

Hard-to-Convert Career Education Programs

An Analysis of Distance Learning Opportunities for Community Colleges in Los Angeles County

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Executive Summary

This report was commissioned by the Los Angeles|Orange County Regional Consortium CEO Workgroup to evaluate research, effective practices, and virtual reality and/or simulated software platforms for hard-to-convert career education (CE) programs. Faculty and deans at the region's 28 community colleges were surveyed about their distance learning strategies, and extensive interviews were conducted with local and nationally recognized subject matter experts. This report summarizes preliminary strategies for the consortium to consider during the transition of traditionally hands-on CE programs into distance learning programs.

The study highlights 12 CE program areas that pose challenges to distance learning and explores opportunities for online conversion:

Automotive Technology—This program lends itself well to online adaption, and several established resources exist for software and simulation platforms that teach to industry standards. Automotive Service Excellence (ASE) offers an online program, and several LA|OC colleges are using Cengage's MindTap which allows faculty to control all aspects of their virtual instruction.

Cosmetology and Barbering—LATTC's cosmetology program has developed courses that meet synchronously to fulfill lab time requirements. Colleges in the region are using MindTap for labs and Zoom to document competencies.

Culinary Arts—Regional colleges should consider adopting Rouxbe for its online training program. LA|OC colleges are reporting challenges in documenting competencies when students lack key ingredients and equipment at home.

Electrical—Recommended resources include Festo and Interplay Skilled Trades but convening regional faculty to evaluate best practices for skills demonstrations and student assessment is advised.

Electronics and Electric Technology—Many online software programs and courses exist in this program area, and many faculty members in the region reported experimenting with various software platforms to deliver instruction and document competencies. Faculty discussion is needed to reach agreement on the degree to which this program can be provided online and to narrow the list of instructional resources.

Emergency Medical Services—In-person clinical requirements for certification poses an obstacle for offering online EMS training. However, although students must log a certain number of hours in ambulance ride-alongs, which is not currently permitted during the pandemic, several resources exist for students to develop and demonstrate skills virtually.

Fire Technology—It is generally agreed that some form of in-person training is required for this program. Online training is available through the National Fire Protection Association.

Manufacturing and Industrial Technology—A wide variety of software and simulation platforms exist in this program area. Faculty should be engaged to determine the most effective software

platforms and how best to schedule face-to-face labs. Software recommendations from faculty in the region include Labster, JoVE, LabArchives, Immerse2Learn, NCSIMUL, and zSpace.

Radiologic Technology—No model online programs could be identified in this area. However, one college reported that it is using online simulations for instruction. Several online platforms exist that could be used for instruction, such as Labster and Visible Body, although no single platform has been developed that solely applies to this program area.

Registered Nursing—As with the EMS program, completion of in-person clinical hours remains a constraint for Registered Nursing students. College representatives stressed that it is of critical importance that clinical spots be retained during the pandemic. Some software, such as Laerdal’s vSim, could possibly count toward clinical hours.

Respiratory Care/Therapy—The study could not identify any model online programs in this area, and no responses were provided to the online survey. The use of simulation software could be expanded, and several online platforms allow student to apply skills knowledge and even make treatment decisions.

Welding Technology—Surprisingly, many resources exist for virtual welding instruction. Faculty should be engaged to determine which software platforms are most effective and which skills can and cannot be demonstrated virtually.

Two colleges merit attention for the quality of their online CE programs. [Ashworth College](#) in Georgia currently offers online programs in Automotive Technology, Electrical, Electronics and Electric Technology, and Culinary Arts. Based on the number of online programs offered and the variety of student resources in each of the supported programs, this college can be considered a leader in CE education. Another standout college in CE education is [George Brown College](#) in Toronto, Canada, which provides online Welding and Culinary Arts programs for international students.

Several platforms and software technologies have applicability across multiple program areas and were recommended by subject matter experts in interviews.

Recommended Software/Platform	Description
CTE Online	An existing resource for California Community Colleges for all 12 programs. An excellent opportunity for the postsecondary schools to collaborate with each other. This resource is available to every instructor at no cost.
ICEV	Curricula for five programs on the targeted list. This site is subscription based and includes its own resource area with a variety of case studies, guides and tutorials to help instructors develop their own content.
Todaysclass	Supports five of the targeted programs including basic health curriculum for Radiology, Registered Nurses, and Respiratory Therapy. Subscription based but provides a variety of online solutions for each program.
Zspace	Content solutions for Auto Technology, Manufacturing, Welding, and Registered Nursing. Nursing is at the basic level but does provide some VR tools allowing for unique learning applications.

Recommended Software/Platform	Description
Sp2	Offers online training and certification assessments for Automotive Technology, Welding, Cosmetology, and Culinary Arts. Well established and offers a schoolwide subscription for each content area.
Labster	Coordinated as a central service through the California Community Colleges Foundation. A realistic lab experience for students to perform experiments and practice skills.
Visible Body	Suite of apps that make learning and teaching anatomy and physiology visual and engaging.
Cengage's MindTap	Cengage has developed partnerships with companies and organizations enabling them to offer a wide variety of online solutions either in a predetermined format through existing online curriculum and simulations or through hybrid solutions. Solutions exist for Automotive Technology, Cosmetology, Culinary Arts, Emergency Medical Services, Health Care, Electronics, Welding, and Manufacturing. The tools and resources can benefit all listed programs, but some will require development.
TRANSFR VR	This unique VR apprenticeship model uses a dialogue system between the trainee and a virtual coach. Trainees move at their own pace and receive strategic, specific feedback to help them learn from their mistakes and master the skills they need to successfully perform their jobs. This tool requires development at the program level.

Recommendations

While the feasibility of distance learning varies by program, there are a few key themes that emerged from the research:

- There is no silver bullet. There will not be one tool that meets multiple colleges' needs, even within the same program area. As a result, regional leadership should agree on the core suite of products that will meet the majority of core services/needs. The region should seek economies of scale to leverage scarce funding/resources/bandwidth and to facilitate communities of practice among faculty regionally.
- Evidence-based precedents for transitioning hands-on CE programs online are rare or nonexistent. However, preliminary research on transitioning hands-on CE laboratories online indicates no learning differences (or industry licensure pass rates) between hands-on and virtual/simulated courses.¹ The region can, and must, lead the adoption of effective strategies to verify skill attainment remotely.
- Delaying hands-on instruction indefinitely is not practical given the future uncertainty. If specific laboratory instruction is not permitted by the county or state, virtual simulations or other "less-than-perfect" approaches must be used to ensure instructional continuity. For programs necessitating hands-on sessions in front of an instructor, programs should be offered on campus with social distancing.

¹ Regina L. Garza Mitchell. (2017) "Online Career and Technical Education in the Community College," Community College Journal of Research and Practice, 41:6, 336-340, DOI: 10.1080/10668926.2016.1270242.

Introduction

Recent global events have fundamentally, and perhaps permanently, changed the way career education (CE) is delivered, presenting an opportunity to better meet the needs of employers, to infuse technology into programs that may not otherwise be clear candidates for innovation, and to ensure the decisions that postsecondary institutions make are student centric, not anchored in what is most comfortable for their faculty and administrators.²

To assist the Los Angeles/Orange County community colleges in adjusting to new health and safety requirements prompted by the pandemic, this study assesses programs that pose a challenge for conversion to distance learning in three areas. The first area is direct patient care, a requirement of many health care programs in which students must complete a certain number of clinical hours. In the Los Angeles/Orange County region, there are 236 program offerings that meet this criterion. The second area is the demonstration of highly refined skills, in programs such as cosmetology and culinary arts, which will also require readjustment in light of the move toward online and/or hybrid instruction. The third area applies to programs that require students to work with heavy machinery or specialized equipment, such as welding and automotive technology.

Using state and regional labor market data, this study identifies 12 “hard-to-convert” CE programs offered by the region’s 28 colleges which may need specific accommodations/adjustments to ensure successful delivery in a remote or limited access learning environment:

- 094800-Automotive Technology
- 300700-Cosmetology and Barbering
- 130630-Culinary Arts
- 095220-Electrical
- 093400-Electronics and Electric Technology
- 125000-Emergency Medical Services
- 213300-Fire Technology
- 095600-Manufacturing and Industrial Technology
- 122500-Radiologic Technology
- 123010-Registered Nursing
- 121000-Respiratory Care/Therapy
- 095650-Welding Technology

The program snapshots included in this report discuss each program area, key takeaways, and recommendations derived from the information gathered through an online faculty survey and expert interviews, including model programs developed by colleges across the nation and recommended software and training platforms.

²David Rosowsky, “If Colleges Are Businesses, Why Not Run Them That Way?” Forbes, May 10, 2020, accessed July 31, 2020, <https://www.forbes.com/sites/davidrosowsky/2020/05/10/if-colleges-are-businesses-why-not-run-them-that-way/#36eb1ad85602>.

Methodology

In March, the American Association of Community Colleges (AACC) surveyed members from its Apprenticeship Advisory Board and Commission on Economic and Workforce Development to understand “online-only related technical instruction.”³ The research revealed three program areas facing challenges with online instruction:

- Programs with direct patient care due to legal and licensing requirements
- Programs that require demonstration of highly refined skills
- Programs that require the use of heavy machinery/equipment or specialized personal protective equipment

These AACC program criteria served as the foundation for the identification of “hard-to-convert” programs in the Los Angeles/Orange County region. Using the California Community Colleges Taxonomy of Programs (TOP) handbook, the research team identified a comprehensive set of programs corresponding with the AACC categories. This set of programs was further refined using two additional criteria:

1. High enrollment as demonstrated via 2018-19 full-time equivalent students, and
2. Demonstrated labor market demand using 2018-19 annual program completions compared with projected 2019-2024 annual job openings in the region.

This resulted in the identification of 12 program areas discussed in this report. A complete list of affected programs identified by the AACC is included in Appendix A.

To understand how the community colleges are handling the transition to online and/or hybrid instruction in the 12 program areas, an online survey was distributed to CE deans and faculty at the consortium’s 28 community colleges. The survey asked respondents to share how students are currently demonstrating competencies while courses are taught online and to recommend software and platforms for regional adoption as courses continue to be taught online. The survey was opened by 57 respondents. (See Appendix B for the survey instrument.)

To further evaluate which online strategies are most promising for program delivery, a series of interviews were conducted with classroom teachers, administrators, and national content experts. Questions focused on emerging trends in online/hybrid delivery for hard-to-convert CE programs, considerations for program quality, and opportunities for innovation.

The research team also reviewed a wide variety of vendors, both K-12 and postsecondary, that provide online delivery, simulated labs, or virtual reality platforms in each of the 12 focus areas. National websites and publications were examined to create a clearinghouse of information centered around COVID-19 resources, and policy considerations. (See Appendix C for professional development resources, Appendix D for a clearinghouse of resources, and Appendix E for a list of interview subjects.)

³ Jen Worth, “Addressing Online Education for CTE/RTI Programs,” American Association of Community Colleges, March 2020, accessed July 31, 2020, https://www.aacc.nche.edu/wp-content/uploads/2020/04/CTE_Online_Recommendation_final2.pdf.

Automotive Technology

Workforce Supply and Demand

TOP	Program	2018-19 FTES	2018-19 Completions	Annual Openings
94800	Automotive Technology	796	606	763

Interview Findings

Automotive Technology lends itself well to the use of software and simulation. According to one interview, the innovation that has come out of the pandemic within CE has primarily occurred in the Automotive Technology area. One online program model is Ashworth College in Georgia which has animated videos and interactive features, a student portal for instant access to online curriculum and support, and a Learning Resource Center with online libraries and labs.⁴ In order to deliver the lab portion of automotive courses, virtual lab videos were created for which the faculty wrote scripts and the lab techs served as actors, demonstrating the skill sets for each specific topic area. Prior to the pandemic, faculty were not open to trying a virtual approach. The pandemic has created a culture in which staff are more accepting of trying new things.

College of Marin has set up a VR lab on campus for students to reserve to utilize/practice hands-on skills in virtual reality (with social distancing) up to 5 hours per student per week for their automotive fundamentals class with a collision course in development (estimated \$100k for customized development of two courses; 12-15 simulated skills). Transfr VR is also heavily utilized throughout the state of Alabama and employers such as Lockheed Martin Corporation. Please refer to this automotive [video](#) (2min).

Survey Findings

Six colleges shared how students are demonstrating competencies for Automotive Technology courses. At some colleges, students were asked to perform lab exercises on their personal vehicles, video record their work, and submit it to their instructors. In some cases, students were present on campus to complete lab work. One college asked its students to attend campus labs in small cohorts. Additionally, colleges mentioned manufacturers' programs that include online assessments and virtual labs. One program is considering the use of virtual reality for instruction of labs; some options include zSpace, Immerse2Learn, and CDX Learning.

Recommendations

1. Develop a process involving faculty to determine the most effective software platforms to use and how to schedule essential face-to-face labs. In the interest of cost effectiveness, faculty should agree on which software platform(s) to use to avoid duplication. Automotive Technology faculty recommend the use of Zoom, Proctorio, Canvas, and manufacturer platforms such as Subaru University and Electude.

⁴ "Online Automotive Technicians Training," Ashworth College, accessed July 31, 2020, <https://www.ashworthcollege.edu/career-diplomas/automotive-technician-training/>.

2. Expand the use of work-based learning with essential businesses, such as dealerships and independent shops, in the community, so that students can complete their hands-on lab work at these businesses.
3. Consider creating self-made lab videos where the instructor demonstrates specific activities that students would do if they were on site.

Resources

Website	Description
Automotive Service Excellence (ASE) Introduction to Automobile Service (IAS) E-Learning Program	The online program focuses on entry-level tasks related to basic automobile service. The first four modules cover general automotive service topics and the fifth consists of a final quiz covering the content in modules 1-4. Those who successfully pass the IAS Quiz may print a customized certificate of completion.
CDX Learning Systems	Offers online resources including interactive content, quizzes, and videos, as well as reporting tools to track student progress. Curriculum in accordance with NATEF and ASE standards.
Cengage’s MindTap	A resource that comes with Cengage Unlimited, so the system works together comprehensively to make textbooks available and to allow faculty to control all aspects of their virtual instruction. A number of LA/OC college programs are already using MindTap or other publisher platforms similar to Cengage.
Electude	Programs in light vehicles, heavy vehicles, and system technologies. A highly adaptable platform that performs equally well in the classroom, in the shop or at home.
LJ Create Automotive Program	This program allows instructors to build a NATEF certified automotive program to train auto technicians. A combination of online digital learning resources and practical equipment.
S/P2	S/P2’s mission is to provide tools that educate students and employees to create safe, productive schools and workplaces, and to help CE students find career opportunities with the right first employer.
Today’s Class Automotive and Fleet Training	For automotive or medium/heavy duty vehicles training. Developed by ASE-certified professionals.
TRANSFR VR	Regarding virtual reality technology, TRANSFRVR is a highly reputable company that offers comprehensive services.
zSpace	zSpace is a supplemental tool for industry certifications within Health Sciences & Public Services, Advanced Manufacturing, the Skilled Trades, Agri-Science (Welding), and Transportation (Auto).

Cosmetology & Barbering

Workforce Supply and Demand

TOP	Program	2018-19 FTES	2018-19 Completions	Annual Openings
300700	Cosmetology and Barbering	2,007	510	2,460

Interview Findings

This study did not identify any completely online programs in this area.

Survey Findings

Five colleges gave input on how students are completing lab work for Cosmetology and Barbering. Zoom is the most common method. Colleges have students live stream labs simultaneously. In one instance, the college is utilizing a textbook publisher's online system that tracks student progress and provides performance statistics and feedback to the student and faculty (Cengage Publishing). At another college, instructors are leveraging MindTap for lab work.

Recommendations

1. For ongoing lab work and demonstration of competencies, it is recommended colleges use MindTap. One college noted there is a "need for a stronger timekeeping solution for hours entered toward licensure."

Resources

Website	Description
Los Angeles Trade Technical College's Cosmetology Program	LATTC schedules courses synchronously to meet the 1,600-hour requirement for students; daily timecards are filled out by students and validated by faculty.
Nepriis	Virtually connects educators and learners with a network of industry professionals, bringing real-world relevance and career exposure to all students. A no-cost platform. Educators can arrange for a virtual chat with industry professionals or have them be a guest lecturer in one or more classes.
S/P2	S/P2's mission is to provide tools that educate students and employees to create safe, productive schools and workplaces, and to help CE students find career opportunities with the right first employer.
Today's Class Cosmetology	The program begins with a foundation of science fundamentals and professional skills and expands into more specialized modules. An assessment builder lets instructors build tests out of questions from multiple courses and customize tests to help prepare students in areas they may be weakest in.

Culinary Arts

Workforce Supply and Demand

TOP	Program	2018-19 FTES	2018-19 Completions	Annual Openings
130630	Culinary Arts	351	296	2,185

Interview Findings

This study did not identify any completely online programs in this area.

Survey Findings

Six regional culinary arts program faculty provided responses on the completion of lab competencies. Survey respondents acknowledged challenges with competency demonstration that extend beyond the use of technology. In culinary arts programs, students are often required to utilize ingredients and equipment that they may not readily have available at home. One college provided students with “pickup packages” that contained food and other necessarily items to complete labs at home. Another college does not require students to buy specific ingredients. Generally, colleges utilize video meal preparation and cooking demonstrations to observe skills and abilities via Zoom and/or Canvas. As one respondent noted, post lab completion, students upload their videos to Canvas to demonstrate work. One college suggested the need to install cameras in kitchens that can capture and share files.

Recommendations

1. Programs should continue to use Canvas and Zoom for cooking demonstrations and teaching platforms.
2. Consider adopting Rouxbe which provides online culinary programs for over 50 schools (including Washington State University, Miami Dade, Ivy Tech, and some California Community Colleges). Rouxbe’s online culinary program and specialty courses are ACFEF-recognized.
3. The regional directors should contact Ashworth College and George Brown College to gather information on their culinary programs.

Resources

Website	Description
American Technical Publisher’s Culinary Arts and Services Program	Publishes instructional materials, textbooks, and related material for apprenticeship and industrial training markets.
Cengage’s MindTap	A resource that comes with Cengage Unlimited. Makes textbooks available to allow faculty to control all aspects of their virtual instruction. A number of LA/OC college programs are already using MindTap or other publisher platforms similar to Cengage.
MYcaert Lesson Libraries	MYcaert provides an integrated online system with instructional components and a management tools to assess CE instruction.
ProSim Restaurant	A series of simulation-based assignments and projects that give students hands-on experience running a restaurant.
Rouxbe	Provides 110 hours of culinary foundational curriculum, a student dashboard, and interactive features and assessments.

Electrical

Workforce Supply and Demand

TOP	Program	2018-19 FTES	2018-19 Completions	Annual Openings
95220	Electrical	122	100	2,749

Interview Findings

One online program identified through interviews is offered by Ashworth College in Georgia. Ashworth's program uses the Binder mobile app, a student portal for instant access to lessons and support, and an online learning resource center that connects students to libraries and labs.⁵

Survey Findings

To complete skill assessment in Electrical programs, one college is utilizing virtual laboratory simulations. A survey participant noted, "The VR software shifts the lab into the virtual realm by allowing students to complete laboratory experiments with 2D animations that can be viewed on their computer." Another respondent is using demonstrations and videos that allow students to communicate competencies. A third respondent said classes were suspended in the Spring 2020 semester, and in the Fall 2020 semester, labs will be conducted face to face; in this case, the lab environment has been adjusted to ensure compliance with all federal, state, and local requirements for social distancing. In addition to an online platform, one respondent noted that students will require physical resources for at-home completion of tasks.

Recommendations

1. Electrical program faculty should be convened virtually to share what they are using and/or where they need more help.
2. Online resources to consider include Festo, a software option recommended for core courses within this field, and Interplay Skilled Trades for electrical and solar technologies instruction.

Resources

Website	Description
American Technical Publishers	Instructional materials, textbooks and related material for apprenticeship and industrial training markets.
Festo	Supplies automation technology and technical educational solutions to more than 35 industries
Interplay Skilled Trades	Online courses in HVAC, Electrical and Solar.
Wester Electrical Contractors Association Electrician Trainee Program	WECA's state-approved Electrician Trainee program is available to students throughout California. All classes are exclusively taught by experienced electrical industry professionals.

⁵ "Online Electrician Training Courses," Ashworth College, accessed July 31, 2020, .<https://www.ashworthcollege.edu/career-diplomas/electrician-training/>.

Electronics and Electric Technology

Workforce Supply and Demand

TOP	Program	2018-19 FTES	2018-19 Completions	Annual Openings
93400	Electronics and Electric Technology	111	127	340

Interview Findings

Electronics and Electric Technology is a natural fit for software platforms, providing simulation suitable for at-home lab assignments. Software in support of this area is plentiful and for the most part, inexpensive for students to use; many firms offer free limited use for students. Ashworth College in Georgia offers an online program that provides students with a textbook and study guides, a digital multimeter, and soldering supplies and electric components.⁶ Colorado Technical University offers flexible online course schedule and a mobile app for students to build a class schedule around their schedule.⁷

Survey Findings

Seven regional colleges offered information about Electronics and Electric Technology programs. There are a few methods of communication currently being used. Video recording of student lab work has been the primary vehicle for demonstration of ability; these videos are uploaded via Canvas. Zoom has also been used for students' lab performance. One college is planning to offer face-to-face labs in Fall 2020. Another respondent noted the challenge of students not having access to necessary equipment and materials. This respondent said, "Meaningful and realistic laboratory projects involve an iterative, trial-and-error process" and "issues and obstacles arise in the practical execution of a laboratory assignment, that cannot be anticipated in advance or modeled on a computer." Respondents recommended the use of Festo, Lab Volt, Electude, MS Azure, Linked Learning, and Canvas. One college suggests a software use survey of all peer faculty in the region by discipline. Yet another college representative stressed that "students need access to the extensive, industry-standard equipment and components in order to learn to function at even the entry-level in the real world." The same respondent noted, "If all the online students could somehow be provided with the physical resources needed in the lab environment, they would still need the close instructor direction and supervision provided in the traditional lab setting in order to succeed."

Recommendations

1. Develop a process involving faculty to determine the most effective software platforms to use, how to best schedule essential face-to-face labs, and which items to include in kits that are distributed to students. In the interest of cost effectiveness, faculty should agree on which software platform(s) to use to avoid duplication.

⁶ "Affordable Online Electronics Course," Ashworth College, accessed July 31, 2020, <https://www.ashworthcollege.edu/career-diplomas/basic-electronics/>.

⁷ "Associate of Science in Electronics Technology," Colorado Technical University, accessed July 31, 2020, <https://www.coloradotech.edu/degrees/associate/electronics-technology>.

- Consider the scheduling of labs. Some faculty have moved the lecture portion of labs to an online format and reserved the remaining hands-on second half of the session for face-to-face instruction. This allows faculty to accommodate half of the students during one of two hands-on sessions. The other half of the students are accommodated in the second session. Together, this comprises the time that the full lab (with lecture) would have taken.

Resources

Website	Description
Altera Quartus II software version 13.0sp1 for Windows	For circuit design.
Cengage's MindTap	A resource that comes with Cengage Unlimited. Makes textbooks available to allow faculty to control all aspects of their virtual instruction. A number of LA/OC college programs are already using MindTap or other publisher platforms similar to Cengage.
Constructor 15	CMH's Constructor v15 covers sensors, controls, activators, and individual motor systems.
Coursera's Introduction to Electronics	Coursework for students covering electronics/electronic engineering technology, offered by Georgia Tech.
FluidSim 5	Festo's FluidSim is a platform that covers the interface between hydraulics and pneumatics and electronics.
LabVIEW	National Instruments (now NI) LabVIEW covers information related to advanced PLCs.
MathWorks MATLAB	SIMUTECH for electrical troubleshooting.
Multisim Live	For circuits and digital electronics design.
MYcaert Lesson Libraries	MYcaert provides an integrated online system with instructional components and a management tools to assess CE instruction.
Project Lead the Way (PLTW)	Provider of curriculum resources for Electronics and Engineering Technology programs.

Emergency Medical Services

Workforce Supply and Demand

TOP	Program	2018-19 FTES	2018-19 Completions	Annual Openings
125000	Emergency Medical Services	308	188	167

Interview Findings

Online classes are held two days a week through the Kiamichi Career and Technical Education Center in Oklahoma, and students participate in clinical activities which includes a mobile truck that travels around the state to deliver specialized instruction in person and for skill demonstrations and assessments.⁸ The 15-month paramedic program requires 1,210 hours for certification with 860 hours of fieldwork. To account for the regulated nature of health care instruction, a comprehensive clinical competency guidebook was developed for use with participating field organizations.⁹

Survey Findings

Seven college representatives reported on practices being used for Emergency Medical Services programs. Respondents commonly agreed that instruction for this program cannot successfully be taught online. Four colleges offered hybrid instruction in the most recent term. Respondents state that competencies cannot be demonstrated online, and the certifying board requires ridealongs that have been put on hold by companies.

Faculty members at one college have submitted safety protocol plans for limited in-person lab time, and another college is listing courses as “in progress” pending the implementation of the district’s recovery plan. Colleges recommended the use of Canvas or Zoom for the lecture component of these programs, and one respondent suggests the use of virtual reality software, zSpace. Additionally, one college is utilizing simulation mannequins for hands-on tasks that would otherwise necessitate clinical experience. It has been suggested that faculty meet virtually to share the methods they are using with students in this program.

Recommendations

1. Develop a process involving faculty to determine the most effective software platforms to use and how to best schedule essential face-to-face labs. If there is a cost, faculty should agree on which software platform(s) to use to avoid duplication.

⁸ “APEC Digital Workforce Development Project: Promising Practices and Design Principles in Career and Technical Education Delivered via Distance Learning,” Asia-Pacific Economic Cooperation, February 2019, accessed July 31, 2020, p. 10, <https://tech.ed.gov/files/2019/04/APEC-Digital-Workforce-Development-Report-on-Promising-Practices-and-Design-Principles-Final.pdf>.

⁹ Ibid.

Resources

Website	Description
60 Seconds to Survival Disaster Triage	A free online “game” that allows users to experience and address actual triage situations with a variety of pre-programmed actions.
Cengage’s MindTap	A resource that comes with Cengage Unlimited. Makes textbooks available to allow faculty to control all aspects of their virtual instruction. A number of LA/OC college programs are already using MindTap or other publisher platforms similar to Cengage.
FISDAP	Provides access to resources in preparation for EMT certification including practice quizzes, a practice exam, podcasts, and virtual skill demonstrations.
Flipgrid	A free online platform that students can use to record videos demonstrating skills.
Zero Hour America’s Medic	An immersive game created to train first responders in handling mass casualty incidents that is free.

Fire Technology

Workforce Supply and Demand

TOP	Program	2018-19 FTES	2018-19 Completions	Annual Openings
213300	Fire Technology	1,199	524	144

Interview Findings

One subject matter expert interviewed believes that for the hands-on portion of Fire Technology that involves actual firefighting, nothing can replace hands-on training and exercises. Purdue University Global in Illinois offers an online fire science associate degree accredited by the International Fire Service Accreditation Congress (IFSAC).¹⁰ The online program focuses on foundational skills in firefighter safety, building codes, fire prevention, code inspection, and firefighting strategy and tactics

Survey Findings

Colleges that offer Fire Technology programs have generally continued in-person demonstrations. As an essential worker program, in-person training has continued for three of the five colleges that responded to the survey. Two colleges do not have lab components for their fire programs, and one has transitioned to online for lectures only. Looking ahead to the possibility of all online instruction, one college reports that they cannot transition to fully online learning. Another college plans to use Canvas and Zoom for lectures, and a third will continue in-person demonstrations and virtual lectures.

Recommendations

1. Follow all CDC recommendations to schedule hands-on training. Rotating students through exercises may be the way to train students safely.
2. Work closely with accrediting bodies to advocate for any needed flexibility as a result of the pandemic.
3. Utilize software technology recommended for EMS for the medical practice side of Fire Technology.

Resources

Website	Description
National Fire Protection Association	NFPA training includes a variety of convenient ways to access codes and standards training and earn CEUs, including online training. Dozens of texts, guides, and other materials that target firefighter and other first responder safety and health.

¹⁰ "Associate of Applied Science Degree in Fire Science," Purdue University Global, accessed July 31, 2020, https://www.purdueglobal.edu/degree-programs/fire-science/online-associate-degree-fire-science/?utm_source=google&utm_medium=organic-gmb9000.

Manufacturing & Industrial Technology

Workforce Supply and Demand

TOP	Program	2018-19 FTES	2018-19 Completions	Annual Openings
95600	Manufacturing and Industrial Technology	361	64	2,404

Interview Findings

Interviews revealed that a common strategy used within Manufacturing and Industrial Technology is the creation of self-made lab videos where the instructor demonstrates specific activities that students would do if they were on site. While not a complete online conversion, this strategy has expanded program delivery options beyond the traditional setting. This study did not identify any completely online programs in this area.

Survey Findings

Five colleges responded with information about how their programs are ensuring competencies via online instruction. Methods for competency demonstration varied. One college noted that faculty decides how skills are demonstrated. Another college is only offering Introduction to Biotech with a lecture and lab; the lab portion of the program consists of simulations using Labster and in-home labs with lab “Paks.” This college is not offering hands on labs until students have returned to in-person instruction.

One college utilized Zoom with instructor demonstrations and students performing the work during synchronous sessions. For another college, its program is not operating fully online. Platform and/or software recommendations for manufacturing and industrial technology include the use of Labster, JoVE, LabArchives, Immerse2Learn, NCSIMUL, and zSpace. One respondent suggested faculty gather by discipline to share software programs being used and noted that their faculty lead “has found some good programs and has been able to teach and assess to achieve all required SLOs.”

Recommendations

1. Develop a process involving faculty to determine the most effective software platforms to use and how to best schedule essential face-to-face labs. In the interest of cost effectiveness, faculty should agree on which software platform(s) to use to avoid duplication.
2. Expand the use of work-based learning with essential businesses in the community so that students can complete their hands-on lab work at these businesses.
3. Consider creating self-made lab videos where the instructor demonstrates specific activities that students would do if they were on site.

Resources

Website	Description
Altera Quartus II software version 13.0sp1 for Windows	For circuit design.
AMATROL	AMATROL designs, develops, and manufactures technical training systems, highly interactive eLearning, and hands-on simulators, in areas including manufacturing.
Cengage's MindTap	A resource that comes with Cengage Unlimited. A number of LA/OC college programs are already using MindTap or other publisher platforms similar to Cengage.
Centers for Applied Competitive Technologies	A list of online resources for CE education.
Code Warrior Development Tool Suites	CodeWarrior software is an integrated development environment for editing, compiling, and debugging software for several microcontrollers and microprocessors, and digital signal controllers used in embedded systems.
FluidSIM	Festo's FluidSim System, which covers hydraulic and pneumatic systems and closely simulates Festo's physical trainers
iCEV	The iCEV platform features comprehensive CE curriculum and instructional materials for seven major subject areas.
Immerse2Learn	Courses in CAM, CAD, CNC inspection, manual machining, and core skills.
JoVE	JoVE educational videos enable quick in-depth comprehension of complex STEM subjects.
Koldwater Training Software LogixPro	LogixPro is a tool for learning the fundamentals of PLC programming.
LabArchives	Software allows students to share lab data. Instructors can assign, grade, monitor, and communicate with students.
Labster	Coordinated as a central service through the California Community Colleges Foundation. A realistic lab experience for students to perform experiments and practice skills.
Lincoln Electric's Torchmate	Allows students to download software and design various projects that can be produced on site when connected to a CNC Plasma machine.
MathWorks MATLAB	PLC programming.
MathWorks SIMUTECH	SIMUTECH is used for electrical troubleshooting.
Multisim Live	For circuits and digital electronics design.
MYcaert Lesson Libraries	MYcaert provides an integrated online system with instructional components and a management tools to assess CE instruction.
NCSIMUL	A complete machining simulation software for debugging, optimizing, and running machining programs for NC (numerical control) machine tools.
PLCLogix	PLCLogix covers the beginning and intermediate portion of the hands-on lab for a PLC class, but not the advanced.
zSpace	zSpace is a supplemental tool to many other industry certifications, including Advanced Manufacturing.

Radiologic Technology

Workforce Supply and Demand

TOP	Program	2018-19 FTES	2018-19 Completions	Annual Openings
122500	Radiologic Technology	415	99	114

Interview Findings

This study did not identify any completely online programs in this area.

Survey Findings

Two colleges provided responses for radiologic technology programs. One college is using simulations, and the second indicated that if required to fully transition online, its program will cease to exist.

Recommendations

1. Explore the use of American Society of Radiologic Technologists (ASRT) positioning learning modules for competency demonstrations.

Resources

Website	Description
iCEV Health Science Curriculum	The iCEV platform features comprehensive CE curriculum and instructional materials for seven major subject areas, including Fundamentals of Health Science.
Labster	Coordinated as a central service through the California Community Colleges Foundation. A realistic lab experience for students to perform experiments and practice skills.
Today's Class Health Science Courses	Instructional material ranging from medical math and taking vital signs to personal and professional development. Content combines information on body structures with detailed digital graphics and animations.
Visible Body	Suite of apps that make learning and teaching anatomy and physiology visual and engaging.

Registered Nursing

Workforce Supply and Demand

TOP	Program	2018-19 FTES	2018-19 Completions	Annual Openings
123010	Registered Nursing	1,125	478	1,796

Interview Findings

The greatest challenge in registered nursing during the pandemic is to continue to meet the requirements of both accreditors and governing bodies, which can be very stringent in certain states including California. Many hospitals and medical centers have stopped allowing students to participate in clinical rotations, which is a key work experience required to become a nurse. Wherever simulation technology can be applied to clinical practicum hours, its use has been critical. Sentiments were expressed that faculty did not really appreciate the use of technology in education until now; that as we move into the future, the use of technology has to be built into nursing programs; and that a significant obstacle is that certification requirements don't align with the use of technology today. Boards of Nursing did relax clinical practicum requirements when the pandemic first hit, but it is uncertain whether they will continue to do so. Faculty had to be innovative when regular clinical rotations were halted by partner hospitals and healthcare providers. While students could not participate in their usual clinicals, instructors with strong relationships with providers were able to arrange for students to conduct supervised telehealth sessions with patients and to provide COVID testing at drive through sites. When regular clinicals resumed, college risk management departments provided enhanced liability coverage, and colleges purchased personal protective equipment for students, requiring them to use it at all times when on site. Two model online programs were identified. Western Governors University in Utah offers a hybrid 2.5-year program with online coursework that prepares students for NCLEX assessment and for obtaining a bachelor's degree.¹¹ The program is offered in areas where the university has partnerships: California, Texas, Florida, Indiana, and Utah (only states with the 900 clinical hours available). The second online model is offered by Brandman University. This is a hybrid program, taught by practicing nurses, that can be completed in a minimum of three years.¹² It also prepares students for NCLEX assessment and for obtaining a bachelor's degree.

Survey Findings

Registered nursing programs reported varied methods for students to demonstrate lab competencies. Some colleges are utilizing virtual labs for simulations and Zoom for other lab work. One college reported that it has had to shut labs down completely; another will not be admitting a fall cohort due to the inability to place students in a lab setting. A primary challenge for colleges is that students cannot complete clinical requirements due to healthcare facilities not allowing students on site. At one college, students were brought onto campus in small cohorts for short periods of time to perform required tasks. Another college is utilizing iHuman for a portion of clinical hours, with students completing the remainder of their clinical hours in hospitals or through telehealth. This approach—completing partial clinical hours in a healthcare setting and the remainder completed virtually—has been adopted by a

¹¹ "College of Health Professions Online," Western Governors University, accessed July 31, 2020, <https://www.wgu.edu/online-nursing-health-degrees.html>.

¹² "RN to BSN Degree Overview," Brandman University, accessed July 31, 2020, <https://www.brandman.edu/academic-programs/nursing-and-health-professions/rn-to-bsn>.

second college. Finally, one college reported it has submitted a safety protocol logistics plan to bring students in for lab work. In consideration of future online instruction, recommended platforms/software include iHuman, Canvas, Zoom, zSpace, and simulation mannequins like Laerdal. Other program needs include a “very robust, strong, very detailed high-ended simulation program to support our clinical component” and collaboration with telehealth programs for nursing students in all content areas. One respondent would like to see nursing directors in the region/Health Workforce Initiative (HWI) be surveyed to learn which software they use.

Recommendations

1. Retain existing clinical sites; once they are lost, this function may be lost permanently to the private sector. Where clinicals are restricted, investigate the possibility of students providing telehealth sessions and providing COVID testing to meet some clinical practicum hours.
2. Work with college risk management departments to provide increased liability coverage for students during their clinical hours. Invest in the CDC recommended personal protective equipment for students and require them to wear it at all times when on clinical rotations.
3. Work closely with accrediting bodies and licensing boards to advocate for any needed flexibility regarding what can count toward required clinical practicum hours.
4. Utilize recommended software to enhance skills practice and to count toward clinical hours.

Resources

Website	Description
Cengage’s MindTap	A number of LA/OC college programs are already using MindTap or other publisher platforms similar to Cengage.
iCEV	The iCEV platform features comprehensive CE curriculum and instructional materials for seven major subject areas, including the Fundamentals of Health Science.
iHuman	The i-Human Patient simulation platform provides safe, repeatable, fully-graded clinical patient encounters for students on their devices.
Laerdal’s vSim for Nursing	A software platform that allows students to experience and respond to simulations for all aspects of nursing practice.
Nepris	Virtually connects educators and learners with a network of industry professionals. Through this no-cost platform, educators can arrange for a virtual chat with industry professionals or have them be a guest lecturer in one or more classes.
State of Oregon Document on Clinical Practice	For Allied Health programs, there is national agreement that students better understand human physiology, with the help of virtual avatars. We in CA need to continue to be cognitively open to, and continue to advocate for, new and expanded approaches. Some states have even found virtual options for clinical experiences.
Today’s Class Health Science	Instructional material ranging from medical math and taking vital signs to personal and professional development. Content combines information on body structures with detailed digital graphics and animations.
Visible Body	Suite of apps that make learning and teaching anatomy and physiology visual and engaging.
zSpace	zSpace is a supplemental tool to industry certifications within Health Sciences & Public Services, Advanced Manufacturing and the Skilled Trades, Agri-Science (Welding), and Transportation (Auto).

Respiratory Care/Therapy

Workforce Supply and Demand

TOP	Program	2018-19 FTES	2018-19 Completions	Annual Openings
121000	Respiratory Care/Therapy	53	12	118

Interview Findings

This study did not identify any completely online programs in this area.

Survey Findings

No responses were provided for the Respiratory Care/Therapy program area.

Recommendations

1. Provide students with a list of supplies to purchase, so that certain skills can be practiced at home (e.g., use of a nebulizer, spirometer, etc.).
2. Expand the use of scenario simulation technology to develop treatment expertise. Consider use of Kettering National Seminars.

Resources

Website	Description
Cengage's MindTap	A number of LA/OC college programs are already using MindTap or other publisher platforms similar to Cengage.
iCEV	The iCEV platform features comprehensive CE curriculum and instructional materials for seven major subject areas, including the Fundamentals of Health Science.
Kettering National Seminars	The Kettering National Seminar platform allows students to move through various scenarios and make treatment decisions.
Today's Class Health Science	Instructional material ranging from medical math and taking vital signs to personal and professional development. Content combines information on body structures with detailed digital graphics and animations.
Visible Body	Suite of apps that make learning and teaching anatomy and physiology visual and engaging.

Welding Technology

Workforce Supply and Demand

TOP	Program	2018-19 FTES	2018-19 Completions	Annual Openings
95650	Welding Technology	224	89	429

Interview Findings

Welding Technology has traditionally been labeled as a program that could not be converted to an online or virtual platform. While that may hold true for some aspects of welding, virtual welding is proving to be a relevant and meaningful tool to expand delivery to students in rural settings and in environments where traditional welding experiences may not be feasible. Clay Wilke, a welding instructor at the College of Southern Idaho, noted that he had built a large repository of videos in Canvas prior to the pandemic and felt well prepared to support his students until they had access to hands-on labs again. The North Dakota Department of Career and Technical Education began its distance-delivered welding program in 2013 and has successfully been expanding the program to additional locations. The program uses a statewide fiber network that provides dedicated bandwidth to connect all schools across North Dakota. The system is fully interactive for two-way communication, in real time. Unique features of the program include the use of high-definition cameras and monitors to demonstrate and supervise the students. This equipment has special filters to address the extreme light conditions created by the welding. Students in the remote locations use a package of mobile welding equipment that is rotated among participating schools. A security system of cameras is installed in each location for an overall view of classroom activity to ensure the safety of the students. Once every nine weeks, the teacher visits the satellite schools to test the students' knowledge face-to-face.¹³ The program converted to online/simulation (hybrid just for proctoring) and the industry pass rates were equivalent. Another model online Welding program is offered by George Brown College in Toronto, Canada, which offers students the opportunity to practice using realistic simulations. The college's Smart Welding Lab provides a monitor and specialized infrared camera that let instructors demonstrate and digitally document welding techniques.¹⁴

Survey Findings

Six colleges provided responses for their Welding Technology programs. Five respondents indicated they are not able to validate student competencies via online instruction. One college has students submit a video to the instructor to demonstrate their skill set achievement; that respondent noted they will have

¹³"APEC Digital Workforce Development Project: Promising Practices and Design Principles in Career and Technical Education Delivered via Distance Learning," Asia-Pacific Economic Cooperation, February 2019, accessed July 31, 2020, p. 11, <https://tech.ed.gov/files/2019/04/APEC-Digital-Workforce-Development-Report-on-Promising-Practices-and-Design-Principles-Final.pdf>.

¹⁴"Welding Techniques Program," George Brown College, accessed July 31, 2020, <https://www.georgebrown.ca/programs/welding-techniques-program-t166>.

a new facility on campus and they anticipate that students will be allowed to attend in person with safety protocols and logistics in place.

Recommendations

1. Develop a process involving faculty to determine how to best schedule essential face-to-face labs.
2. Expand the use of work-based learning with essential businesses in the community so that students can complete their hands-on lab work at these businesses.
3. Investments should be made in clean room technology for in-person teaching, welding equipment, and an area to perform work. Respondents stressed that welding skills cannot be demonstrated virtually and must be done in-person. One college representative cautions that without the ability for hands-on training, the community colleges could lose students to private, for-profit institutions and that faculty will likely return to industry or leave to teach at private schools.

Resources

Website	Description
American Welding Society	Online courses, career path information, school locations, scholarship opportunities, industry articles, and SENCE Training.
Cengage's MindTap	A number of LA/OC college programs are already using MindTap or other publisher platforms similar to Cengage.
Centers for Applied Competitive Technologies	A list of online resources for CE education.
iCEV	The iCEV platform features comprehensive CE curriculum and instructional materials for seven major subject areas.
Lincoln Electric Welding Training	Offers comprehensive online training programs for all aspects of welding and has welding simulators that can be provided on loan to students so they can practice real-world welding skills.
Nepris	Virtually connects educators and learners with a network of industry professionals. Through this no-cost platform, educators can arrange for a virtual chat with industry professionals or have them be a guest lecturer in one or more classes.
S/P2	S/P2's mission is to provide tools that educate students and employees to create safe, productive schools and workplaces, and to help career tech students find career opportunities with the right first employer.
zSpace	zSpace is a supplemental tool to many other industry certifications within Health Sciences & Public Services, Advanced Manufacturing and the Skilled Trades, Agri-Science (Welding), and Transportation (Auto).

Conclusion & Recommendations

Although online career education (CE) is an emerging practice, both secondary and postsecondary institutions throughout the world are taking a proactive approach in identifying content that can be successfully delivered in a virtual environment. Online program delivery, however, is not new and did not emerge solely during the pandemic. For example, in 2019, the U.S. Department of Education's Office of Career, Technical, and Adult Education launched a program to support competency-based CE through new and innovative delivery models to reach rural students. Still, until recently, distance learning did comprise a very small percentage CE program offerings, representing just 6% of all online content at the K-12 level.¹⁵ Due to the limitation in offerings, there have been few studies on the efficacy of delivering CE curriculum online.

As the Los Angeles|Orange County Regional Consortium works to transition CE programs to distance learning platforms, consortium leadership should be mindful of the transformation rapidly occurring not only through instructional delivery, but in work-based learning. This study focuses on expanding CE distance learning opportunities, but there are other potential avenues for the development of skills and knowledge, such as innovative workplace experiences in the virtual realm. For example, the West Virginia Department of Education designed Simulated Workplace experiences for students through a collaboration with business and industry leaders.¹⁶ Industry partners can provide an essential bridge for developing skills and competencies when classrooms and labs are not available.

Finally, given that workforce needs continue to exist, it is critical that CE programs remain nimble and responsive to maintain a strong talent pipeline. Many of the identified programs will necessitate some type of hybrid approach in delivering distance learning. Simulated labs, while helpful in sparking interest and developing preliminary skills, are not a permanent replacement for applied learning. Experts believe approximately 70% of hands-on lab work can be accomplished using simulation, videos, and customized kits that are sent to students for use at home; for the remaining 30%, there is no substitute for actual hands-on lab work. However, if college laboratories are not accessible, then work-based learning could be substituted. More rural settings have piloted rotational in-lab time, decoupling lectures from labs within a single course, and revising scheduling to facilitate dramatically smaller laboratory class sizes. These approaches could be applied the Los Angeles/Orange County region.

Recommendations

The following recommendations are generalized and can be applied broadly across all programs as the consortium transitions to distance learning CE platforms:

Consider curriculum portability and widespread course content access for faculty. The consortium's faculty are talented, but they are also human beings; thus, some of their individual lectures and course content are far better than others. Create a content delivery clearinghouse for regional faculty to submit and share their best recorded lectures for faculty in the same disciplines to drop into their Canvas shells.

¹⁵ "Keeping Pace with K-12 Online Learning," Evergreen Education Group, 2016, accessed July 31, 2020, <https://eric.ed.gov/?id=ED576762>.

¹⁶ Simulated Workplace, accessed July 31, 2020, <https://sway.office.com/fStHfSqBEucBtk8A?ref=Link>.

Redefine the faculty workload and remote-work expectations within CE disciplines to achieve synergies and leverage faculty strengths. To remain competitive, and for long-term adjustments to be effective, the redistribution of instructional duties within some CE areas may be required. Some faculty could be assigned to deliver content (and/or cull instructional materials) while others could focus on competency validation. Work with local unions to permit a flexible structure (at least as a temporary measure) where some faculty deliver the preponderance of lectures, and others focus on hands-on skill verification and employer engagement.

Return to the basics and direct the Regional Directors to virtually convene faculty by priority sector on a regular basis. Create an informal space for faculty to collaborate and agree on the adoption of software and simulation technologies, plan for curriculum portability, and curate customized kits to meet all or part of the hands-on lab experience for students among ALL CE programs within the consortium. Create a formal feedback loop between faculty and students to validate the quality of the product. As Orange County has done, adopt “vertical sector leads” for programs without a Regional Director.

Incentivize the expanded use of virtual reality and augmented reality (VR/AR) technology. Partner with industry leaders to shape the development of tools and connect with other postsecondary institutions throughout the nation that have successfully integrated this emerging technology. AR/VR is currently a less-than-perfect solution that is improving rapidly. One promising platform is [MagicLeap](#) which has developed headset devices (\$2,400 each) that enable students to digitally manipulate the physical environment around them.

Ensure faculty and staff have access to appropriate professional development. Develop consistent messaging among institutions to guide implementation and engage faculty and staff.

Expand work-based learning opportunities as a viable way to offer students hands-on lab experiences. Proactively engage with local CE advisory committees to facilitate skill verification and validate program quality. As the primary recipient of the talent pipeline, industry stakeholders are well positioned to help support community college programs and students.

Develop a formal feedback loop among faculty, students, and employers to foster more robust communication and skills development, particularly in the absence of hands-on labs. Using the program snapshots provided in this report, create relevant working groups to narrow prospective vendors and facilitate the integration of supportive technology into existing programs and ensure ongoing quality control.

Appendix A: Comprehensive List of Affected Programs

Direct Care Programs

- 1205.00 – Medical Laboratory Technology
- 1205.10 – Phlebotomy
- 1206.00 – Physicians Assistant
- 1208.00 – Medical Assisting
- 1208.10 – Clinical Medical Assisting
- 1210.00 – Respiratory Care/Therapy
- 1211.00 – Polysomnography
- 1212.00 – Electro-Neurodiagnostic Technology
- 1213.00 – Cardiovascular Technician
- 1214.00 – Orthopedic Assistant
- 1215.00 – Electrocardiography
- 1217.00 – Surgical Technician
- 1218.00 – Occupational Therapy Technology
- 1219.00 – Optical Technology
- 1220.00 – Speech-Language Pathology and Audiology
- 1221.00 – Pharmacy Technology
- 1222.00 – Physical Therapist Assistant
- 1225.00 – Radiologic Technology
- 1226.00 – Radiation Therapy Technician
- 1227.00 – Diagnostic Medical Sonography
- 1228.00 – Athletic Training and Sports Medicine
- 1230.00 – Nursing
- 1230.10 – Registered Nursing
- 1230.20 – Licensed Vocational Nursing
- 1230.30 – Certified Nurse Assistant
- 1230.80 – Home Health Aide
- 1239.00 – Psychiatric Technician
- 1240.00 – Dental Occupations
- 1240.10 – Dental Assistant
- 1240.20 – Dental Hygienist
- 1240.30 – Dental Laboratory Technician
- 1250.00 – Emergency Medical Services
- 1251.00 – Paramedic
- 1255.00 – Mortuary Science
- 1262.00 – Massage Therapy
- 1299.00 – Other Health Occupations
- 2105.50 – Police Academy
- 2133.00 – Fire Technology
- 2133.10 – Wildland Fire Technology
- 2133.50 – Fire Academy
- 2199.00 – Other Public and Protective Services

Demonstration programs

- 0102.10 – Veterinary Technician (Licensed)
- 0102.40 – Equine Science
- 0109.00 – Horticulture
- 0430.00 – Biotechnology and Biomedical Technology
- 0850.10 – Sign Language Interpreting
- 0934.00 – Electronics and Electric Technology
- 0934.10 – Computer Electronics
- 0934.10 – Industrial Electronics
- 0934.60 – Biomedical Instrumentation
- 0934.70 – Electron Microscopy
- 0934.80 – Laser and Optical Technology
- 0935.00 – Electro-Mechanical Technology
- 0935.10 – Appliance Repair
- 0956.00 – Manufacturing and Industrial Technology
- 1306.00 – Nutrition, Food, and Culinary Arts
- 1306.20 – Dietetic Services and Management
- 1306.30 – Culinary Arts
- 1306.60 – Dietetic Technology
- 3007.00 – Cosmetology and Barbering
- 3020.20 – Piloting
- 0952.10 – Carpentry
- 0952.30 – Plumbing, Pipefitting, and Steamfitting
- 0952.40 – Glazing
- 0952.50 – Mill and Cabinet Work
- 0952.90 – Roofing
- 0953.00 – Drafting Technology
- 0954.00 – Chemical Technology
- 0955.00 – Laboratory Science Technology

Heavy Machinery

- 0934.40 – Electrical Systems and Power Transmission
- 0945.00 – Industrial Systems Technology and Maintenance
- 0946.00 – Environmental Control Technology (HVAC)
- 0946.10 – Energy Systems Technology
- 0947.00 – Diesel Technology
- 0947.20 – Heavy Equipment Maintenance
- 0947.30 – Heavy Equipment Operation
- 0947.40 – Railroad and Light Operations
- 0947.50 – Truck and Bus Driving
- 0948.00 – Automotive Technology
- 0948.40 – Alternative Fuels and Advanced Transportation Technology
- 0949.00 – Automotive Collision Repair
- 0950.00 – Aeronautical and Aviation Technology
- 0950.10 – Aviation Airframe Mechanics
- 0950.20 – Aviation Powerplant Mechanics
- 0950.40 – Aircraft Electronics (Avionics)
- 0950.50 – Aircraft Fabrication

- 0952.00 – Construction Crafts Technology
- 0952.20 – Electrical
- 0956.00 – Manufacturing and Industrial Technology
- 0956.30 – Machining and Machine Tools
- 0956.40 – Sheet and Structural Metal
- 0956.50 – Welding Technology
- 0956.70 – Industrial and Occupational Safety and Health
- 0956.80 – Industrial Quality Control

Appendix B: Internal Survey Instrument

The CEO group of the Los Angeles/Orange County regional consortium would like to understand your colleges' experience with the transition of career education programs to online instruction in the wake of the COVID pandemic. Please invest five minutes in this brief survey. Your feedback shall help direct regional resources.

1. Please provide us with the following:

Your Name
College Name
Your position/title
Email address
Phone number

2. In order to successfully complete this program, a student will likely need to demonstrate mastery of skills, techniques, and/or operations. While fully online, how are students currently demonstrating mastery of competencies for lab components of the curriculum?

For example, in a culinary arts program, students would need to cook or bake a food item for tasting.

3. If we are required to transition to fully online instruction, we still want to ensure effective teaching and learning in our hands-on CE labs. What online platforms/tools would you recommend adopting regionally?

If your college offers Cosmetology and Barbering, please answer the following two questions for the Cosmetology and Barbering program.

4. While fully online, how are students demonstrating competencies for lab components of the curriculum?

5. If we are required to transition to fully online instruction, we still want to ensure effective teaching and learning in our hands-on CE labs. What online platforms/tools would you recommend adopting regionally?

6. While fully online, how are students demonstrating competencies for lab components of the curriculum?

7. If we are required to transition to fully online instruction, we still want to ensure effective teaching and learning in our hands-on CE labs. What online platforms/tools would you recommend adopting regionally?

If your college offers Electrical, please answer the following two questions for the Electrical program.

8. While fully online, how are students demonstrating competencies for lab components of the curriculum?

9. If we are required to transition to fully online instruction, we still want to ensure effective teaching and learning in our hands-on CE labs. What online platforms/tools would you recommend adopting regionally?

If your college offers Electronics and Electric Technology, please answer the following two questions for the Electronics and Electric Technology program

10. While fully online, how are students demonstrating competencies for lab components of the curriculum?

11. If we are required to transition to fully online instruction, we still want to ensure effective teaching and learning in our hands-on CE labs. What online platforms/tools would you recommend adopting regionally?

If your college offers Emergency Medical Services, please answer the following two questions for the Emergency Medical Services program.

12. While fully online, how are students demonstrating competencies for lab components of the curriculum?

13. If we are required to transition to fully online instruction, we still want to ensure effective teaching and learning in our hands-on CE labs. What online platforms/tools would you recommend adopting regionally?

If your college offers Fire Technology, please answer the following two questions for the Fire Technology program.

14. While fully online, how are students demonstrating competencies for lab components of the curriculum?

15. If we are required to transition to fully online instruction, we still want to ensure effective teaching and learning in our hands-on CE labs. What online platforms/tools would you recommend adopting regionally?

If your college offers Manufacturing and Industrial Technology, please answer the following two questions for the Manufacturing and Industrial Technology program.

16. While fully online, how are students demonstrating competencies for lab components of the curriculum?

17. If we are required to transition to fully online instruction, we still want to ensure effective teaching and learning in our hands-on CE labs. What online platforms/tools would you recommend adopting regionally?

If your college offers Radiologic Technology, please answer the following two questions for the Radiologic Technology program.

18. While fully online, how are students demonstrating competencies for lab components of the curriculum?

19. If we are required to transition to fully online instruction, we still want to ensure effective teaching and learning in our hands-on CE labs. What online platforms/tools would you recommend adopting regionally?

If your college offers Registered Nursing, please answer the following two questions for the Registered Nursing program.

20. While fully online, how are students demonstrating competencies for lab components of the curriculum?

21. If we are required to transition to fully online instruction, we still want to ensure effective teaching and learning in our hands-on CE labs. What online platforms/tools would you recommend adopting regionally?

If your college offers Respiratory Care/Therapy, please answer the following two questions for the Respiratory Care/Therapy program.

22. While fully online, how are students demonstrating competencies for lab components of the curriculum?

23. If we are required to transition to fully online instruction, we still want to ensure effective teaching and learning in our hands-on CE labs. What online platforms/tools would you recommend adopting regionally?

If your college offers Welding Technology, please answer the following two questions for the Welding Technology program.

24. While fully online, how are students demonstrating competencies for lab components of the curriculum?

25. If we are required to transition to fully online instruction, we still want to ensure effective teaching and learning in our hands-on CE labs. What online platforms/tools would you recommend adopting regionally?

Appendix C: Professional Development Resources

Regardless of the path forward, faculty and staff engagement and involvement will be key to any successful transition. One common theme expressed in many interviews is that the pandemic has created an opportunity for us to work together to transform education. Educators are more open than ever to new ways of doing things and are communicating and collaborating with each other more than they ever have. However, we also found hesitancy among faculty and staff about their ability to effectively convert their course instruction to an online or hybrid environment in a long-term or permanent capacity. Given the vast amount of digital resources we found to support nearly all the hard-to-convert programs, it's reasonable to assume that one of two things may be happening:

1. Instructors are being inundated by information from vendors and do not have a clear sense of whether the content aligns with program standards or their existing curriculum.
2. Instructors do not have a clear vision or the motivation to develop a more robust online presence and are simply trying to “wait it out.”

One interviewee categorized current instructor strategies along the following spectrum:

1. **Basic:** Relying on tools such as Zoom to provide distance learning in a real-time or an asynchronous capacity. Theory tends to be the primary focus, with some attempt at remote skills verification.
2. **Intermediate:** Using a blended model, relying on both remote instruction and in-person or community-based labs. This may include more industry engagement to verify skills and assess competencies.
3. **Advanced:** Accessing the most cutting-edge technology and integrating virtual reality to explore facets of the program historically only available in a real-world, applied setting. These simulated environments range from automotive technology and welding to the health sciences and can provide unprecedented access for both students and faculty to expand their skills.

Programs that have fared the best over the past several months have often been those taught by instructors who had already integrated technology into their classroom. Learning management systems such as Canvas, which California has already adopted, are a meaningful first step in ensuring all instructors are well equipped to take their programs into a remote environment. However, the availability of technology does not mean all CE instructors have uniformly embraced this resource. We would encourage the consortium to continue its focus on Canvas professional development and training, as well as deeply engaging them in the decision-making process about which vendors best meet their needs.

Several entities have created free resources for faculty and staff:

- [CTE Learn](#)

- [Best Practices for Returning CTE Programs in Fall 2020](#)
- [North Dakota Online Resources for Educators](#)

Given the ongoing uncertainty during the pandemic, it would be short-sighted for both institutions and instructors to develop strategies that only address the upcoming semester or school year. Rather, institutions should actively pursue “pushing the envelope” and begin exploring tools and resources that could become a permanent component of their programs. The following questions may help facilitate a more open dialogue about feasibility and sustainability:

- When navigating decisions regarding face-to-face labs, software platforms to use, and which items to include in kits that are distributed to students, who and by what process should these decisions be made? Should vendors be standardized among and between institutions?
- To what extent can colleges expand their use of work-based learning with essential businesses in the community, so that students can complete their hands-on lab work at these businesses and use industry experts to verify skill attainment?
- What funding can colleges consistently dedicate to CE to cover additional resources that are needed now that were not needed before the pandemic?
- What can be done to lighten faculty workload and/or compensate them for their additional effort during this time of transition?
- To what extent can colleges realign duties among instructors within specific programs? How can we build on the existing strengths of staff to help maximize the student experience?
- What types of supports can be provided to students who are struggling with distance learning? How can we ensure equity and best support special populations?¹⁷

¹⁷“When the Crisis Is Over: Becoming Student-Ready in Post-Pandemic Higher Education,” Student-Ready Strategies, accessed July 31, 2020, <https://static1.squarespace.com/static/5c8be57190f90442d34c30c4/t/5e95f3a5bf791f4fb83a0d84/158688553565/COVID+Report.pdf>.

Appendix D: Comprehensive Appendix of Online Resources and Tools

These are resources for career development, employability skill development, project management, industry engagement and other topics that can be integrated into most CE subject areas.

Skills to Succeed Academy is an online multimedia experience for student career planning, exploration and employability skill development (Accenture): <https://www.acteonline.org/s2s/>

- To access free modules, visit <http://s2sacademy.org> and register with ACTE Student Code 04ATgl and ACTE Staff Code 04ATgl9999 (this provides additional resources just for teachers and advisers)

CareerPrepped lifelong career success system with virtual work-based learning activities and multi-media learning experiences addresses 43 “soft skills,” including a digital portfolio, targeted resume builder, interview preparation videos and a job center (Max Knowledge):

<https://www.ctelearn.org/careerprepped>

- CareerPrepped is free for ACTE Members, including members of ACTE’s Unified State Association Partners, through the generous support of MaxKnowledge, Inc.

The Center for Global Education at Asia Society, ACTE and Advance CTE offers career planning tools that address career pathways and employability skills in the global economy

<https://asiasociety.org/education/career-planning-tools>

- All materials are available completely free-of-charge thanks to generous support from the Project Management Institute Educational Foundation. For more information, contact Heather Singmaster (hsingmaster@asiasociety.org).

eDynamic Learning offers free activities and resources for career discovery:

<https://edynamiclearning.com/category/activity> and <https://edynamiclearning.com/career-compass>

CareerExplorer virtual career exploration, work-based learning and early learner solutions for states: <https://headed2.com>

- Headed2 is making its virtual career planning resource available for all 50 states and Puerto Rico at no cost through the end of this academic year.

SkillsUSA Career Essentials: <https://www.skillsusa.org/complimentary-access-skillsusa-career-essentials>

- SkillsUSA is providing complimentary access to Career Essentials for a limited quantity of students.

Microburst EmployABILITY Soft Skills Program and distance learning resources:

- The EmployABILITY Soft Skills Program is now virtually accessible for all levels. Contact Microburst Learning for more information: 803-719-5073, chat at <https://www.microburstlearning.com/ess/support.html> or email info@microburstlearning.com.

- Microburst is also offering free soft skills content for distance learning, including an activity to help students develop their planning and organizing skills and the “Why Soft Skills” Lesson: https://microburstlearning.com/ess/TimeAway/story_html5

EnvisionIT provides free college and career readiness curriculum addressing career readiness/transition planning, IT literacy, reading/writing and financial literacy:

<https://nisonger.osu.edu/research/envision-it/what-is-envisionit>

Soft Skills High is a virtual solution for teaching, assessing and certifying students in 21st century essential skills: <https://www.softskillshigh.com>

- At this time, Soft Skills High is offering a free online teacher training program to support building best practices for soft skills instruction. Learn more and sign up at <https://www.softskillshigh.com/lp.php>

Emerge with Rubin online training for business communication skills (Danny Rubin):

- To access 11 free assignments from the Emerge with Rubin online program, complete the form at <https://danny50f1e1.clickfunnels.com/squeeze-page1584126067584>

Talking Safety online workplace safety curriculum (NIOSH and NOCTI):

https://www.nocti.org/niosh/Niosh_Flyer_2016-web.pdf

PMIEF Fundamentals of Project Management online assessment and resource library:

https://www.nocti.org/pdf/pmief/PMIEF_FLYER.pdf and

https://pmief.org/library/resources?utm_source=COVID%20Bar%20Resources%20Page

Nebraska Career Clusters virtual industry tours: <https://www.nebraskacareerclusters.com>

ConnectED Day at Work Videos: https://connectedstudios.org/life_videos

Careers in the Military (ASVAB CEP): <https://www.careersinthemilitary.com/home>

FabFems database of women in STEM professions who are inspiring role models for young women: <https://www.fabfems.org>

CTSO Virtual Conference Tips and Tricks (Jen Girvin, Colorado FBLA-PBL State Adviser, and Kent Seuferer, Iowa CTSO State Adviser): <https://youtu.be/acPEbjJo8sQ>

Multidisciplinary Resources

These are resources for discipline-specific curriculum and assessments across multiple CE subject areas.

- The CE Distance Learning weekly publication, created by the California Department of Education’s Career and College Transition Division in partnership with ACTE, CTEOnline.org and the San Diego County Office of Education’s Office of College and Career Readiness, highlighted sector-specific lesson plans, webinars and resources for spring 2020:
<https://www.acteonline.org/lesson-plan-resources>
- Today’s Class online curriculum in Agriculture, Automotive/Diesel Technology, Barbering, Cosmetology, Health Science and Workplace Readiness: <https://www.todaysclass.com>
- NOCTI Digital Study Guides and Credentialing Assessments:
 - For schools and states who had already purchased digital study guides for this year, expirations are extended until June 30, 2021.
 - For schools and states that would like to purchase digital study guides that had not purchased either in the past, contact nocti@nocti.org.
 - All expiration dates for NOCTI credentialing assessments that have not been utilized for 2020 will be extended to June 30, 2021, at no charge.
- Certiport CTE Learning Products and Practice Tests:
 - For U.S. schools experiencing difficulties due to COVID–19 and closed campuses, Certiport and their valued learning partners are offering free 90-day trials of distance learning products: <https://gocertiport.pearsonvue.com/learning-product-trial>
 - Certiport has developed a home-based assessment solution using virtual machines that allows for administered exams that test candidates can take from home until December 31, 2020: <http://www.certiport.com/examsfromhome>
- Cengage digital platforms and ebooks: <https://www.cengage.com/covid-19-support>
- Goodheart-Wilcox Learning Companion digital curriculum and activities: <https://www.g-wlearning.com>
- iCEV online curriculum and distance learning resources: <https://www.icevonline.com/distance-learning#ctec>
 - Online Tools for 7 CTE Subject Areas. To learn more, fill out the form at the link above.
- Realityworks free lesson plans, webinars about delivering Realityworks curriculum online: <https://www.realityworks.com/our-partnership-with-educators>
- Nasco lesson plans and activities in STEM, FCS and Health Education: https://www.enasco.com/lessonplans?ic_source=prepare&ic_creative=GlobalNavLink&ic_id=LessonPlans-1119
- Educate.Today free videos and tools in a variety of CTE subject areas: <https://educate.today>
 - Career Exploration category includes Business/Industry, Health/Sports, Law/Criminology, Education, Media Fields, Public Service/Government and more
 - STEM/STEAM category includes Robotics, Engineering, Infrastructure, Aviation, Transportation and more

- National Academy Foundation resources and curriculum for IT, Finance, Health Sciences, Hospitality & Tourism and Engineering/STEM: <https://naf.org/resources-for-making-an-effective-switch-to-remote-teaching>
- CTE Online free teacher-created curriculum resources: <https://www.cteonline.org>
 - CTE Online is curating lessons, projects and resources for all 15 industry sectors in the CTE Distance Learning Group at <https://www.cteonline.org/groups/view/CTEDLR>. Users will need to log-in or sign up for a free account to access.
- Career Cluster-specific lesson ideas, online curriculum and online certifications (curated by the Career & Technical Association of Texas):
<https://docs.google.com/spreadsheets/d/1gdf2Rw6gu2icdUTW3OSIy1jFjsUzImwXltVsAHhVExs/edit?usp=sharing>
- Shared drive of lesson plans in construction, woodworking, welding, agriculture, photography, video production, automotive, and other subjects developed by two technology teachers from Southeast Kansas: Email tmaiseroulle@vikingnet.net, using an email address connected to a Google account.
- MIT Open Courseware in STEM, Business and Health and Medicine:
<https://ocw.mit.edu/courses/find-by-topic>
- Quizizz free online quizzes in CTE, Computer Science and Skills, and Health:
<https://quizizz.com/admin>
- Described and Captioned Media Program free educational videos for learners with visual and hearing impairments (U.S. Department of Education): <https://dcmp.org>
 - Click on “Browse Topics” to find relevant videos
 - Business topic includes Agriculture, Construction, Energy, Industry, Management and Manufacturing
 - Careers topic includes Automotive Maintenance and Repair, Industrial Arts, Welding, Job Skills and Occupations
 - Home and Family topic includes Carpentry, House Construction, Cooking and Child Development
 - Health and Safety topic
 - Technology topic
- CTE Coalition: Industry Dedicated to Keeping CTE Moving: <https://ctecoalition.com>
 - The CTE Coalition is a group of world-class industry partners and CTE organizations who have partnered to provide the resources necessary to keep CTE programs moving forward in these unprecedented times.

Electrical Engineering, Technology, and IT

General/Cross disciplinary Resources

- Project Lead the Way (PLTW):
 - PLTW distance learning resources: <https://www.pltw.org/pltw-covid-19-resources>
 - PLTW is pausing school grant reporting requirements for 2019-20 programs: <https://www.pltw.org/news/still-working-to-serve-you>
- COVID-19 teacher resources for technology and engineering education (International Technology and Engineering Educators Association): <https://www.iteea.org/Resources1507/covid.aspx>
- Open P-TECH free digital learning: <https://www.ptech.org/open-p-tech>

Networking/Robotics/Engineering

- CompTIA ITFundamentals + CertMaster, voucher extensions, remote testing options and Instructor Network webinars:
 - ITFundamentals+ CertMaster is now available for free: <https://www.comptia.org/home>
 - Online testing: <https://www.comptia.org/testing/testing-options/take-online-exam>
 - CompTIA Instructor Network on-demand webinars can be viewed at <https://bit.ly/CIN-VirtualClassroomTips>
- Cisco e-learning resources and online testing:
 - Networking Academy Packet Tracer free networking simulation tool: <https://www.netacad.com/courses/packet-tracer>
 - Cisco DevNet Sandbox free tools for development and testing: <https://developer.cisco.com/docs/sandbox>
 - Online testing for Cisco certification exams: <https://www.cisco.com/c/en/us/training-events/training-certifications/online-exam-proctoring.html>
 - NDG was sponsoring Linux I and Linux II for Cisco Networking Academies until June 1: https://www.netdevgroup.com/online/content/linux/learn_linux_free.html
- C-STEM Studio free platform in computing and robotics (UC Davis): <https://c-stem.ucdavis.edu/studio>
- VEX Robotics Support for Teachers During the COVID-19 Outbreak: <https://blog.vex.com/2020/03/20/support-for-teachers-during-the-covid-19-outbreak>
- NASA Robotics Alliance Project: <https://robotics.nasa.gov/edu/educators.php>
- Carnegie Mellon Robotics Academy: <https://www.cmu.edu/roboticsacademy>
- FIRST Robotics @ Home: <https://www.firstinspires.org/community/home-learning>
- Kiss Institute Practical Robotics free supplemental curriculum: <https://www.kipr.org/response>
- EngineerGirl career exploration and videos about women in engineering: <https://www.engineergirl.org>
- James Dyson Foundation free engineering curriculum: <https://www.jamesdysonfoundation.com/resources/engineering-box.html>

- IEEE resources:
 - REACH open education resource on the history of technology, its role in society and technological literacy skills: <https://reach.ieee.org>
 - Try Engineering eLearning Resources: <https://tryengineering.org/teachers/tryengineering-covid-19-response-elearning-resources>
 - Robots: <https://robots.ieee.org>
 - Future Engineers online STEM/STEAM challenges: <https://www.futureengineers.org>
- EDISON gamified engineering design software: <https://www.parametricstudioinc.com/edison-software>
- National Cybersecurity Training and Education Center resources: <https://www.ncyte.net>

CAD/CAM/3D Printing/Makerspaces

- Festo Didactic eLearning offers: <https://www.festo-didactic.com/int-en/news/our-current-elearning-offers.htm>
 - eLearning courses in the Festo Classroom Manager: This special offer includes all available eLearning courses from Festo Didactic (33 courses) and entitles you to use them for 3 months.
 - eLearning courses as SCORM packages: This offer includes a limited use of the eLearning course in a Learning Management System until 31 October 2020.
- ToolingU-SME free program bundles: <https://www.toolingu.com/Resources/Blog/March-2020/CTE-Support-Resources-Available>
 - Each CTE student is eligible to one free bundle of classes.
 - Fundamental Manufacturing Processes video series: <https://www.youtube.com/playlist?list=PL3AFB507B668AF162>
- SolidWorks free resource download: https://www.solidworks.com/sw/education/SDL_form.html
 - Use SDK_ID: TCOVID19 and choose the current SolidWorks version
 - During the download process you will receive an email with the 24-character serial number needed to install and activate.
 - Students can use an online version of SolidWorks for 10 hours by visiting my.solidworks.com and clicking on “Try SolidWorks” at the top of the page, then “Sign Up.”
- Autodesk free software, content and curriculum: <https://www.autodesk.com/education/covid19>
 - Free software: Autodesk has granted access to its tools to students and educators for the past five years with no charge. This remains unchanged. Please visit www.autodesk.com/education to get started.
 - Free content & curriculum: Autodesk has packaged content for educators to support distance learning efforts and self-paced training for students. Visit <https://academy.autodesk.com/> to find resources.

- Fusion 360 free 3D CAD/CAM design software:
<http://www.autodesk.com/products/fusion-360/students-teachers-educators>
- Tinkercad free online collection of software tools: <https://www.tinkercad.com/circuits>
- SketchUp 3D modeling software: <https://www.sketchup.com/products/sketchup-for-schools>
 - SketchUp for Schools will be available to everyone through September 30 without the previous requirement of a school subscribing to Google Apps for Education or Microsoft Education platforms.
- Onshape SaaS CAD solution: <https://www.onshape.com/cad-blog/ptcs-commitment-to-you-our-customers-during-covid-19>
 - PTC is making freely available its Onshape SaaS CAD solution, plus the associated learning resources, to high schools and universities that wish to offer collaborative virtual STEM and 3D CAD classes to students learning at home, on their own devices. Please contact PTC Academic at www.ptc.com/en/academic-program/contact-us if there is a school you would like us to engage.
- camInstructor: <https://share.hsforms.com/1vMICfJtsTdOdFNI6nMjqFA2bydq>
 - camInstructor is providing online access to instructors and students to our Mastercam Mill 2D, 3D, Lathe and Solids training material for a period of 30 days free of charge.
- Fab@School Maker Studio web-based design and fabrication tool:
<https://www.fablevisionlearning.com/giftforteachers>
- Makers Empire Learning at Home resources: <https://www.makersempire.com/learning-at-home-coronavirus-covid-19-new-resources-teachers-parents>
- DIY library of hands-on projects for kids: <https://diy.org>
- MakerBot:
 - 3D printing initiatives to combat COVID-19:
<https://www.makerbot.com/stories/professional-3d-printing-resources/makerbot-3d-printing-initiative-to-combat-covid-19>
 - Student Certification Classroom Solution at a significant discount:
<https://pages.makerbot.com/20certificationonline.html>

Coding

- WeTeach_CS: https://www.tacc.utexas.edu/-/weteach_cs-resources-for-online-instruction
 - The WeTeach_CS channel on YouTube.com contains over 200 videos related to computer science learning concepts and skills.
- Girls Who Code At Home free activities: <https://girlswhocode.com/code-at-home>
- Beauty and Joy of Computing: an AP CS Principles course (University of California, Berkeley and Education Development Center, Inc.): <https://bjc.edc.org>
- Code Break interactive computer science classroom with weekly challenges to engage students of all abilities, even those without computers: <https://code.org/break>
- Carnegie Mellon Computer Science Academy free high school CS curriculum:
<https://academy.cs.cmu.edu/coronavirus2020>
- MIT App Inventor: <http://appinventor.mit.edu>

- Hour of Code tutorials: <https://codehs.com/hourofcode>
- CompuScholar online classes: <https://www.compuscholar.com/schools/news/2020/03/16/free-access-for-schools-closed-by-coronavirus>

General STEM Resources

- Learning Blade STEM resources for remote/at-home use: <http://www.learningblade.com/remote>
- STEM in 30 and Smithsonian Learning Lab (Smithsonian Institution): <https://airandspace.si.edu/connect/stem-30> and <https://learninglab.si.edu/distancelearning>
- PBS Learning Media: Engineering and Technology (PBS): <https://www.pbslearningmedia.org/subjects/engineering-technology/>
- NOVA Energy Lab and Cybersecurity Lab games (PBS): <https://www.pbs.org/wgbh/nova/labs>
- Resource library (National Geographic): <https://www.nationalgeographic.org/education/resource-library>
- Flinn Scientific STEM activities and video labs: <https://www.flinnsci.com/athomescience>
- Colorado STEM Network: <https://sites.google.com/view/colorado-stem-network>

Additional Resources

- All About Circuits free video lectures: <https://www.allaboutcircuits.com/video-lectures>
- Esri ArcGIS mapping software: <https://www.esri.com/en-us/landing-page/industry/education/2020/gis-cte>
 - The ArcGIS for Schools Bundle is available at no cost for classroom instruction.
- The University of Texas at Austin’s Petroleum Extension (PETEX®) e-learning: <https://petex.utexas.edu/about/news/661-covid-19-response-petex-e-learning-resources-for-educators>
 - PETEX® will be making all e-learning available online at no charge to all public high schools and community colleges for the remainder of the Spring 2020 and Summer 2020 semesters. For these high schools and community colleges, PETEX® has reduced its technology costs to only require a one-time \$10 per student setup fee.
- Aviation 101 free, self-paced course (Embry-Riddle Aeronautical University): <https://news.erau.edu/headlines/as-many-schools-close-embry-riddle-offers-free-online-courses-for-k-12-students>
- CSI: The Experience Web Adventures (Rice University): <http://forensics.rice.edu>
- Resources for Online Biosciences Learning (Amgen Biotech Experience): <https://www.amgenbiotechexperience.com/resources-online-biosciences-learning> and https://docs.google.com/spreadsheets/d/1C0YbCFLQc8pgG5_z-ts9rvgM3PscQmLU76Hj2w3bTWc/edit#gid=1728867575
- Energy.gov Online Learning Resources: <https://www.energy.gov/kindergarten-through-high-school>
- What’s in a Label? Exploring Fuel Economy and the Environment lesson (EPA): <https://www.epa.gov/sites/production/files/documents/fueleconomyhighschool.pdf>

- Green Careers Webinar Series with sustainability professionals (SEI Energize Careers):
<https://www.energizeschools.org/distancelearning.html#greencareers>
- Path to Aviation pilot and teacher handbook (Aircraft Owners and Pilots Association):
<https://www.aopa.org/-/media/Files/AOPA/Home/News/All%20News/2009/Teachers%20take%20notes%20from%20pilots%20at%20AirVenture/path.pdf>

Appendix E: List of Interviewees

The list below is a summary of the wide range of CE experts (n=37+) consulted throughout this study representing 13 states and hundreds of institutions:

- Linda Romano, Board Member, Association for Career and Technical Education (ACTE), Health Science Education Division Vice President, Health Science Educator, Newburgh Enlarged City School District – Newburgh, New York
- Patrick Biggerstaff, Board Member, Association for Career and Technical Education (ACTE), Administration Division Vice President, Director of Career and Technical & Adult Education, Ben Davis High School – Indianapolis, Indiana
- Tammy Vanthul, Dean, Nursing for Riverside City College – Riverside, California
- Michael Connet, Associate Deputy Executive Director – Outreach and Partnership Development, Association for Career and Technical Education (ACTE) – Alexandria, Virginia
- Tom Washburn, Executive Director, Law & Public Safety Education Network – Milton, Georgia, Retired Educator
- Jesse Lopez, Dean of Business, Technical Careers, & Workforce Initiatives, San Diego Miramar College – San Diego, California
- Bill O’Neil – Instructor, Industrial Electrical Technology, Mechatronics-Industrial Automation, Chaffey College – Rancho Cucamonga, California
- John Pax – Instructor, Automation, Sinclair Community College – Dayton, Ohio
- Douglas Redman – Instructor, Automotive Tech, College of the Desert – Palm Desert, California
- Sanja Keller – Program Director, Respiratory Care, Sinclair Community College – Dayton, Ohio
- Nick Weldy – Superintendent/CEO, Miami Valley Career Technology Center – Englewood, Ohio
- Glen Graham – Instructor, Electronics/Electrician, Norco College – Norco, California
- Tim Baber – Welding Technology Chair, College of the Canyons – Santa Clarita, California
- Cecilia Bidigare – Professor of Nursing/Co-Director Health Sciences Simulation Center, Sinclair Community College – Dayton, Ohio
- Kenny Melancon – Instructor, Diesel Automotive, San Bernardino Valley College – San Bernardino, California
- Dan Sullivan - Instructor, Fire Technology, Crafton Hills College - Yucaipa, California
- Mariano Rubio – Instructor, Auto and Heavy Truck, Citrus College – Glendora, California
- Dr. Jason Parks - Dean of Instruction for CTE, Norco College - Norco, California
- Carole Lindsey – Instructor, Welding (for AG), Norco High School – Norco, California
- Richelle Krumsiek - Instructor, Pre-engineering, Tulsa Tech – Tulsa, Oklahoma
- Larry Engelbrecht - Advisory Committee Member for California Energy Commission's Clean Transportation Program - California
- Kimberly Green - Executive Director, Advance CTE - Maryland
- Larisa Schelkin, CEO, President & Founder, Global STEM Education Center, Inc
- Dr. Al Solano, Founder & Coach, Continuous Learning Institute
- Elizabeth Bolden, Pennsylvania Commission for Community Colleges
- Joe Ray - Director of Sales/Marketing - Southwest, Klein Educational Systems

- Rick Radcliffe - Sales Consultant - Southern California, Klein Educational Systems
- Rodney Farrington, Lewis- Clark State College (Culinary)
- Clay Wilke, College of Southern Idaho (Welding)
- Dawood Sultan, Mercer (Health Professions)
- Steve Klein, Education Northwest
- Wayde Sick, CTE Director, North Dakota
- Robin Bagent, College of Southern Idaho
- Mac Beaton, Henrico School District, Virginia
- Pradeep Kotamraju Ph.D., Director, Career and College Transition Division, California Department of Education
- Tamika Connor, Calbright

Individuals interviewed shared perspectives from the following states:

- California
- Georgia
- Idaho
- Indiana
- Maryland
- New York
- North Dakota
- Ohio
- Oklahoma
- Oregon
- Pennsylvania
- Texas
- Virginia