester and/or across time? Did the length and structure of lessons change? In contexts with multiple program offerings, was delivery similarly altered across all programs?
- In cases of virtual delivery, were there synchronous and/or asynchronous components? Were determinations on those structures made at the classroom, school, or other level?
- What technology challenges did students, teachers, and programs face, and how were those challenges addressed? What share of students were affected by technology challenges initially in spring 2020 and during the 2020–21 academic year? What were the equity issues related to technology challenges during this period? Were there long-term effects on student outcomes related to inequitable access?
- Does or will the program continue to offer virtual classes or curricula?

- How were CTE teachers prepared and supported for the shift to virtual or hybrid instruction? What difference did professional development make for the CTE student experience? How was teacher retention affected by the pandemic's toll on mental health and/or high labor market demand for certain skills (e.g., welding, nursing)?
- How did the program leverage Perkins and CARES Act funding, and other sources of support, during the pandemic?

Understanding what changed

- How did the program provide hands-on learning opportunities during the pandemic, and how were those opportunities different from what the program offered prior to the pandemic? Did the program send home equipment and supply kits for CTE students? If so, which programs and for students at which levels? Were the kits part of synchronous or other instruction?
- Did the program offer virtual work-based learning opportunities, including virtual internships? If so, for which programs and for students at which levels?
- How did alternative approaches to hands-on learning and/or work-based learning affect student development of employability skills?
- What curricula, tools, components, or pathways changed or were implemented during the pandemic period? How did these changes alter the CTE student experience?
- How did employer engagement change in terms of participation level and the quality or intensity of employer–student interactions? What issues did employers highlight regarding the nature/quality of their engagement during the pandemic period?
- What aspects of the CTE program's COVID-19 experience have had the most lasting repercussions, either positively or negatively? How is the program different from before the pandemic?

Understanding outcomes and data reporting issues

- What effect did the pandemic have on student recruitment and enrollment in the 2020–21 academic year? In 2021–22 and beyond?
- What effect did the pandemic have on student participation and engagement in CTE classes? In CTSOs? What were the equity implications for how engagement differed across student groups during this period?
- Did the state, local education agency, school, or program change grading standards or policies in spring 2020? In the 2020–21 academic year? If so, how? Did those changes address issues of credit accumulation, promotion, or completion/graduation? If so, how?
- How were opportunities for certification and accountability examinations altered by the pandemic?
- How did the program or school's response to the pandemic disrupt or alter typical data collection, data submission, and data reporting processes?

Conclusions

The program staff and administrators we spoke with shared a common reflection that, despite all the adjustments necessitated by the pandemic, CTE instructors and school staff showed remarkable dedication, resilience, and commitment to student engagement and success. Some administrators noted that the role of the school in providing meals to students and their families, distributing technology devices and internet access solutions, and delivering other support services truly demonstrated an embrace of a whole-child, whole-family approach. The rapid and extraordinary responses required to meet the pandemic's challenges while continuing to serve students and meet CTE learning objectives cannot be understated. Research focused on or inclusive of this period will need to deliberately consider the context and extent of the change and disruption that a CTE program and its participating students experienced. As education systems seek a return to "normal," researchers also should carefully note how the new normal may differ from operations before the pandemic when examining the impact of CTE programs on student and labor market outcomes.

Reference

Hughes, K. L., Miller, T., & Reese, K. (2021). *Ready for causal research: A national evaluability assessment of career and technical education programs (final report).* American Institutes for Research, Career and Technical Education Research Network. https://cteresearchnetwork.org/sites/default/files/2021-04/CTE-Research-Network-508.pdf

Appendix. Summary of CTE Programs in This Study

	The Central Orange County CTE Partnership
Operations	**Programmatic Level**: Orange County Department of Education **Location**: Orange County, California **Number of Schools**: 21 high schools in 3 Central Orange County school districts **Number of Students Served (estimated, annual)**: 17,000 (2018–19) **Website**: https://ocde.us/EducationalServices/CareerEducation/ctep/Pages/default.aspx **Entrance Requirements**: None **Unique Information**: This partnership is a subset of the Orange County Pathways programs run by the Orange County Department of Education and serves 200 CTE teachers.
Curriculum	**Number of Pathways**: 26 pathways in 15 career clusters **Sequenced CTE Pathway Curriculum**: 188 courses across *introductory, completer, and capstone* levels (*300 hours minimum for each pathway*); some pathways (46 courses) incorporate college credit (articulation agreements with 10 local community colleges). **Proximal Curriculum**: Many pathways offer blended coursework—traditional academic courses taught through a CTE lens. **Additional Information**: Some pathways (83 courses) meet one or more of the prerequisites for entrance into California State University or the University of California.
Components	**CTE/Program-Centered Components**: Work-based learning (internship or apprenticeship) through capstone courses (common student experience); six career and technical student organizations (participation varies across pathways), with industry challenges incorporated through these organizations. **Additional Components**: Each pathway has an optional accompanying 4-year plan of secondary courses that students can choose to follow to get a fuller experience within the pathway. The CTE Partnership had more than 400 active business partnerships as of 2018–19. The partnerships with local businesses include agreements that the businesses will take interns and help review curriculum.
Completion	**Completion Definition**: Students must take at least one level 2 and one level 3 course within the same pathway. **Number/Percentage of Completers**: 1,260 completers (2018–19); many students complete more than one pathway. **Credentials Available**: Every pathway also has at least one relevant industry credential associated with it. Some credentials are attached to specific classes, and some are separate to be done as activities or modules outside class. In all cases, the school pays for students to take the examinations to obtain these credentials.
Response to COVID-19	**Spring 2020**: Programs moved to fully virtual delivery. **2020–21**: Programs operated in multiple formats and changed formats across time based on individual district-level determinations. **Challenges**: Supporting teachers to shift content online; could not provide services or certification examinations for impacted seniors after graduation **Innovations**: Increased engagement with local business partners to leverage technology and virtual platforms; asynchronous and virtual teacher professional development; and made human-centered design thinking a more common practice among teachers.

NOTE: Items in italics are required activities for CTE students.

The Central Regional Area Career and Technical Center

Operations

Programmatic Level: Virtual CTE center

Location: Bismarck, North Dakota

Number of Schools: One virtual CTE center provides services for 28 member districts.

Number of Students Served (estimated, annual): 600 (as of 2018–19)

Website: https://cractc.org/

Entrance Requirement: Open enrollment is available for students in member districts.

Unique Information: Students participate in CTE coursework that would otherwise be unavailable because of high equipment cost and/or prohibitive per-pupil course cost in part because they live in rural districts. Local facilitators assist in coordinating and managing course operations.

Curriculum

Number of Pathways: Eight career areas: agriculture, aviation, family and consumer sciences, graphic design, information technology, marketing, medical careers, and STEM (science, technology, engineering, and mathematics)

Curriculum Overview: Thirty online, blended, or interactive television courses; all courses embed project-based learning principles and employability skills (e.g., communication, collaboration, problem solving).

Additional Information: The model heavily relies on technology (content delivery and simulation), local facilitators, and scheduled whole-class in-person meetings (central or widely accessible location) to deliver coursework. Local facilitators provide on-the-ground support to students in their local areas and administrative support for each course. Courses follow either a distance learning or blended learning format delivered by Moodle (a learning management system).

Components

CTE/Program-Centered Components: Career exploration activities and college tours (middle school); industry competitions, internships, and work-based learning experiences vary by sector and course sector.

Additional Components: The program highlights the availability and requirements for state-funded CTE postsecondary scholarships. Each instructor has work experience and/or certification in the course content and receives training in technology, blended learning pedagogy, and the effective use of local facilitators.

Completion

Completion Definition: Course or program of study completion

Number/Percentage of Completers: Unavailable

Credentials Available: Many courses include industry-relevant skills assessments as part of the coursework, or the coursework is aligned with one or more certification examinations.

Response to COVID-19

Spring 2020: Classes moved to fully virtual delivery.

2020–21: Resumed virtual-hybrid class delivery but with fewer in-person days and continued strong enrollment growth.

Challenges: Lack of in-person, real-world learning opportunities for students; technology integration; and compatibility across multiple districts

Innovations: Added career-ready practices curriculum in responsibility, communications, and technical skills. Students' growing comfort and experience with technology tools led to better engagement in virtual class sessions.

Delaware Pathways

Operations

Programmatic Level: State level

Location: Delaware

Number of Schools: Students from all of Delaware's 38 high schools and all 6 regional CTE centers

Number of Students Served (estimated, annual): 16,000 high school students (40 percent of the state total in 2019–20)

Website: http://delawarepathways.org/

Entrance Requirement: None at the state level. Individual schools may have pathway entrance requirements. To enter one of the four technical schools in the New Castle Vocational/Technical School District (serving New Castle County, Delaware), the POLYTECH School District (serving Kent County, Delaware), or the Sussex Technical School District (serving Sussex County, Delaware), which house more intensive CTE programs, an application is required, and entrance is determined by lottery.

Unique Information: CTE programs are designed at both the state and local levels, with parallel expectations for state approval. For programs designed at the state level, the Delaware Department of Education designs the career pathways, course sequences, postsecondary and industry partnerships, teacher training, policies, instructional framework, competency profiles, and procedures while also structuring some of the program components, such as graduation planning and the career and technical student organizations that the high schools implement.

Curriculum

Number of Pathways: 24 career pathways

Curriculum Overview: CTE pathways consist of at least *three sequenced CTE courses that offer early college credit* and certificate courses. Some pathways incorporate Project Lead the Way curricula and/or are NAF academies. Students at New Castle Vocational/Technical School District typically complete eight CTE courses within a designed sequence. Students in POLYTECH School District and Sussex Technical School District typically complete more than six CTE courses within a designed sequence.

Additional Information: Delaware Pathways works with one community and technical college (Delaware Technical Community College, a statewide system), and four universities/colleges provide dual enrollment for early college credit and certification courses.

Components*

CTE/Program-Centered Components: Career and technical student organizations aligned to pathways (40 percent–50 percent of students), work-based learning (16 percent), and *development of a 5-year student success plan* (100 percent)

Additional Components: Each school may extend the CTE program through additional dual-enrollment courses and work-based learning programs. Each technical school and most comprehensive schools have a work-based learning coordinator or a teacher/administrator who handles the career immersion aspect of the work-based learning continuum. Teachers receive between 40 and 80 hours of training. They have two types of training: content development and professional practice development.

Completion

Completion Definition: Completion of three CTE courses

Number/Percentage of Completers: In 2019–20, 71 percent of all students in grades 9–12 (31,202) successfully completed a CTE course, 58 percent of all juniors (5,869) concentrated in a CTE program, and 63 percent of all high school graduates (5,904) completed a CTE program.

Credentials Available: Credential obtainment is a focus in information technology, construction, manufacturing, culinary, education, and health care. Approximately 15 percent of the students receive credentials through the pathway.

Other Outcomes: Delaware Pathways is measuring career and college readiness and transition to postsecondary education or the workforce. As of 2017–18, 65 percent of the students were college and career ready, and 64 percent of the completing students transitioned to postsecondary education or the workforce.

Response to COVID-19	Delaware Pathways
	Spring 2020: Classes moved to fully virtual delivery. **2020–21**: Began fully virtual, with some schools opening hybrid options in the fall before returning fully online after Thanksgiving through winter 2021. **Challenges**: Student engagement, especially for seniors who were struggling academically. Uncertainties about the return to in-person learning delayed planning and implementation of some curriculum components in the virtual environment. **Innovations**: The state provided two allocations of flexible funding to schools in the 2020–21 academic year to meet the challenges of the moment. The state partnered with the Southern Regional Education Board to provide a professional learning series for teachers on online instruction, synchronous/ asynchronous planning, and more. Schools developed reverse field trips (where virtual students came to school for the day) to provide students, especially seniors, with more hands-on learning opportunities.

NOTE: Items in italics are required activities for CTE students. *Percentages indicate the percentage of students in the high school receiving particular components.

Evanston Township High School Career and Technical Education Department

Operations

Programmatic Level: High school/district

Location: Evanston, Illinois

Number of Students Served (estimated, annual): In 2018–19, the program served 625 ninth graders, 554 tenth graders, 552 eleventh graders, and 524 twelfth graders.

Website: https://www.eths.k12.il.us/domain/366

Entrance Requirement: Most entry into the program is through open registration, with a few courses requiring prerequisites or lottery-based entrance because of demand.

Unique Information: Students must take at least one CTE course to graduate from Evanston Township High School; a majority of students do not commit to completing a pathway.

Curriculum

Number of Pathways: Seven

CTE Pathway Curriculum: Pathways have between two and 10 courses; they include a mix of CTE courses (including Project Lead the Way courses), Advanced Placement courses, engineering and manufacturing dual-enrollment courses through a local community college, two integrated courses, and lab hours.

Curriculum Overview/Additional Information: Some pathways have lab hour requirements, including manufacturing (4 days per week), engineering (4 days per week), automotive technology (4 days per week), early childhood education (twice per week), and culinary arts (twice per week).

Components*

CTE/Program-Centered Components: *Complete one CTE course* (100 percent) and *career exploration through SchooLinks* (100 percent); additional components are course specific: Work-based learning exposure such as expert speakers or field trips (<40 percent), industry-sponsored events or challenges (<15 percent), and coordination with external organizations for job placement (<5 percent).

Completion

Completion Definition: Pathway course sequence completion

Number/Percentage of Completers: Unavailable

Credentials Available: Pharm Tech, Water Operator in Training, Early Childhood Education (Illinois ECE level I), OSHA (Occupational Safety and Health Administration) Workplace Safety, and ServSafe Food Handler & Food Manager

Response to COVID-19

Spring 2020: Classes moved to fully virtual delivery.

2020–21: Virtual block schedule; teachers were encouraged to use a mix of synchronous and asynchronous elements in each class period.

Challenges: Student engagement and participation is a significant challenge. Virtual classrooms do not meet the learning needs or teaching styles for many students in CTE. The loss of recruiting activities will likely result in lower CTE enrollment in 2021–22.

Innovations: Created kits and purchased food deliveries to allow students in culinary, construction, and other programs to continue hands-on learning opportunities. Implemented a "career pathway of the month" program to engage employers in the virtual classroom. Block scheduling and technology integration will be foundational to project-based learning after the pandemic ends.

NOTE: Items in italics are required activities for CTE students. *Percentages indicate the percentage of students in the high school receiving particular components.

The Film Technician Program at Central New Mexico Community College

Operations

Programmatic Level: Dual enrollment in high school and postsecondary within a community college

Location: Albuquerque, New Mexico, and local high schools

Number of Schools: One community college

Number of Students Served (estimated, annual): 400

Website: https://www.cnm.edu/programs-of-study/programs-a-z/film-technician

Entrance Requirement: An open registration process is for introductory classes. Students must meet the Accuplacer scores necessary to enroll in other courses at the community college. High school students must meet dual-enrollment requirements set by the college and the area school district.

Unique Information: The postsecondary portion of the program is a preapprenticeship in film production; courses are led by Central New Mexico (CNM) instructors who are active members of the International Alliance of Theatrical Stage Employees or affiliated with the union. They are working professionals with strong connections in the industry. Bilingual courses are offered.

Curriculum

Number of Pathways: One (multiple certifications and credentials available)

Sequenced CTE Pathway Curriculum: **Secondary students (grades 10–12)**: Dual-credit classes in Introduction to Film and/or Introduction to Editing at their high school (approximately 85 percent of students) or at CNM (approximately 15 percent of students) with access to the film studio and other resources. **Postsecondary students**: Regular courses and hours in the studio and film editing lab are part of their coursework.

Components

CTE/Program-Centered Components: Field trips and industry events to the Prop House, ABQ Studios, NM Music and Film Experience (postsecondary students); SkillsUSA and industry events (all students); and a variety of work-based learning experiences, including staffing the WESST Productions broadcast studios (all students).

Additional Components: Recently launched a summer bootcamp to provide professional development opportunities for high school teachers leading dual-credit courses. Students earn 15 days of credit on a feature film, which counts toward the required 30 days needed to become a member of the International Alliance of Theatrical Stage Employees Local 480.

Completion

Completion Definition: Course completion and credential attainment

Number/Percentage of Completers: Approximately 95 students earn a credential (certificate or degree) each semester.

Credentials Available: Part of the associate of applied science and associate in arts degree programs; Credentials in Film Crew Technician, Postproduction Technician, and/or Construction for Film.

Response to COVID-19

Spring 2020: Classes moved to fully virtual delivery.

2020–21: Hybrid, with theoretical components online and in-person instruction for hands-on production components

Challenges: The campus emergency management working group vetted class plans for 2020–21. These plans required reducing class sizes to meet safety protocols. This likely will impact student persistence and completion for students who could not schedule needed classes.

Innovations: Program opened a second studio space during the pandemic, which allowed the college to meet some student demand. The program will likely include online classes in the future to give students additional flexibility.

Franklin Technology Center at Joplin School District

Operations

Programmatic Level: District

Location: Joplin, Missouri

Number of Schools: One center serving Joplin High School, three nearby school districts, and home-schooled and private school students

Number of Students Served (estimated, annual): 700 in grades 9–12, approximately 200 juniors or seniors in pathways

Website: http://ftc.joplinschools.org/

Entrance Requirement: An application and interview are required to concentrate in a pathway starting in the junior or senior year; open enrollment for introductory CTE courses.

Curriculum

Number of Pathways: 14 pathways

Curriculum Overview: Both 1- and 2-year training programs are offered. All courses incorporate a competency-based curriculum. Students achieve a program's competencies by mastering a series of lessons or tasks. All pathways have embedded academic credit for English and mathematics/science.

Additional Information: There are typically 30–35 students enrolled in each pathway. For eight of the 14 pathways, dual credit classes are available through two local community colleges: Crowder College and Ozark Technology College.

Components

CTE/Program-Centered Components: *Lab hours* (*3–4 days per week*), industry-sponsored events, expert speakers, internships, job shadowing, apprenticeship, employability skills training, résumé writing, job interviewing based on SkillsUSA curricula, career and technical student organizations (DECA [formerly known as Distributive Education Clubs of America], Future Business Leaders of America, Future Health Professionals [formerly known as Health Occupations Students of America], Technology Student Organization), and career counseling with a full-time counselor.

Additional Components: To stay current with their instruction and industry trends, most instructors and administrators participate in industry externships, the ACT Summer Institute hosted by the state of Missouri, and other professional development conferences or sessions that are relevant to their pathway.

Completion

Completion Definition: Successful course completion with 80 percent competency mastery.

Number/Percentage of Completers: One hundred twenty-four students completed a pathway in 2018–19.

Credentials Available: All pathways lead to an industry certificate with assessment that is free to students. Students enrolled in a CTE pathway also can earn a 1- or 2-year certificate of training if they complete their program with 80 percent mastery of program competencies.

Response to COVID-19

Spring 2020: Classes moved to fully virtual delivery.

2020–21: Fully in-person classes

Challenges: Students lost work-based learning opportunities in some pathways. Communications and alignment with partner schools may be operating under different protocols. Recruitment delays occurred for 2021–22.

Innovations: Growing interest from students and employers in apprenticeship opportunities

NOTE: Items in italics are required activities for CTE students.

	William S. Hart Union High School District Career and College Readiness Program
Operations	**Programmatic Level**: District **Location**: Santa Clarita, California **Number of Schools**: Seven comprehensive high schools (including one academy school), an adult school, a continuation school, a school for those with emotional needs, and six middle schools **Number of Students Served (estimated, annual)**: 10,700 students (2017–18); 22,000 (2020-21) **Website**: https://www.pathwaytomyfuture.org **Entrance Requirement**: 90 percent open registration; academy school requires application **Unique Information**: Not all career pathways are available in every school, but students can enroll in classes at any site. Students in the district are required to take at least one CTE course.
Curriculum	**Number of Pathways**: 32 unique pathways (75 across all schools) **Sequenced CTE Pathway Curriculum**: *Two years of coursework with lab settings and two to four community college courses* **Nonsequenced CTE Pathway Curriculum**: 36 CTE electives for junior high **Curriculum Overview/Additional Information**: The district ensures that college courses either help complete an associate degree or are transferable to the Cal State or the University of California System; 10 percent of students have an integrated course experience.
Components*	**CTE/Program-Centered Components**: College and career seminar (ranges by school; 10 percent–25 percent of students participate); career and technical student organizations (approximately 20 percent; most students committed to pathways participate), *internships, 40–120 hours* (approximately 25 percent of students); work-based experiences, including job shadowing in 10th grade (80 percent of students), expert speakers (90 percent of students), and field trips (50 percent of students); and school-based enterprise (10 percent of students) **Proximal Components**: Connecting to Success Career Conference (approximately 100 percent of students), Xello college and career readiness activities (approximately 100 percent of students), college credit through dual enrollment (approximately 20 percent of students) **Additional Components**: Annual meeting hosted by the district, teacher convenings, college faculty convenings, and supplemental training (e.g., externships) for teachers
Completion	**Completion Definition**: Any student completing a capstone course (California); 300 hours of CTE curriculum (Perkins V definition), completing 2 years of coursework plus two to four college courses plus internship (district requirements) **Number/Percentage of Completers**: 80 percent (California), 50 percent (Perkins V), district completion unavailable **Credentials Available**: Medical assistant, pharmacy technical, dental assistant, phlebotomy, dental radiology, infection control, ServSafe, and cardiopulmonary resuscitation **Credentials Awarded**: Approximately 30 percent of students committed to a pathway obtain an industry-recognized or state agency certification

Response to COVID-19	William S. Hart Union High School District Career and College Readiness Program
	Spring 2020: Program shifted to fully virtual delivery. **2020–21**: Fully virtual, with synchronous classes Mondays through Thursdays and asynchronous classes on Fridays **Challenges**: Teacher workload and the time required to transition curricula online and create engaging activities **Innovations**: Teachers created kits to engage students at home with hands-on learning. Teachers also developed content and tools that will be leveraged in future classes. Developed an "adopt a pathway" program to connect local business partners one-on-one with pathway teachers and lead staff.

NOTE: Items in italics are required activities for CTE students. *Percentages indicate the percentage of students in the high school receiving particular components.

	INCubatoredu Course (Uncharted Learning)
Operations	**Programmatic Level**: External organization **Location**: Alabama, California, Colorado, Florida, Georgia, Illinois, Indiana, Louisiana, Maine, Minnesota, Nebraska, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Virginia, and Wisconsin; the majority of participating high schools are in Texas and Illinois. **Number of Students Served (estimated, annual)**: 3,192 students (2017–18); 4,084 students (2018–19); and 7,700 students (2019–20) **Website**: https://www.unchartedlearning.org/student-programs/incubatoredu **Entrance Requirement**: Determined by district or school **Unique Information**: Uncharted Learning, a nonprofit organization, partners with districts and schools to provide the INCubatoredu entrepreneurship curriculum, experiential professional development, and resources to engage communities. Schools implement the program with their own teachers in their own facilities in an academic classroom setting. Students enroll and engage in a full-year course (170 school days) or a one-semester course if there is block scheduling.
Curriculum	**Number of Pathways**: One pathway (business and marketing course) **Curriculum Overview/Additional Information**: Eight units of 35 structured lesson plans and assessment. Uncharted Learning aligns courses to the National Consortium of Entrepreneurship Standards, the Common Core State Standards, and 21st Century Learning and Innovation Skills. The curriculum includes employability skills training in networking, public speaking, and writing. The curriculum centers on the entrepreneurial process and lean start-up methods, where student teams fully develop a business concept and bring it to market. Businesses are fully owned and operated by students.
Components*	**CTE/Program-Centered Components**: *Mentoring* (100 percent), *expert speakers* (100 percent), *and employability skills training* (100 percent); instructors build business partnerships within the local area thatwill serve as hosts for field trips, expert speakers, mentors that advise student businesses, and investors. **School Opt-in Components**: Some schools (15) have articulated agreements with postsecondary institutions that designate the course as dual enrollment, proficiency, or prior learning credit. **Additional Components**: Uncharted Learning provides oversight on updates to the curriculum every year with the support of subject matter experts, training through a 2-day conference and a virtual meeting for teachers, and materials and assessments for classroom instruction.
Completion	**Completion Definition**: Passing the INCubatoredu course **Number/Percentage of Completers**: Unavailable **Credentials Available**: Some schools incorporate Certiport Entrepreneurship and Small Business certification.
Response to COVID-19	**Spring 2020**: Program shifted to support fully virtual delivery. **2020–21**: Implementing schools operated in multiple formats. Pitch competitions and other events shifted to a virtual format. **Challenges**: Supporting teachers with virtual professional development opportunities; connecting mentors and industry professionals with programs in a virtual environment; and understanding how implementing schools are using and adapting the curriculum **Innovations**: Developed alternate capstone projects and virtual pitch competitions. Developed new teacher professional development supports and volunteer engagement approaches that will continue beyond the pandemic.

NOTE: Items in italics are required activities for CTE students. *Percentages indicate the percentage of students in the high school receiving particular components.

Introduction to the Trades Skilled Trades Program

Operations

Programmatic Level: District

Location: Fairbanks, Alaska

Number of Schools: Students from five high schools in the district can enroll in the program.

Number of Students Served (estimated, annual): 160, with 12–15 high school juniors and seniors annually enrolled in each course

Website: https://www.k12northstar.org/Page/7859

Entrance Requirement: Ranked order admissions process with waiting lists common. Criteria for consideration include whether the student is on track to graduate, attendance record, demonstrated interest and commitment, future career goals, and a letter of recommendation and transcript.

Unique Information: Courses are held at the Fairbanks Pipeline Training Center, a 30-acre facility funded by the state and local trades unions.

Curriculum

Number of Pathways: Six (building trades, welding, electrical, heavy equipment maintenance, laborers, and process technology)

Curriculum Overview: Afterschool pre-apprenticeship course, offered on a pass/fail basis, 2 days per week for 2.5 hours per day during the spring semester. Curriculum aligns with union standards and emphasizes preparedness for working on an adult work crew. All classes have a classroom and a hands-on skill development component.

Additional Information: The process technology class is a dual-enrollment class with the University of Alaska–Fairbanks. Emphasis is placed on the importance of attendance and frequent drug and alcohol testing in these fields.

Components

CTE/Program-Centered Components: *Work site visits and industry field trips*

Additional Components: Union instructors have strong industry connections and provide mentoring and career guidance in a simulated work environment. Local apprenticeship programs reserve spots for Introduction to the Trades graduates. Course completion can be the first stage of applying to the School to Apprenticeship Pathway, which provides an entry position in a union apprenticeship.

Completion

Completion Definition: A student must attend 90 percent of the time to be a completer of the program. Passage or failure of the course indicates completion.

Number/Percentage of Completers: 35–45 annually

Credentials Available: Industry certifications, including Occupational Safety and Health Administration certifications, are embedded in the curriculum.

Other Outcomes: Union data show that prior to the development of the Introduction to the Trades course, students enrolling in an apprenticeship program directly from high school were likely to drop out in the first year, with only 35 percent completing. Since the course has been offered, approximately 80 percent persist in/complete the apprenticeship.

Response to COVID-19

Spring 2020: Program ceased operation.

2020–21: Program remained closed through winter 2021. At the time of the interview, the program was developing plans for a 2-week summer session to prepare students for employment and apprenticeship opportunities.

Challenges: State and local restrictions related to the pandemic prevented the program facility from reopening in fall 2020. Climate conditions prevented open-air or outdoor activities through spring 2021.

Innovations: Program saw increased interest and engagement with area employers interested in supporting and maintaining a talent pipeline.

Jessamine Career and Technology Center

Operations

Programmatic Level: District

Location: Nicholasville, Kentucky

Number of Schools: One county CTE center, three district comprehensive high schools, and two middle schools

Number of Students Served (estimated, annual): 2,112 in grades 9–12

Website: https://www.jessamine.k12.ky.us/12/Home

Entrance Requirement: Predominately open registration, but some final pathway courses require an application.

Unique Information: Students typically spend one to two periods daily at the Jessamine Career and Technology Center campus.

Curriculum

Number of Pathways: 32 pathways in 9 career clusters

Sequenced CTE Pathway Curriculum: *Four sequenced courses per pathway*. Some pathways have options for the four courses; others have set four courses. Pathways can include required courses, electives, integrated courses, and dual enrollment.

Curriculum Overview/Additional Information: Focus is on student development of four employability skills: time, task, and resource management; communication and collaboration; participation and problem solving; and professionalism (10 percent of grade).

Components*

CTE/Program-Centered Components: Engage with industry through expert speakers and field trips (100 percent); meet with college and career readiness advisor in a career and technical student organization aligned to a pathway (Family, Career and Community Leaders of America; FFA [formerly known as Future Farmers of America]; DECA, formerly known as Distributive Education Clubs of America; Future Health Professionals, formerly known as Health Occupations Students of America; Student Technology Leadership Program; Technology Student Organization); mock trial; military team; gain work-based experience through internship elective or other opportunity (20 percent); work through a school-based enterprise (small number of students).

Additional Components: The Center provides oversight on articulated agreements with regional universities, curriculum and content updates, and professional development (18 hours annually) for CTE teachers and tracks program outcomes (e.g., completing pathways, assessments, certifications).

Completion

Completion Definition: Finishing the four-course sequence in a career pathway and high school graduation

Number/Percentage of Completers: 400 in 2018–19; about 80 percent of students complete the program.

Credentials Available: State Registered Nurse Aide, Certified Phlebotomist, ProStart Culinary certification, Kentucky Child Development Associate, Automotive Service Excellence Student Certification (Diesel Mechanics), and many information technology certifications

Credentials Awarded: About 65 percent of students graduate with a credential.

Other Outcomes: Although not required, students are encouraged to take the CTE end-of-program assessment and/or certification in pathways.

Response to COVID-19	Jessamine Career and Technology Center
	Spring 2020: Classes moved to fully virtual delivery. **2020–21**: Multiple delivery formats were available, including fully virtual and hybrid. Students participating in the hybrid program attended in-person 2 days per week and were virtual 3 days per week. **Challenges**: Right-sizing the student workload in spring 2020 and providing real-world experiences. Both teachers and students struggled with the transition. **Innovations**: Adapted rigorous recruitment process to a virtual format to help rising ninth graders plan their pathways. Implemented new and better communications with families that had not previously existed, especially for high school students.

NOTE: Items in italics are required activities for CTE students. *Percentages indicate the percentage of students in the high school receiving particular components; some activities do not have a known percentage.

	Miami Animation and Gaming International Complex at Miami Dade College
Operations	**Programmatic Level**: Institution of higher education **Location**: Miami, Florida **Number of Students Served (estimated, annual)**: More than 500 (2017–18) **Website**: https://magic.mdc.edu/ **Entrance Requirement**: Students must apply to Miami Dade College to enroll in the program. **Unique Information**: The population is urban, low socioeconomic status, postsecondary students drawn heavily from the local Miami area, where 25 percent of the residents live in poverty.
Curriculum	**Number of Pathways**: Two associate in science degree pathways and one micro-credential (college credit certificate in virtual reality and augmented reality technologies) **Sequenced CTE Pathway Curriculum**: Two-year, 60-credit postsecondary cohort-based program incorporating project-based learning throughout; biweekly consultation with assigned industry mentor; program focuses on employability skills, including collaboration, project management, and creative problem solving. Students learn software, coding/programming, and creative skills and use projects to generate material for their professional portfolios. **Additional Information**: Pitches to the industry on game or animation ideas are developed as part of course requirements. The program receives 15 percent of any student earnings generated in this way. Students with grade point averages less than 2.5 receive targeted support to continue.
Components	**CTE/Program-Centered Components**: Industry internships; *expert speakers and frequent industry mentorship (embedded in program)* **Additional Components**: All instructors in the program have industry-relevant work experience and take part in professional development each summer because technological advances in the animation field happen rapidly.
Completion	**Completion Definition**: Completion of an associate in science degree in game development and design or animation and game art and a 15-credit micro-credential (college credit certificate) in virtual reality or augmented reality **Number/Percentage of Completers**: Estimated annual completion of 239 students **Other Outcome**: The program estimates that approximately 90 percent of the graduates are either pursuing a 4-year degree, working in the animation industry, or participating in an internship.
Response to COVID-19	**Spring 2020**: Classes moved to fully virtual delivery. **2020–21**: Fully virtual **Challenges**: COVID-19–related restrictions resulted in some program classes not being offered in 2020–21. Courses with intensive technology requirements and wearables, such as Virtual Reality classes, were not offered. **Innovations**: Discovered that Discord is an effective platform for reaching and communicating with students who won't answer email, a problem that the college had been trying to address for several years. MAGIC created a virtual platform on Discord that mimicked the MAGIC lab and program.

NOTE: Items in italics are required activities for CTE students.

Miami Dade County Public Schools CTE program

Operations

Programmatic Level: County/district

Location: Miami, Florida

Number of Schools: 75 middle schools, 56 comprehensive high schools, 3 CTE centers, 7 alternative schools, and pathways with dual enrollment offered by Miami Dade Technical College

Number of Students Served (estimated, annual): More than 100,000 students (approximately one third of the district's student body); in 2019–20, about 22,500 students in middle schools and 81,500 students in high schools

Website: https://ctemiami.net/

Entrance Requirement: Long-standing choice model in the district; option to choose a neighborhood school or apply to a magnet school or other programs in schools across the district. Application process involves assignment by a centralized random lottery, where students provide preferences for five choice options. The minimum grade point average for admission to CTE programs ranges from 2.0 to 2.5.

Unique Information: CTE courses delivered through NAF and non-NAF academies as well as magnet and nonmagnet schools. Miami Dade County Public Schools is the fourth largest district in the United States.

Curriculum

Number of Pathways: Approximately 80 career pathways across 16 career clusters, often offered at multiple high schools; 60 NAF academies

Sequenced CTE Pathway Curriculum: Designated courses in each program of study, CTE and non-CTE; CTE courses are classified as middle school/career exploratory (grades 6–8), career preparatory (grades 9–12), technical education (grades 6–12), work-based learning and capstone courses (grades 9–12), and postsecondary courses in technical colleges (dual enrollment).

Components

CTE/Program-Centered Components: Career and technical student organizations (DECA [formerly known as Distributive Education Clubs of America]; Future Business Leaders of America; Family, Career and Community Leaders of America; FFA [formerly known as Future Farmers of America]; Florida Public Service Association; Future Health Professionals [formerly known as Health Occupations Students of America]; SkillsUSA; and Technology Student Association); career-based competitions; field trips; college tours; paid summer internship experience (approximately 3,000 students annually among more than 800 providers, many of which are small businesses); academic supports; career counseling; advising; and dual enrollment (about 2,200 students)

Additional Components: Local business leaders and postsecondary partners serve as mentors, funders, and advisory board members. Teachers receive technological training and professional development and often collaborate with postsecondary faculty and industry leaders to ensure that content at the secondary level is aligned to promote college and career success.

Completion

Completion Definition: Completion of designated course sequence in the program of study (CTE and non-CTE courses)

Number/Percentage of Completers: Unavailable

Credentials Available: The Florida Career and Professional Education Act provides incentives for aligned certification attainment. Many but not all career pathways incorporate an industry certification attainment with articulated college credit in high school.

Response to COVID-19	Miami Dade County Public Schools CTE program
	Spring 2020: Classes moved to fully virtual delivery. **2020–21**: Multiple delivery formats: started fall 2020 fully virtual; opened in-person opportunities in October 2020 while continuing to offer virtual classes. **Challenges**: Student engagement and providing work-based learning opportunities were significant challenges. **Innovations**: Created a YouTube channel for communicating with parents in multiple languages. Added a previously planned Agriculture CTE program as a new pathway opportunity in 2020–21. Implemented a virtual summer internship program to provide work-based learning opportunities for 2,000 students with the district and area employers.

Missoula County Public Schools District Automotive Program

Operations

Programmatic Level: District

Location: Missoula, Montana

Number of Schools: Four high schools

Number of Students Served (estimated, annual): 125

Entrance Requirement: Open registration but typically higher demand than available space. Counselors identify students with a clear interest in the automotive industry.

Unique Information: The program takes place at the Community Auto Training Center, which is at one high school. Students from the three other district high schools commute to the center via bus for 2-hour block classes 5 days per week.

Curriculum

Number of Pathways: 1

Sequenced CTE Pathway Curriculum: *Four-course pathway* includes combination classroom and lab instruction. The program is based on the CDX curriculum, which aligns with Automotive Service Excellence certifications and other curriculum and industry certifications. Students must earn at least a C to move on to the next class in the sequence.

Additional Information: The program has articulation agreements with the local trade school and Butte Community College. An industry gap analysis identified the need for welders in the region, so the district developed a separate welding program that includes dual credit options with the local community college. Full alignment with SkillsUSA is a target for the program.

Components*

CTE/Program-Centered Components: Mentoring (three students to one mentor) and career advising (100 percent); development of portfolios and résumés in class (100 percent); required *job shadowing* (Auto 3 and Auto 4 students); internship at a local auto shop (approximately half of Auto 4 students); guest speakers; and field trips with local employers, such as the partnership with Montana Job Service (100 percent)

Additional Components: Teachers oversee their own continuing education/training each summer, local business partnerships, student exploration of the field and mentorships, and connection between students and employers. The local Ford dealer is now helping connect the program to Ford's Accelerated Career Exploration program, which offers Ford tech training and certifications to high schools.

Completion

Completion Definition: Completing a four-course pathway

Number/Percentage of Completers: Unavailable

Credentials Available: Tire Industry Association, Snap-On NC3 Certification Program, S/P2 (Safety and Pollution Prevention Training), Valvoline Oil, and Occupational Safety and Health Administration 10-Hour Safety curriculum; opportunities to earn industry certifications are integrated throughout the program. The program covers the cost of some but not all certificate examinations for students.

Response to COVID-19	Missoula County Public Schools District Automotive Program
	Spring 2020: Classes moved to fully virtual delivery. **2020–21**: Hybrid block schedule, with the student population split in half and attending in-person 2 days per week and virtual using Google Classroom 3 days per week. Virtual classes were primarily asynchronous. **Challenges**: The cost of providing individual equipment, such as welding helmets, and the availability of personal protective equipment to support in-person learning; increased teacher workload resulting from in-person and virtual instruction while still mentoring students; and outreach and communications to students and families in spring 2020. **Innovations**: A new online curricula provided teachers with engagement and progress metrics that helped teachers identify students who were struggling and informed planning and communications. Students appreciated the opportunity to manage their time and pacing through the theory portion of the curriculum. Added additional certification opportunities through the Ford Automotive Career Exploration program.

NOTE: Items in italics are required activities for CTE students. *Percentages indicate the percentage of students in the high school receiving particular components.

	NAF
Operations	**Programmatic Level**: External organization **Location**: 34 states plus Washington, D.C.; Puerto Rico; and the U.S. Virgin Islands **Number of Schools**: 406 nationally **Number of Students Served (estimated, annual)**: 620 NAF academies and more than 112,000 students in 2019 **Website**: https://naf.org/ **Entrance Requirement**: None required by NAF; any requirements are school or district specific. **Unique Information**: NAF academies are small learning communities within existing schools in which students focus on a career cluster or an industry. A school may house more than one NAF academy.
Curriculum	**Number of Pathways**: More than five pathways (finance, information technology, engineering, health sciences, hospitality and tourism, and other-themed) **Curriculum Overview**: Four-course sequence with work-based learning often occurring in the summer between junior and senior year. **Additional Information**: NAF provides schools with a project-based-learning-focused curriculum that incorporates input from industry representatives. NAFTrack certification is an optional experience available for schools and students. NAFTrack is a college and career readiness measure that also benefits students in job searching.
Components	**CTE/Program-Centered Components**: Expert speakers, college and career skills workshops, mock interviews, worksite tours, and internships (An estimated 84 percent of students participated in at least one work-based learning activity, 29 percent of students participated in internships.) **Additional Components**: The NAF educational design consists of four essential elements: academy development and structure, curriculum and instruction, advisory board, and work-based learning. The NAF organization provides oversight and guidance on academy structure, data review, and student supports; business and community advisory board development and function; instructional supports, technical assistance, and peer networking for teachers; and training and supports for work-based learning. NAF also oversees an annual academy assessment cycle each year, during which academies reflect and review their student outcomes to implement continuous improvement.
Completion	**Completion Definition**: Four-course sequence and high school graduation; separate NAFTrack certification completion: four semesters of NAFTrack-approved courses and performance-based assessment, 120 hours of qualifying internships (currently reduced to 80 hours because of COVID-19–related limitations). **Number/Percentage of Completers**: Ninety-nine percent of students still enrolled as seniors graduated from high school in 2018–19. **Other Outcomes**: According to a propensity score matching study of 10 school districts released in 2017,* students with full program participation graduated at a 6 percent higher rate than non-NAF students. Students simply enrolled in NAF academies graduated at a 3.3 percent higher rate. Students with full program participation and also flagged as “at risk to graduate” after freshman year were 10 percentage points more likely to graduate than non-NAF students.

Response to COVID-19	NAF
	Spring 2020: The NAF national office supported academies as they moved to a fully virtual delivery and removed the paywall for all academy curricula, resources, and toolkits. **2020–21**: Implementing schools operated in multiple formats in 2020–21. **Challenges**: Disparate capacities across schools and districts offering NAF Academies; lack of in-person work-based learning experiences; and impact of the pandemic on continuous improvement cycles at each participating school **Innovations**: Greatly expanded virtual internship offerings to provide opportunities to a broader set of students, often connecting students from across the country who would not otherwise have been able to participate in an internship opportunity together. Started a newsletter (NAF Career Insider) for students and alumni to share information about virtual internships, entry-level jobs, and networking opportunities.

*Sun, J., & Spinney, S. (2017). *Transforming the American high school experience: NAF's cohort graduation rates from2011–2015.* ICF International. https://files.eric.ed.gov/fulltext/ED590583.pdf

	Northwest ISD Biomedical Sciences Academy (incorporating Project Lead The Way)
Operations	**Programmatic Level**: Local education agency **Location**: Dallas–Fort Worth, Texas, Metroplex **Number of Schools**: One high school (offered to all high school students in the district) **Number of Students Served (estimated, annual)**: 300 in 2019–20 **Website**: https://www.nisdtx.org/cms/One.aspx?portalId=232201&pageId=10036995 **Entrance Requirement**: Open application process for eighth graders, including an interest survey, an e-portfolio, and student interviews. There is an active waitlist and opportunities for rising sophomores and juniors to enter the program. **Unique Information**: Students placed in the academy transfer to that high school (one of four in the district) for all their coursework.
Curriculum	**Number of Pathways**: One (biomedical sciences) **Sequenced CTE Pathway Curriculum**: *Four-course Project Lead The Way model* with a mix of classroom, lab, and work-based learning experiences. Senior-year students have the option to do the capstone course or enroll in the district's emergency medical technician or certified medical assistant courses, with the expectation that students will take certification examinations necessary to become licensed.
Components	**CTE/Program-Centered Components**: *Job shadowing as part of the senior biomedical innovation course and working to create an innovation within the location, internships, guest speakers* (classroom-embedded activities), Future Health Professionals (formerly known as Health Occupations Students of America) competitive events (approximately 45 students annually), real-world research through partnerships with Tulane University. **Additional Components**: A local health clinic; Texas Health Resources will be adding clinical offices to meet local demand for sports medicine. Academy students will have the opportunity to intern in this clinic once it opens.
Completion	**Completion Definition**: Completion of four sequenced courses and certifications **Number/Percentage of Completers**: Unavailable **Credentials Available**: All participating students earn *Basic Life Support and Occupational Safety and Health Administration certifications*.
Response to COVID-19	**Spring 2020**: Classes moved to fully virtual delivery. **2020–21**: Multiple delivery formats, with some students in person and others virtual beginning in September 2020 **Challenges**: Maintaining the appropriate pacing through the curriculum. COVID-19 restrictions and limited availability of personal protective equipment prevented the full use of a new lab facility opened for the 2020–21 academic year. The program anticipates that students who attended in person and those who attended virtually will have significantly different skill levels going forward. Fewer students applied for 2021–22 enrollment. **Innovations**: Implemented a Project Lead the Way unit on COVID-19 to help students understand what they were going through and think about the science involved. Recognized the value of high-quality recordings of teacher demonstrations to make the classroom more inclusive.

NOTE: Items in italics are required activities for CTE students.

Perquimans County Schools CTE Program

Operations

Programmatic Level: District

Location: North Carolina

Number of Students Served (estimated, annual): 450 middle school students in CTE exploratory programming; 350 high school students in a CTE course

Website: http://www.pqschools.org/departments/career-and-technical-education

Entrance Requirement: There are no entry requirements for students to enroll in single CTE courses or pathways.

Unique Information: Courses are integrated into middle schools and comprehensive high schools; all students work with career development coordinators.

Curriculum

Number of Pathways: Seven

Sequenced CTE Pathway Curriculum: Four CTE courses in a pathway (prior to changes instituted for Perkins V implementation): two foundational courses, one upper-level course, and one enhancement course. A small portion of students take dual-enrollment courses with a local community college.

Components*

CTE/Program-Centered Components: **Middle School Students**: Field trips to business (100 percent), visits from expert speakers (100 percent), industry-sponsored events (100 percent), and career advisement (100 percent); **High School Students**: Regular hours in lab space (100 percent), field trips to business (100 percent), visits from expert speakers (100 percent), industry-sponsored events (100 percent), employability skills training (100 percent), comprehensive academic planning (100 percent), dual-enrollment courses (<5 percent), and semester-long internships (<5 percent).

Additional Components: The administration oversees the tracking and reporting of program outcomes, reviews labor market data, develops industry and higher education partnerships, and creates programming in conjunction with partners.

Completion

Completion Definition: Completion of four-course sequence to complete a pathway (prior to changes instituted for Perkins V implementation)

Number/Percentage of Completers: Each year, approximately 80 students complete a CTE pathway.

Credentials Available: Students can earn industry-standard credentials in every pathway. The National Career Readiness Certification is offered through passage of the WorkKeys assessment.

Response to COVID-19

Spring 2020: Classes moved to fully virtual delivery, including paper options for some students.

2020–21: Multiple delivery formats, including hybrid and fully virtual. The ratio of in-person to virtual days for hybrid students varied by school level and increased across time. Hybrid high school students attended in-person 2.5 days per week in fall 2020; in March 2021, hybrid students shifted to in-person instruction 4 days per week.

Challenges: Demands on teachers to support virtual and in-person students simultaneously and developing applied work skills in the virtual environment. Some CTE courses can be delivered only in person per third-party requirements.

Innovations: Implementing technology solutions to connect with students and families, especially for tutoring and career counseling. Providing virtual CTE classes to meet the interest of small groups of students who would not otherwise be engaged.

NOTE: Items in italics are required activities for CTE students. *Percentages indicate the percentage of students in the high school receiving particular components.

	Rockcastle Area Technology Center, Health Sciences Pathway
Operations	**Programmatic Level**: State/county **Location**: Rockcastle County, Kentucky **Number of Schools**: One state-supported Area Technology Center **Number of Students Served (estimated, annual)**: 116 (2017–18) **Website**: http://rockcastle.kyschools.us/ratc/health-science/ **Entrance Requirement**: Application process with additional criteria for students to enroll in the pathway. **Unique Information**: Center instructors are state employees, and state resources cover facilities and equipment costs. Students in the pathway attend regular classes at the nearby high school and pathway courses part-time at the Center.
Curriculum	**Number of Pathways**: One (as the focus of this nominated program; more within the Rockcastle Area Technology Center) **Sequenced CTE Curriculum**: *Four core courses, including lecture and lab experiences: Principles of Health Science, Emergency Procedures for Heath Care Professions/Medical Terminology, Health & Wellness/Medical Math, and Body Structures & Functions.* **Curriculum Overview/Additional Information**: The program has an articulation agreement with Somerset Community College, and students may choose to take courses for dual credit; scholarships are available to help cover the costs.
Components	**CTE/Program-Centered Components**: Work-based learning through co-op, apprenticeship positions, and clinicals (all grades 11 and 12 students participate); Future Health Professionals (formerly Health Occupations Students of America) and participation in industry events and health-related community service activities (100 percent) **Additional Components**: The program launched an apprenticeship program for students in the state-registered nurse aides/nursing pipeline with Rockcastle County Regional Hospital.
Completion	**Completion Definition**: Completion of four-course sequence **Number/Percentage of Completers**: Approximately 12 percent (2017–18) **Credentials Available**: Industry certificates in phlebotomy, electrocardiography, pharmacy technology, and state-registered nurse aides. Available even if students do not complete the four-course sequence.
Response to COVID-19	**Spring 2020**: Classes moved to fully virtual delivery. **2020–21**: Multiple delivery formats, including in-person and virtual that shifted across time **Challenges**: Loss of work-based learning opportunities in hospitals and other health-care settings; maintaining curriculum pacing required for state examinations; demands on teachers to support in-person and virtual students simultaneously in the same class; and finding a balance between synchronous and asynchronous requirements to help students succeed. **Innovations**: Developed standards and protocols to allow students to engage in in-person work-based learning in acute and long-term care units starting in spring 2021. Materials and processes for nontraditional instruction will continue into the future.

NOTE: Items in italics are required activities for CTE students.

Simulated Workplace in West Virginia

Operations

Programmatic Level: Statewide

Location: West Virginia

Number of Schools: 130 secondary schools

Number of Students Served (estimated, annual): 24,000

Website: https://wvde.us/simulated-workplace/

Overview: Simulated Workplace (SWP) is a series of 12 frameworks or protocols that define how the traditional classroom setting and student experience will be altered to transform into student-led companies that simulate real-world work experiences. All state-approved CTE courses in West Virginia have followed the SWP model since 2016, resulting in more than 1,200 SWP companies.

Entrance Requirement: Decided on a school-by-school basis, with a requirement to pass a safety assessment and adhere to protocols. Students apply to student-led simulated companies through an interview process. Students who are not offered entry can receive guidance in finding a student-led simulated company.

Curriculum

Number of Pathways: Implemented within 82 pathways

Sequenced CTE Curriculum: *Four core classes (sequential and project-based learning)* and at least four elective courses; participating students master technical skills that stack along a career pathway. They work within business processes and expectations, with an embedded employability skill curriculum (e.g., communication, leadership).

Curriculum Overview: The West Virginia Department of Education worked with industries, businesses, and the education sector to create 12 framework-setting protocols and processes aligned to real working environments that define the course experience, including organization and roles of the student-led company; application/interview structure; formal attendance system that mimics an industry-related company; drug-free work zones; quality control (6S environment); safe work areas, workplace teams, and project-based learning/student engagement; student-developed company policy and procedures (handbook); company meetings; on-site business review; and an accountability system using data review that incorporates student reporting, portfolios, and technical assessments.

Components

CTE/Program-Centered Components: Internship; industry challenges include events through Project Lead the Way or SkillsUSA; reverse career fairs; dual-enrollment opportunities (90 percent).

Additional Components: All SWP teachers must have at least 5 years of industry experience and complete a 2-year SWP training, which includes receiving 18 college credits, paid for by SWP, with optional annual training.

Completion

Completion Definition: To complete, students must complete the four core courses and pass a technical assessment.

Number/Percentage of Completers: Unavailable

Credentials Available: Student pursuit of 650 credentials is included overall, with the pursuit of three to four credentials associated with each pathway. Credentials are organized into three tiers based on difficulty and length to obtain. Funding is available to support student testing.

Response to COVID-19	Simulated Workplace in West Virginia
	Spring 2020: Program moved to a fully virtual delivery. **2020–21**: Multiple delivery formats shifted across time based on COVID-19 case numbers. **Challenges**: Student engagement; loss of work-based learning opportunities, including internships; and the availability of personal protective equipment for in-person hands-on activities. **Innovations**: Opportunity to test new tools and ways of teaching. Development of virtual completer certification and an opportunity for 2020 graduates to complete intended industry credentials at a later date.

NOTE: Items in italics are required activities for CTE students.

South Technical High School, Special School District of St. Louis County

Operations

Programmatic Level: Technical high school/district

Location: St. Louis, Missouri

Number of Schools: 1 of 2 technical high schools in the Special School District of St. Louis County, a countywide district serving 23 comprehensive high schools

Number of Students Served (estimated, annual): 750 (375 juniors and 375 seniors); students spend half of the day at South Tech.

Website: https://www.ssdmo.org/domain/41

Entrance Requirement: Admissions open to students who are on track to graduate and attending a high school in St. Louis County, including all public, private, and homeschool students. Process includes a South Tech application for one CTE pathway during the sophomore year. A student's application is scored based on a rubric with a set number of criteria (e.g., interest, course history). If a pathway fills, waitlists for eligible applicants are formed.

Curriculum

Number of Pathways: 29 pathways, including 5 hybrid pathways designed for students with special needs.

Sequenced CTE Pathway Curriculum: South Tech's curricula have three levels of objectives: *level 1 (primary), level 2 (secondary), and level 3 (tertiary)*. Students spend an average of 80 percent of course time in a lab and 20 percent in the classroom. The program has articulation agreements with community colleges to offer dual-enrollment credits for six pathways (<20 percent).

Components*

CTE/Program-Centered Components: Internships (15 percent), *SkillsUSA* (100 percent), *industry-sponsored events* (100 percent), expert speakers and field trips (100 percent), and career and technical student organizations (15 percent; e.g., Family, Career and Community Leaders of America); *"2+2 planning" to help students plan for South Tech and 2 years after graduation* (100 percent), employability skills training (100 percent), integrated secondary education courses (<20 percent), mentoring (<20 percent), and preapprenticeship training (<20 percent).

Additional Components: Administration oversees the tracking of student outcomes, develops partnerships with higher education institutions and regional/national career and technical networks, provides professional development for teachers, and reviews state and national labor data. To assess program quality, Missouri's Department of Elementary and Secondary Education requires each program to complete a Common Criteria for Quality Indicators assessment.

Completion

Completion Definition: Completion of courses and participation in ACT WorkKeys National Career Readiness Certification.

Number/Percentage of Completers: Approximately 83 percent of participants complete the 2-year program at South Tech and graduate high school.

Response to COVID-19

Spring 2020: Classes moved to fully virtual delivery.

2020–21: Virtual only through winter 2021

Challenges: Keeping students engaged virtually in classes that were expected to be hands-on and helping students manage asynchronous classes and a mix of homeschool and CTE program requirements. Both teachers and students suffered from the fatigue of being online all day.

Innovations: Employed better use of technology to provide all students with a better view of teacher demonstrations; incorporated supplemental online tools and resources to round out curricula and support student development.

NOTE: Items in italics are required activities for CTE students; *Approximate percentage of students participating in the experience.

The Switch Lab: Street Legal, Drivable Electric Vehicle Kit, Curriculum, and Support

Operations

Programmatic Level: External organization

Location: 16 states (currently most widely used in California)

Number of Students Served (estimated, annual): 4,500 students and 150 schools in 2020

Website: https://www.theswitchlab.com/

Entrance Requirement: There are no entrance requirements beyond what schools require for students to enroll in specific courses within which the kit and curriculum are used.

Unique Information: The Switch Lab offers a project-based learning program consisting of a full-size electric vehicle building kit, curriculum, and workshop opportunities for educators, high school students, college students, and community members interested in learning how to build electric vehicles.

Curriculum

Number of Pathways: Not applicable; known to be used in manufacturing; science, technology, engineering, and mathematics programs; and transportation, distribution, and logistics CTE pathways.

Curriculum Overview/Additional Information: The program is designed for implementation within an education setting as part of a contextualized, applied learning experience or capstone project for students within a related CTE pathway (e.g., automotive or engineering) or core education class (e.g., physics). It also is designed to build employability skills for the workplace. The standard curriculum package includes The Switch EV, Build Your Own Electric Vehicle textbook, instructor guide, and downloadable student workbook and study guide; there is an option to buy an enhanced curriculum with more materials. The program is implemented in a 17-week semester course, an 8-week afterschool course, or a 2-week intensive course.

Components

School Opt-in Components: SkillsUSA participation; schools vary in additional program components. Schools have indicated that opportunities include field trips to businesses, learning from expert speakers, taking part in engineering challenges, and limited job shadowing.

Additional Components: The Switch Lab staff implement a 4-day training for instructors, oversee developing secondary and postsecondary partnerships, work with the California Department of Energy for implementation, serve on college advisory boards, and perform outreach for interested schools.

Annual Design Award: Switch Vehicles Inc. provides schools funds to enhance the program by designing and presenting new features or vehicle enhancements. Successful presenters receive funds to construct and test their enhancements.

Completion

Completion Definition: Student ability to drive (or ride if too young to drive) the electric vehicle they assemble.

Number/Percentage of Completers: Unknown; information not collected from participating schools.

Credentials Available: Incorporated learning is applicable for the Automotive Service Excellence testing, which provides industry-recognized credentials.

Response to COVID-19

Spring 2020: Program moved to fully virtual delivery.

2020–21: Implementing schools operated in multiple formats.

Challenges: Developing and delivering virtual content for hands-on curricula and teacher professional development

Innovations: Created virtual modules, circuit and battery assembly kits, and competitions to support virtual students.

Union Grove High School CTE Program

Operations

Programmatic Level: High school

Location: Union Grove, Wisconsin

Number of Students Served (estimated, annual): About 800 students take at least one CTE course each year (grades 9–12), of which about 400 are concentrators (students who take at least three courses within one career cluster during high school).

Website: https://www.ug.k12.wi.us/domain/70

Entrance Requirement: Students enroll in a CTE course through a standard course request process, and certain advanced-level CTE courses require instructor approval.

Curriculum

Number of Pathways: 15 within 4 career clusters

Sequenced CTE Pathway Curriculum: Pathways include three levels of courses: introductory, intermediary, and advanced/capstone course. Introductory CTE courses contain career exploration activities (e.g., field trips, expert speakers), which intend to expose students to the variety of careers aligned with the pathway. In all pathways, students spend about 80 percent of their time in the lab and 20 percent in the classroom.

Nonsequenced CTE Pathway Curriculum: The school has a formal articulation agreement with Gateway Technical College and has a "Start College Now Program," where students can take up to 19 credits of technical college classes. The school will pay for tuition and books if the student passes the class(es).

Components*

CTE/Program-Centered Components: *80 percent of course hours in lab space* (100 percent), *employability skills training* (100 percent), field trips to businesses and visits from experts (100 percent), participation in career and technical student organizations (50 percent), participation in dual-credit courses (<50 percent), participation in work study (<40 percent), and participation in youth apprenticeship (<5 percent).

Proximal Components: *Job shadowing* (100 percent, requirement as a junior) and *participation in overall high school career advisement and Career Cruising* (100 percent).

Additional Components: Administrators oversee curriculum development in partnership with student, school board, business partner, and chamber of commerce input; partnerships with industry and higher education professionals; program outcomes and improvements; and labor market assessment. Teachers are responsible for pursuing professional development (e.g., externships or auditing college courses) and creating articulation agreements with colleges.

Completion

Completion Definition: Completion of three courses in pathway.

Number/Percentage of Completers: About 80 students complete a pathway annually.

Credentials Available: Six of the 15 pathways incorporate pursuit of an industry-recognized credential.

Response to COVID-19

Spring 2020: Classes moved to fully virtual delivery.

2020–21: Hybrid delivery, with students attending in-person on alternating days

Challenges: Loss of in-person experiences; modifying the curriculum for hybrid/virtual delivery; and loss of recruitment events for 2021–22

Innovations: Hybrid approach served smaller groups of students in more hands-on, in-person experiences. Implementation of online activities, experiences, resources, and communications will continue beyond the pandemic.

NOTE: Items in italics are required activities for CTE students. *Percentage of students taking at least one CTE course.

Virtual Enterprises International

Operations

Programmatic Level: External organization

Location: California; Florida; Illinois; Massachusetts; Michigan; Missouri; Nebraska; New Jersey; New York; North Carolina; Oregon; Pennsylvania; South Carolina; Tennessee; Texas; Virginia; West Virginia; and Washington, D.C.

Number of Schools: 430 in 2018–19 (approximately 40 in career centers or CTE centers)

Number of Students Served (estimated, annual): 15,000

Website: https://veinternational.org

Entrance Requirement: Schools/districts oversee entrance requirements (if any); none required from Virtual Enterprises (VE) International.

Unique Information: VE provides a live, global business simulation, with accompanying curriculum, which can serve as an in-school, work-based learning option for schools and districts. The credited, yearlong course for schools to purchase uses an online platform (VE Hub) for students to form simulated business and virtual products or services in an industry of their choice (e.g., technology, advertising). Students interact with other virtual businesses across the country and are connected by a central web-based banking system.

Curriculum

Number of Pathways: The VE course often is taken within a business management, entrepreneurship, or marketing pathway, but it can be implemented as a capstone course in subjects such as engineering or computer science.

Curriculum Overview: Stimulates the functions and demands of real-world businesses by having students create and manage a start-up company. Students interview for and hold professional roles within the company and are responsible for working together to strategically plan for and operate their business; conduct market research; develop a business plan; design and implement an e-commerce website; pay wages and taxes; maintain a 401(k); and develop an annual report. Students receive virtual salaries, learning about personal finance by budgeting for real-world obligations such as rent and personal income taxes and act as consumers for the products of other simulated businesses. Students are assessed at the end of the year using a National Occupational Competency Testing Institute assessment and complete periodic self-assessments linked to employee performance evaluations focused on employability skill development.

Additional Information: VE aligns the curriculum with their Career Readiness Framework.

Components

CTE/Program-Centered Components: VE holds regional, national, and online trade shows/competitions with access to real professionals (70 percent–85 percent student participation).

School Opt-in Components: Other types of CTE experiences (e.g., mentorship, field trips) are dependent on the schools, geography, and ability to travel.

Additional Components: VE designs the curriculum with industry input (e.g., Intuit, Society for Human Resource Management Foundation), holds a 4-day intensive national teacher conference each summer for all new and returning teachers to attend, and fosters teacher collaboration. VE has agreements with colleges for dual enrollment.

Completion

Completion Definition: Completing course and assessment

Number/Percentage of Completers: 13,000 (2017–18); 12,000 (2016–17), and 12,000 (2015–16)—site self-reported

Credentials Available: At some sites, students earn industry credentials (Microsoft, QuickBooks).

Response to COVID-19

Virtual Enterprises International

Spring 2020: Program moved to fully virtual delivery.

2020–21: Implementing schools operated in multiple formats; trade shows and other events shifted to a virtual format.

Challenges: Loss of full learning experience offered by in-person events and understanding how the curriculum has been adapted in various contexts

Innovations: Virtual trade shows and other events reached a broader segment of schools and industry partners than would have typically been engaged. Worked with employer partners to implement a virtual internship program.

CTE | Career & Technical Education RESEARCH NETWORK

1400 Crystal Drive, 10th Floor
Arlington, VA 22202-3289 | **AIR.ORG**

cteresearchnetwork.org

The American Institutes for Research (AIR) and its partners—the Association for Career and Technical Education (ACTE), JFF, and Vanderbilt University—serve as the CTE Research Network Lead. The Network Lead provides network administration and coordination as well as research, training, and dissemination to increase the number and quality of CTE impact evaluations and strengthen the field's research capacity.

AIR® Advancing Evidence. Improving Lives. www.air.org | Association for Career and Technical Education ACTE® www.acteonline.org | JFF www.jff.org | VANDERBILT UNIVERSITY www.vanderbilt.edu

The work of the CTE Research Network Lead is supported by the Institute of Education Sciences at the U.S. Department of Education with funds provided under the *Carl D. Perkins Career and Technical Education Act* through Grant R305N180005 to the American Institutes for Research (AIR). The work of the Network member projects is supported by the Institute. The opinions expressed are those of the authors and do not represent the views of the Institute or the U.S. Department of Education.

15872_08/21