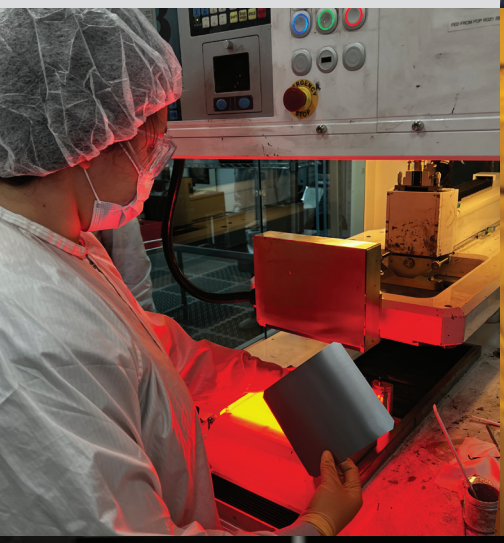
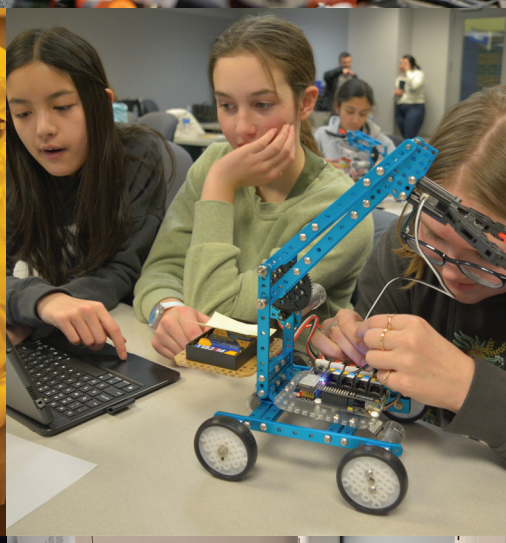
ADVANCED TECHNOLOGICAL EDUCATION

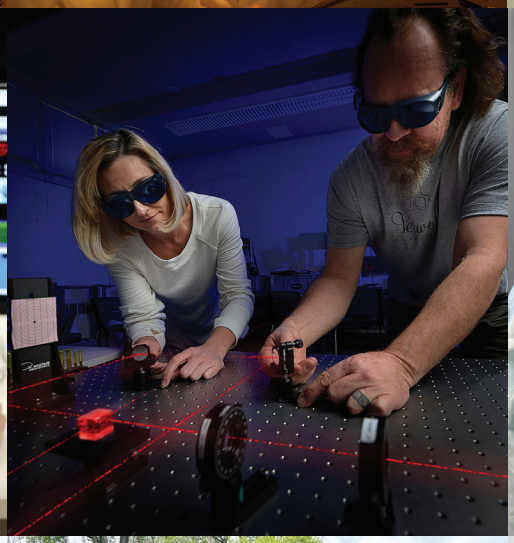
IMPACTS

Thirty Years of Advancing Technician Education

ATE @30



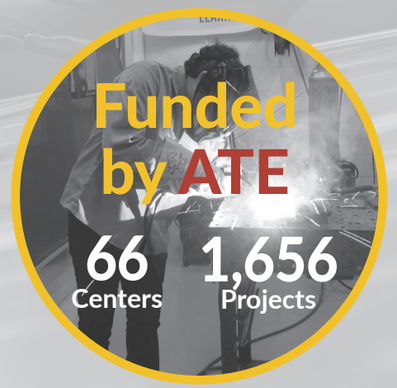




NSF

Thirty Years of Advanced Technological Education

Building a Skilled Technical Workforce



October 1992 Congress passes Scientific and Advanced Technology Act, Public Law 102-476, known as SATA. President George H.W. Bush signs it on October 23.

1993
- NSF plans Advanced Technological Education (ATE) Program based on SATA.
- National Science Board approves ATE program.
- Formal announcement appears in Federal Register in August.
- Preliminary proposals and planning grants are due in November.

1991 Price re-introduces legislation; Maryland Senator Barbara Mikulski introduces a companion bill.

1989 North Carolina Congressman David Price introduces Science and Technology Literacy Act legislation.

1994 NSF funds 3 centers, 16 planning grants, 39 projects.

October 27, 1994 The American Association of Community Colleges convenes first ATE Principal Investigators' Conference.

From 1993 to 2023, 765 institutions and organizations received ATE awards. Some institutions received a single project, center, or research grant, while other institutions have received multiple awards.

2020 ATE grantees mobilize in response to the COVID pandemic with innovations that sustain STEM education programs.

2022 Congress reauthorizes the ATE program.

1980 1989 1990 1991 1992 1993 1994 1995 1998 2001 2004 2007 2013 2017 2018 2019 2020 2021 2022 2023 2024

Early 1980s The American Association of Junior and Community Colleges (now the American Association of Community Colleges) advocates for two-year colleges to receive more NSF funding. Pennsylvania Congressman Doug Walgren introduces legislation to increase NSF grants to two-year colleges.

FY 94 $13.4 million

FY 95 $23 million

FY 98 $31 million

1998 11 centers, 158 projects

2001 Regional centers begin.

FY 04 $45 million

FY 07 $47.2 million 247 active grants

FY 13 $64 million 292 active grants

FY 17 $66 million 306 active grants

FY 23 $76 million 368 active grants

Sources: National Science Foundation, American Association of Community Colleges, EvaluATE, and ATE Central

National Science Foundation

Our nation's economy, security, and prosperity are driven by advances in innovation and technology. We rely on a robust, technologically capable workforce to strengthen our competitiveness, power new advances, and enhance how research breakthroughs can support people and communities across the nation. I am excited to share the extraordinary work of the US National Science Foundation's (NSF) Advanced Technological Education (ATE) program and the ATE-supported projects and centers featured in this 30th anniversary edition of *ATE Impacts*.

This publication showcases the work of some outstanding grantees, just a snapshot of the thousands of fantastic ATE projects that have prepared students for advanced technology careers since 1994. Over thirty years, this program has grown and evolved along with technology to prepare students from across the country for successful technical careers in an array of rapidly evolving technical industries.

NSF is proud to support each new generation of technicians, engineers, educators, researchers, and innovators—the people at the heart of our nation's science, technology, engineering, and mathematics (STEM) workforce. A diverse and capable workforce is vital to maintaining the nation's standard of excellence in STEM and the ATE program is an important contributor to our ongoing progress. With its focus on two-year community and technical colleges, the ATE program advances NSF's commitment to enabling "Innovation Anywhere and Opportunity Everywhere" and strengthening the nation's position at the forefront of competitiveness by broadly engaging STEM talent from across the whole range of the nation's demographic and geographic diversity.

The ATE program exemplifies the power of partnerships. Each ATE project and center works in collaboration with industry or other education sectors to achieve its goals. ATE is a wonderful example of what happens when we bring together creative educators with timely ideas, enterprising partners, and infrastructure that supports innovation and opportunities for career development. NSF is proud to support the efforts of two-year institutions, their programs, and their students through ATE funding.

ATE Impacts captures the essence of this critical program and is intended to inspire even more participation. If you are part of the ATE community, thank you and congratulations on the critical work that you and your teammates are doing. If you are not involved in the initiative, I hope you will explore ATE resources, consider partnering with an ATE project or center, or submit a proposal to improve technological education and become part of this thriving community.

So much amazing work has been done during the past 30 years of Advanced Technological Education. We look forward to the next three decades of success—at speed and scale!

Sincerely,

Sethuraman Panchanathan
Director, National Science Foundation

2415 Eisenhower Ave
Alexandria, VA 22314

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Introduction

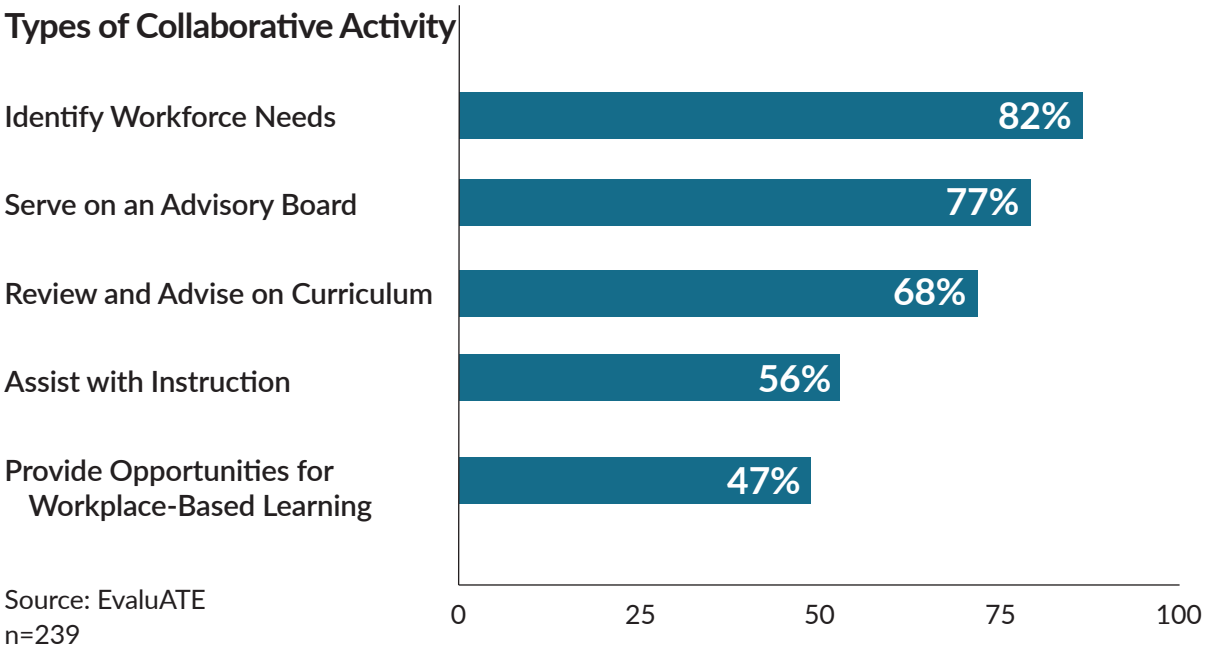
ATE: Thirty Years of Innovation & Impacts

For 30 years the National Science Foundation's Advanced Technological Education (ATE) program has been strengthening the knowledge and skills of technicians who perform critical tasks in high-tech workplaces. The quality of these technicians' work is a crucial component in ensuring productivity for the fields that drive our nation's economy.

"I can't think of a single industry where technology is not impacting the knowledge, skills, and abilities that technicians need," V. Celeste Carter, the lead program director of ATE at the National Science Foundation, said during the CCPI-STEM Thought Leaders' Dialogue in 2023.

Statistics from the National Science Board, which governs the National Science Foundation (NSF), bear this out. In its *State of US Science and Engineering 2022* publication the board reported that there are 20 million workers in the skilled technical workforce who do not have bachelor's degrees compared with 16 million people with at least a bachelor's degree in the US science, technology, engineering, and math (STEM) workforce.

ATE Collaborations with Business & Industry in 2022



Source: EvaluATE
n=239

In the 2023 ATE annual survey, 80% of 298 ATE initiatives reported having a collaboration with business or industry during 2022. The types of collaborations those 239 initiatives engaged in are detailed above. More than half of the 298 ATE initiatives also reported having colloborations with two- or four-year colleges as well as K-12 schools or school systems. Collaborations within the host institution, with other colleges, and public agencies are among the other types of collaborators the survey respondents listed.

Attracting Bipartisan Support

The ATE program was launched in 1993 by NSF in response to the Scientific and Advanced Technology Act, passed by Congress in 1992 and signed by President George H.W. Bush. The first of ATE's competitive grants were awarded in 1994. Over the past three decades the ATE program has grown and evolved with bipartisan support to meet the needs of students and high-tech employers.

Rosalyn Hobson Hargrave, division director of NSF's Division of Undergraduate Education, noted at the 2023 ATE Principal Investigators' Conference that the ATE program is the division's longest-running program. "It has staying power because it is significant. It is important. And we value the role that ATE plays in our entire portfolio. I think one of the amazing things about the ATE program is it embodies partnerships—and partnerships between industry, between education, between nonprofits. It is those partnerships that strengthen our educational experiences," Hargrave said.

Another unique aspect of the ATE program is that two-year college educators have leadership roles in ATE initiatives, which are essentially tests of faculty-driven ideas for improving multiple aspects of technician education.

Addressing Emerging Industry Workforce Needs

This publication, *ATE Impacts 2024-2025*, highlights an array of dynamic projects and centers, their key activities, and their outcomes.

In the micro- and nanotechnology section of the book on pages 94 to 105 readers are introduced to the multifaceted collaborations developed by ATE micro- and nanotechnology centers and projects. These build on ATE initiatives' individual and collective strengths to increase the use of the innovative curricula and instructional materials developed during the past two decades with ATE grants.

In the less well known but strategically important field of photonics, the Center for Laser and Fiber Optics Education (LASER-TEC) on pages 52 to 53 leads the way with curricula that are used in all 31 US colleges with optics and photonics programs.

The ATE program is also blazing new ground in the emerging field of quantum science. The EdQuantum project on page 61 has developed courses that introduce this complex subject to two-year college students via an open-access platform. This approach aims to add

Researchers Examine Economic Development Impact of ATE Program

Researchers at Rutgers University used an ATE research grant to study the economic impact of the NSF ATE program. One of the project's publications, a case study of four ATE centers, reports that all four centers:

- engage in education to prepare technicians for employment in industry sectors important to their regions;
- offer pathways from elementary schools to and through community college certificate and associate degree programs, with intentional connections to baccalaureate programs and beyond;
- embed credentials within articulated curricula to prepare technicians with knowledge and skills needed to be productive in their respective fields; and
- offer support for businesses operating statewide or in regions of their states.

"Regional engagement involving education, employers, government, and other stakeholders was ubiquitous to all of the ATE grantees," the researchers stated in *Lessons in Community Colleges Economic Development from NSF ATE*.

diversity to the skilled technical workforce, reduce geographic barriers, remove social barriers, foster equal economic growth across the nation, and help ensure US leadership in this emerging field.

The increasing and varied needs for technicians to support electric vehicle manufacturing, maintenance, and charging infrastructure is the focus of several projects. Among these is the National Electric Vehicle Consortium (NEVC) on page 63, which facilitates national collaborations across all electric vehicle (EV) sectors and development of standards for both industry and academic certificates.

The ATE program flexes to support national and regional industries, and this particularly stands out in biotechnology. InnovATEBIO, the National Biotechnology Education Center on pages 40 and 41, offers 40 different degrees through its national network of community college programs. Center leaders also encourage biotech educators to work with employers on state-based collaborations and through the center's cross-sector hubs.

Meanwhile the Cell Therapy Workforce project on page 43 created the nation's first community college program to prepare entry-level technicians to do flow cytometry, an analytical tool previously only used in research labs by people with graduate degrees.

Reaching Historically Underrepresented Populations

Many ATE initiatives focus on recruiting populations historically underrepresented in STEM to pursue technical careers. Helping these students complete credentials is an integral part of ATE.

The Women Reinvigorating Industry Support and Empowerment (Women RISE) project on page 91, for instance, empowers women to pursue and persist in high-tech fields of study, including artificial intelligence, cloud computing, cybersecurity, the Internet of Things, and data analytics.

The Microelectronics and Nanomanufacturing Veterans Partnership (MNVP) on page 104 teaches veterans semiconductor-related skills that give them entrée to this high-demand field.

The National Cybersecurity Training and Education Center (NCyTE) on pages 84 to 85 began the Community of Practice Circle for tribal community colleges in late 2023. This initiative is co-sponsored by Microsoft and is in collaboration with Advancing Indigenous People in STEM.

The Technician Education Readiness Pathway (ASTERP) on page 26 adapted the guitar-building lessons created by another ATE project to link mathematics and English skills in ways that spark the interest of students in American Samoa.

The Appalachian Solutions in Cybersecurity Innovation Initiative (ASCII) on page 86 developed a robust pathway to cybersecurity careers from rural secondary schools to associate degree programs that prepare students to work as penetration testers, information security engineers, digital forensics analysts, and information security analysts.

Developing New Programs for Unmet Needs

ATE grantees are expected to respond to unmet needs in their areas of expertise. The book features two examples of ATE centers' creative efforts to address the needs of key audiences—one that needs additional education to start a career and another that needs additional education to teach specialized skills.

DeafTEC, the Technological Education Center for Deaf and Hard-of-Hearing Students, on pages 68 to 69 partnered with CompTIA to provide a 10-week boot camp on computer repair and maintenance to non-matriculated deaf and hard-of-hearing individuals. During the camp participants are introduced to degree options and prepared for an industry certification exam that can lead to employment. (For more information about ATE accessibility efforts, see page 10.)

The National Geospatial Technology Center of Excellence, known as GeoTech, on pages 80 to 81 has developed the Geospatial Education Certification (GeoEdC). It is for educators who need credentials to teach about rapidly changing geospatial technologies, which do not fit in to most traditional educator preparation programs. GeoEdC captures both contextual and pedagogical knowledge in the geospatial technologies curriculum for educators.

Building Community & Supporting Growth

The ATE program also provides mentoring programs and cross-cutting projects to support grantee teams in their NSF-funded work. These various initiatives aim to amplify the work of grantees, help them expand their programs and strengthen their partnerships, encourage them to engage a larger, more diverse student body, and grow their own leadership and professional skill sets.

As you read *ATE Impacts 2024-2025*, we hope that it leads you to discover new ideas, find potential collaborators, spark innovations, and build connections in the way that the ATE program has assisted educators across the country for the last 30 years.

Participants put the finishing touches on a solar energy installation during a Center for Renewable Energy Advanced Technological Education's (CREATE) Faculty Energy Institute. (See page 30)

ATE Impacts Videos

https://ateimpacts.net/videos

Two-year community and technical colleges serve as critical places of learning for the skilled technical workforce. The text, photos, and data in the *ATE Impacts* book shine a spotlight on the innovative work being done by the faculty and staff at these institutions in collaboration with business, industry, and other partners.

The *ATE Impacts* book is complemented by a series of videos produced in partnership with Vox Television. These videos feature ATE community members—including industry partners, administrators, educators, and students—who explain the positive impact the ATE program has had on their lives.

Yeni Martinez
Agronomist
Betteravia Farms
Allan Hancock College Graduate
Santa Maria, CA

"What I love about it is that I make the calls. When I'm working in a field, I decide what to do and what not to do ... It's a better-paying job than working at minimum wage. It gives me stability in life and it's something I enjoy doing. So I don't wake up in the morning like, 'Oh, I don't want to go to work today.' It's like, 'Okay, let's get started!'"

Luke Barnett
Chief Science Officer & CEO
KeraNetics, Inc
Winston-Salem, NC

"The educational system in the US is the best in the world because we put resources into it, both in the medical space and the tech sectors. And NSF has been a leader in a lot of that ... It takes everyone. It's an ecosystem, it really is. And if one cog in that wheel doesn't work, the whole system doesn't work. It's been rewarding to be a part of this and watch Winston-Salem grow from an old tobacco and textile town to biotech and high tech and education and the kind of things that we're starting to be known for now."

ATE Impacts Videos

https://ateimpacts.net/videos

Jacki Klancher
Professor of Environmental Science and Health
Director of Instruction and Research at the Alpine Science Institute
Central Wyoming College
Lander, WY

"I think the ATE program has had a magnificent impact on student success, student recruitment, student retention, and attracting a more diverse student audience to our programs. And I'm really proud to be able to offer something that's so practical that you can apply it with a two-year degree or you can build on it and take it where you want to. I feel great satisfaction that when they leave at the end of the summer, their pockets won't be empty and their minds will be full."

Thomas Singer
Professor Emeritus
Mechanical Engineering Technology
Sinclair Community College
Dayton, OH

"In the 1990s, learning went all collegiate and the only way to succeed was that you had to have a baccalaureate four-year degree. But in reality, that's not true; this project began as a way to bring back hands-on learning into a traditional classroom."

ATE & Accessibility

Accessibility in education and the workplace is a cornerstone of creating an inclusive and diverse environment. It ensures that individuals with varying abilities and backgrounds have equal opportunities to learn, work, and contribute. By offering accessible learning materials, adaptive technologies, and other accommodations, educators ensure that students with disabilities can reach their full potential and move on to careers where, with similar accommodations, their unique range of perspectives and talents can enrich their workplace and field. The National Science Foundation and the ATE community celebrate diversity and inclusion and recognize that prioritizing accessibility is a vital step toward breaking down barriers and ensuring that everyone has an equal opportunity to succeed in educational environments and the STEM technical workforce.

Projects and centers in the ATE community are keenly aware of the need to ensure accessibility and focus on making the resources they use and the environments they work in more accessible for students and faculty—creating accessible curriculum, labs, presentations, and videos.

The **Center for Applied Special Technology** (CAST, https://cast.org) is a leader in promoting Universal Design for Learning (UDL), a framework for improving and optimizing teaching and learning for all people. CAST works with ATE grantees to create accessible curriculum, materials, and resources. CAST's ATE case studies showcase UDL in action through examples like biotech pathways for deaf/hard-of-hearing (HH) students, accessible presentation of technical information, and active learning in bilingual classrooms.

DeafTEC, the Technological Education Center for Deaf and Hard-of-Hearing Students (on pages 68 and 69), seeks to increase the number of deaf/HH people in highly-skilled technician jobs by raising awareness of deaf/HH peoples' potential. It also provides resources for creating accessible materials, inclusive classrooms and workplaces, as well as professional development opportunities for educators and employers.

Johnston Community College (JCC) is the home of **Bio Blend 2.0** (on page 42), which focuses on preparing people on the autism spectrum for biotechnology careers. The project seeks to improve the inclusion of students with autism, ultimately leading to more neurodiverse people in STEM-related programs and fields, and provides professional development in neurodiversity and UDL for college faculty, career counselors, and industry partners. JCC also offers a related Autism 101 course for employers, helping them better understand how to support employees on the spectrum.

For more information on accessibility and the ATE community's work on accessibility please visit AccessATE at https://accessate.net

To learn more about the National Science Foundation's commitment to supporting persons with disabilities in STEM please visit https://new.nsf.gov/funding/initiatives/broadening-participation/supporting-persons-disabilities-stem

> ***"The US National Science Foundation is dedicated to increasing the involvement of individuals with disabilities in science, technology, engineering, and mathematics (STEM). NSF's strategic investments ensure individuals of diverse abilities can contribute to US leadership in STEM."***
>
> Source: NSF Website/Supporting Persons with Disabilities in STEM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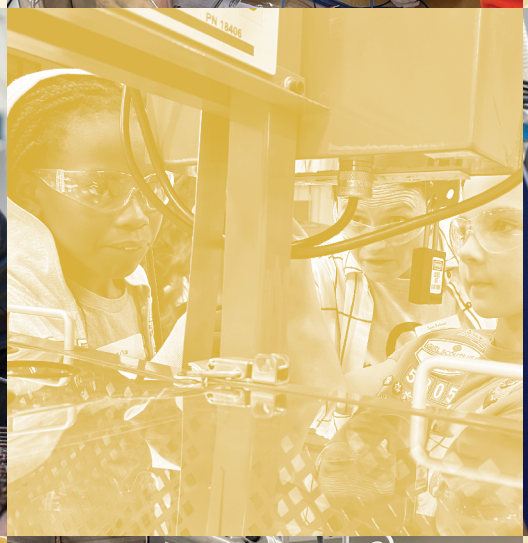
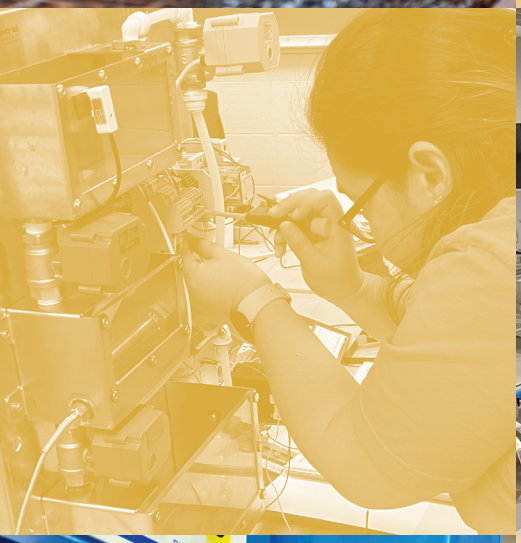
ATE @30

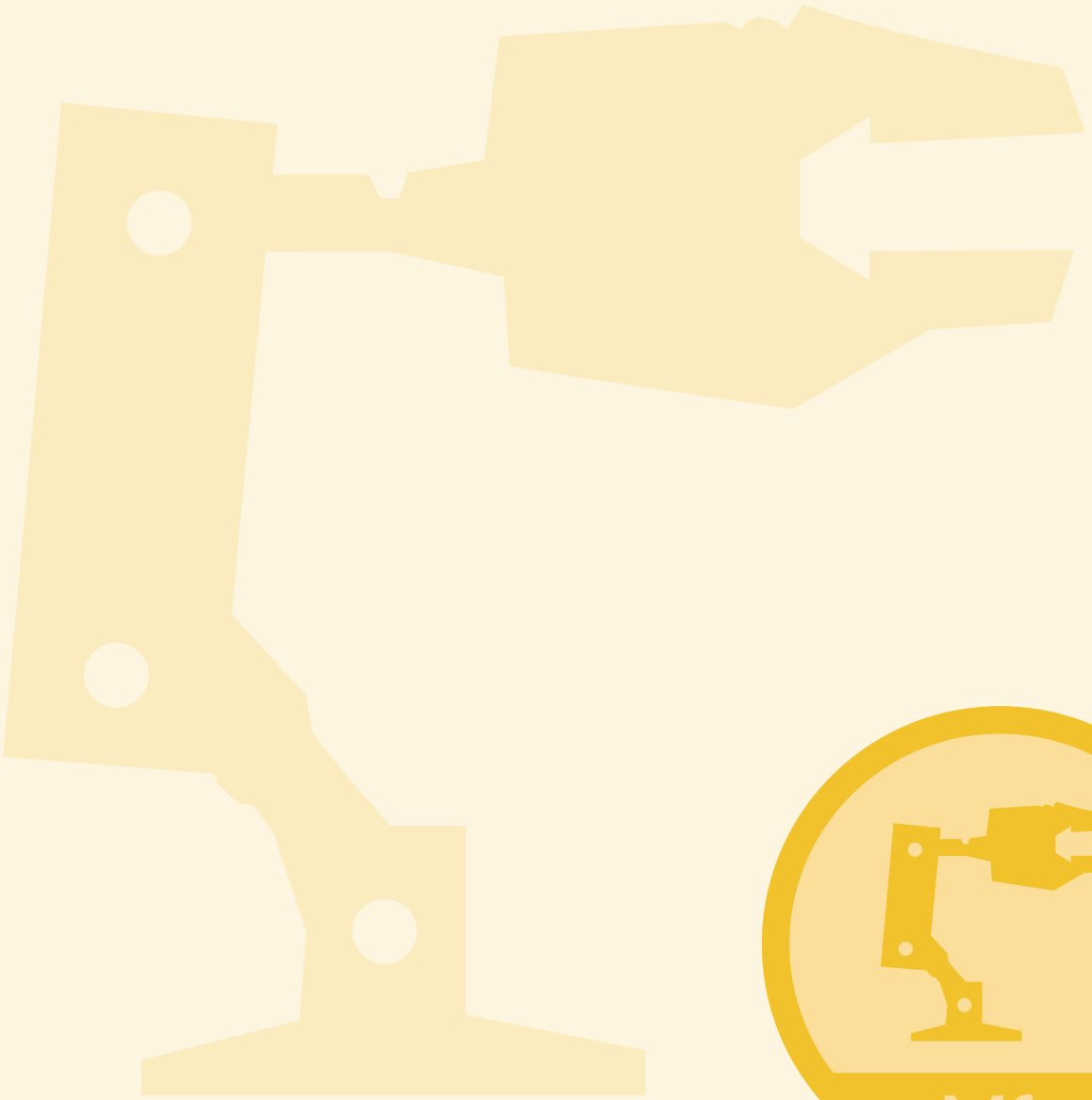





Power Electronics Controller
Power Electronics Controller
Manages flow of electrical energy delivered by traction battery
Controls speed of electric traction motor and torque
BACK
NEXT

Advanced Manufacturing Technologies

https://ate.is/mfg



Mfg

Students use CA2VES's virtual reality simulations to learn about the various components of electric vehicles.

CA2VES

Center for Aviation and Automotive Technological Education Using Virtual E-Schools

CA2VES's Digital Learning Tools Add Dimensions to Existing Courses

CA2VES launched in 2012 to create and deliver accessible e-learning materials for aviation and automotive technological education. The transformative, scalable, and flexible e-learning delivery model that CA2VES developed seamlessly integrates classroom and hands-on laboratory experiences for a diverse technician-education audience.

Through its unique online learning platform, EducateWorkforce.com, CA2VES creates and distributes VR and curricula customized to the educational and training needs of technical colleges and numerous, cross-cutting manufacturing industries. These tools help educators blend powerful online and digital solutions into their existing courses. From 2013 to August 2023, CA2VES's materials have been accessed by more than 17,000 active users on EducateWorkforce.com who are from 49 states and the District of Columbia.

Key Activities

- Develops virtual reality (VR) simulations
- Offers flexible e-learning curriculum modules
- Conducts research on the efficacy of various e-learning approaches
- Creates, refines, and disseminates professional development resources for two-year college instructors
- Provides mentoring to ATE partner projects

17,000 Students Have Used CA2VES Learning Tools that Include:

350+
3D & Computer-Aided Design Models

170+
Virtual Reality Modules

237
e-Learning Modules

57
Courses

9
e-Books

From 2013 to August 2023, 17,000 individuals accessed CA2VES digital learning tools through its EducateWorkforce.com platform.

Partnerships Facilitate AR & VR Learning for Aircraft & Electric Vehicle Maintenance

CA2VES has two primary partnerships that have seen significant impact since 2022.

CA2VES is partnering with the new nonprofit branch of the Aviation Technician Education Council (ATEC), Choose Aerospace, to focus on exposing high school students to aircraft maintenance careers. Through this partnership, the General Aircraft Maintenance course, developed through CA2VES, has been disseminated to 27 high schools and used by more than 300 students. Moving into 2024, CA2VES and Choose Aerospace continue to work together to develop and disseminate other areas of the Federal Aviation Administration's (FAA) aircraft maintenance curricula in an online format.

Trident Technical College is leading the collaboration that includes Spartanburg Community College, Greenville Technical College, and CA2VES to create a consortium of technical colleges and industry partners to address the workforce needs of electric vehicle (EV) manufacturers and maintenance service providers. Revolutionizing Electric Vehicle Education (REVVED) will conduct evidence-based research studies to investigate integration of virtual and augmented reality systems to support electric vehicle manufacturing and education. The digital learning tools will be based on industry needs and be available at EducateWorkforce.com. Industry and educational partners are providing guidance on the creation of educational modules and feedback on their effectiveness, thus ensuring that a competitive workforce is being developed.

> *"CA2VES's innovative approach to learning gives schools the opportunity to adopt aviation-focused content without the high facility, equipment, and material costs typically associated with aviation programs."*
>
> Crystal Maguire
> Executive Director
> Aviation Technician
> Education Council
> Jenks, OK

CA2VES-produced videos for online learning now include a new module on "Airframe and Powerplant," which is supplemental to the approved curriculum meeting FAA standards.

A Johnson & Johnson Vision Care intern maintains advanced manufacturing processing equipment.

FLATE

Florida Advanced Technological Education Center

ET Forum Keeps Curriculum Fresh

The Florida Forum on Engineering Technology (ET Forum) is a semiannual conference for Florida community and state college engineering technology educators and their stakeholders. FLATE has convened the ET Forum 50 times between 1996 and 2023; 24 state and community colleges have taken turns hosting.

Each forum provides information for curriculum updates. During the two-day forum educators have the opportunity to learn new skills, share best practices, network with colleagues, and engage with industry. In 2016-2017 St. Johns River State College faculty and administrators attended two ET Forums to learn about building their own ET program. It became active in fall 2017, had 87 students in 2022-23, and continues to grow.

Key Activities

- Embeds Industry 4.0 technician skills in statewide curriculum
- Creates multi-entry and exit pathways for technicians
- Supplies infrastructure for career awareness, recruitment, and retention
- Delivers professional development to technician educators
- Leads a community of practice for excellent technician education
- Facilitates a statewide industry advisory board

Students learn about compressors and gas flow control systems during a Manufacturing Month tour of HOERBIGER in Pompano Beach, FL.

FLATE Partners with J&J Vision to Expand Manufacturing Academy

Johnson & Johnson Vision (J&J Vision)—with its global headquarters in Jacksonville, FL—partners with Duval County Public Schools (DCPS), Florida State College at Jacksonville (FSCJ), and FLATE to develop a workforce pipeline called the Academy of Advanced Manufacturing and Engineering.

This collaboration, which included ATE grant support, began in 2012 with the goal of enabling more students to gain access to hands-on training and mentoring in STEM, distribution, and logistics education. With J&J Vision's commitment to equity and career development for young people, the academy has resulted in more than 50 students being placed in internships, 80 students graduating, and three becoming full-time J&J Vision employees.

In 2023 the academy expanded to more high schools in Northeast Florida and added opportunities for college credit as well as industry certifications. According to Abe Alangadan, J&J Vision senior product portfolio manager, "We cannot succeed with just working with DCPS and FSCJ but need to build a larger ecosystem to reach students." FLATE, FloridaMakes, and CareerSource Florida continue to work in partnership with J&J Vision to expand the academy program in Northeast Florida and offer the program to additional institutions around the state.

"We're recruiting for the future. Today we have over a dozen students that worked with us through our internship program and are now full-time employees. Our goal in working with schools is to give students their first real-time experience at a real job, side-by-side with our workers."

Len Zaiser IV, CEO & Founder
Azimuth Technology, Naples, FL

FLATE's Industry Relationships

14
Regional Manufacturers Associations (RMA)

2,400
Florida Manufacturing Employers in the RMA Network

400
FLATE Industry Partners

FLATE's Outreach Activities

95
Industry Partners hosted 65 Student Tours and Events, impacting 3,731 students in 2022

600
Educator-Industry Connections at FLATE Speed Networking Events in 2022-2023

FLATE's Partners on Advisory Boards

230
Industry Representatives on Florida State College Advisory Boards

25
Statewide Engineering Technology Industry Advisory Board Members

Being part of FloridaMakes expands FLATE's access to manufacturers and broadens its capacity to share manufacturing career info with students. More than 250 individuals who partner with FLATE influence curricula as education advisory board members.

An educator focuses on wiring her mechatronics instrumentation trainer during a professional development workshop.

NCNGM

National Center for Next Generation Manufacturing

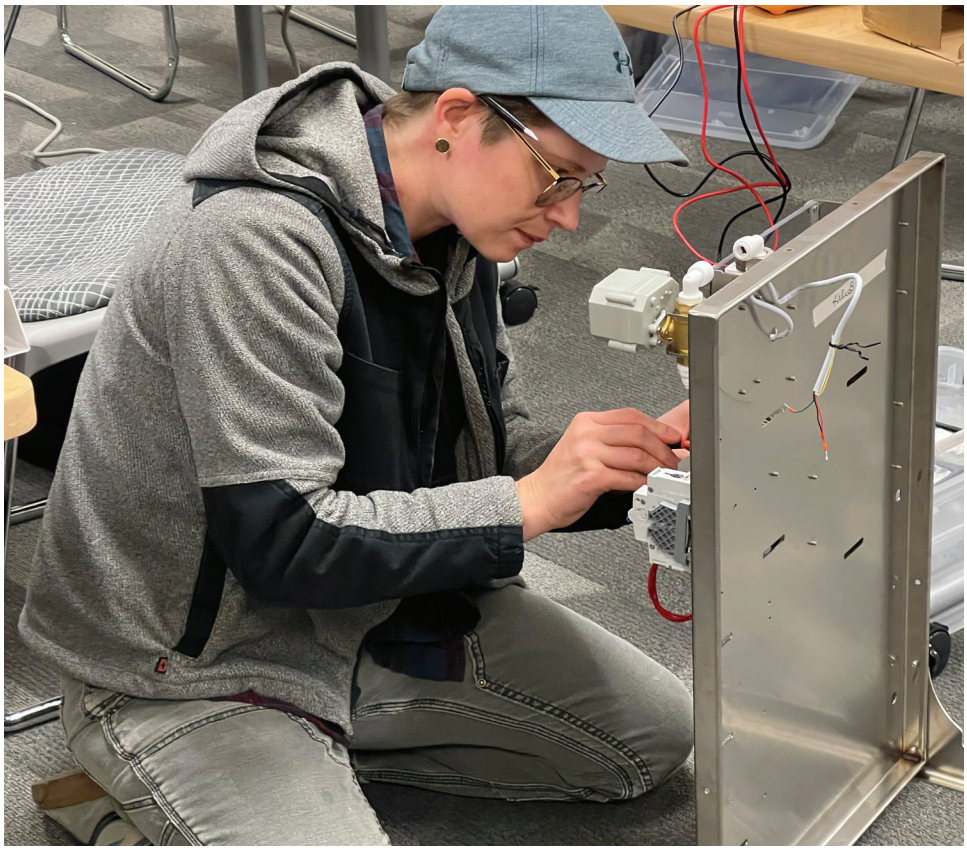
NCNGM Promotes Advanced Manufacturing with Partners Across US

NCNGM provides opportunities for educators and students to learn about advanced manufacturing technologies and careers through hands-on activities and educational resources. Professional development workshops for educators are provided through virtual and in-person formats to accommodate NCNGM's national audience. Participants receive the technologies used during the workshops. These have included mechatronics trainers, mini-drones, and computer-aided design software licenses, so that the educators can develop curriculum for implementation in their classrooms.

NCNGM's partners across the US host in-person expos, workshops, and company tours where high school and community college students learn about local manufacturing programs and experience technologies first-hand.

Key Activities

- Creates advanced manufacturing educational materials and shares them through a free repository
- Advances connections between manufacturing stakeholders
- Leads efforts to recruit and retain a diverse manufacturing technician workforce
- Offers professional development for educators



An educator builds a mechatronics instrumentation trainer during a professional development workshop.

Business & Industry Leadership Teams Shape Advanced Manufacturing Curricula

NCNGM partners with employers nationally to ensure initiatives for educators and students meet current and future advanced manufacturing workforce needs. The center uses business and industry leadership teams (BILTs) to engage industry representatives in the process for defining the knowledge, skills, and abilities (KSAs) covered by the center's curriculum for advanced manufacturing technician programs. In 2023, NCNGM coordinated the work of 11 BILTs that provided input on the content for design, fabrication, processing, supply chain, quality control, and Industry 4.0 courses. Additional BILTs will be developed in the future as needed to accommodate new technologies.

A mechatronics student configures sensors in a pressure gauge using a device communicator in an instrumentation lab.

NCNGM Expands Mechatronics Workshops for Educators

NCNGM provides educators with mechatronics workshops based on the model program that faculty at Central Community College in Columbus, NE, created with ATE grant support. During the workshop, college faculty and high school teachers build desktop mechatronics trainers and are provided with curriculum for use in their classrooms and dual enrollment programs.

Through NCNGM's support multi-level workshops were offered to educators from nine states to address the growing need for mechatronics technicians in the workforce. NCNGM plans to further expand workshops because they include multiple skill sets that manufacturers have identified as valuable for technicians to know.

"Strong partnerships are the key to preparing advanced manufacturing technicians for employment that is driven by Industry 4.0. Stanley Black & Decker is proud to partner with the National Center for Next Generation Manufacturing, which provides national platforms for industry and academia to come together for discussions that are critical to workforce needs and technician education."

Martin Guay
Vice President of Business Development
Stanley Black & Decker
New Britain, CT

Since 2021 NCNGM has Provided

17
In-Person and Virtual Professional Development Opportunities for

300+
Educators and Presented

35
Sessions at National Conferences for

68,370
Hours of Professional Development Delivered to

950+
Session Attendees

A student enrolled in a course that uses Weld-Ed curriculum removes dross that occurred when cutting out his class project.

Weld-Ed

National Center for Welding Education

Partnership Places Community College Interns in University Research Lab

In August 2021 seven Columbus State Community College welding students embarked on paid internships at Ohio State University's Manufacturing & Materials Joining Innovation Center (Ma²JIC).

This two-semester pilot program, facilitated by Weld-Ed with the support of a Skills Training in Advanced Research & Technology (START) grant from NSF, placed the community college students in lab assistant roles to work side-by-side with Ohio State faculty and students as they conducted research in materials joining. The interns applied their welding skills to tests of unique materials, new practices, and applications and learned to operate software and equipment in the research lab.

All of the interns made presentations at a university forum; two interns shared their experiences at Ma²JIC's conference at the University of Tennessee-Knoxville.

Weld-Ed, AWS & LIFT Seminar Addresses Workforce Challenge

Weld-Ed continues to address the lack of comprehensive short-term professional development with relevant industry-recognized certification in lightweighting welding technology. It partners in this effort are other academic institutions, the American Welding Society (AWS), and LIFT, a national manufacturing innovation institute that is a public-private partnership between the US Department of Defense and industry.

In January 2023 Weld-Ed, AWS, and LIFT piloted the Lightweight Welding and Certified Welding Supervisor Seminar at the LIFT Learning Lab. The Certified Welding Supervisor (CWS) is an existing credential through AWS; it aligns closely with the regional needs of LIFT and the lightweighting welding industry.

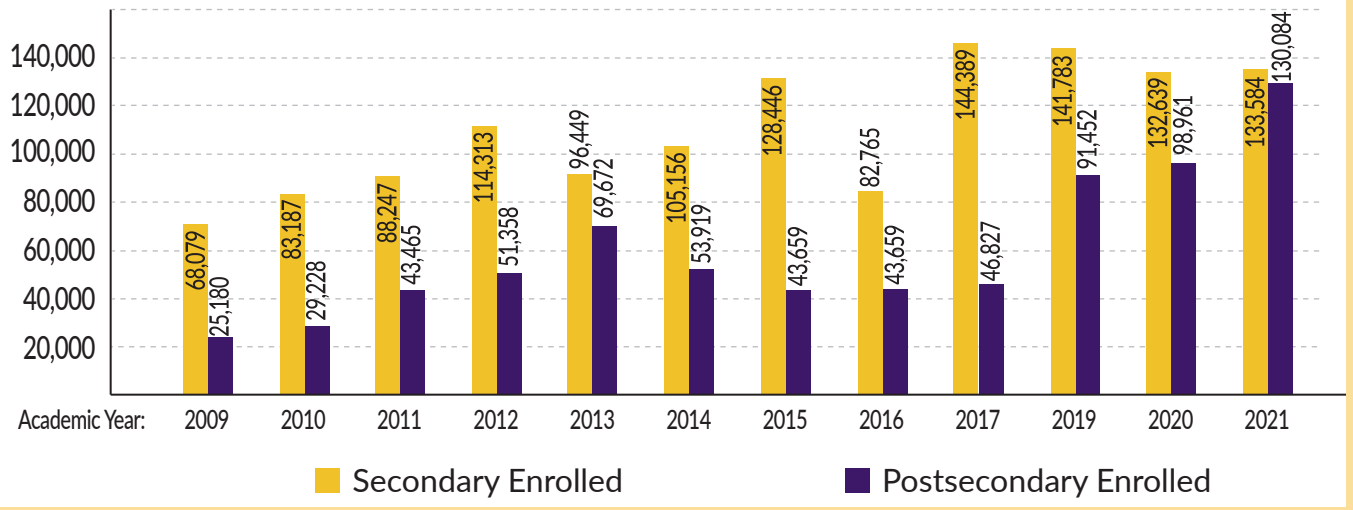
Seven industry professionals registered for the 40 hours of instruction that occurred on weekday evenings in January. Five completed the training. Four of the five took and passed the CWS exam.

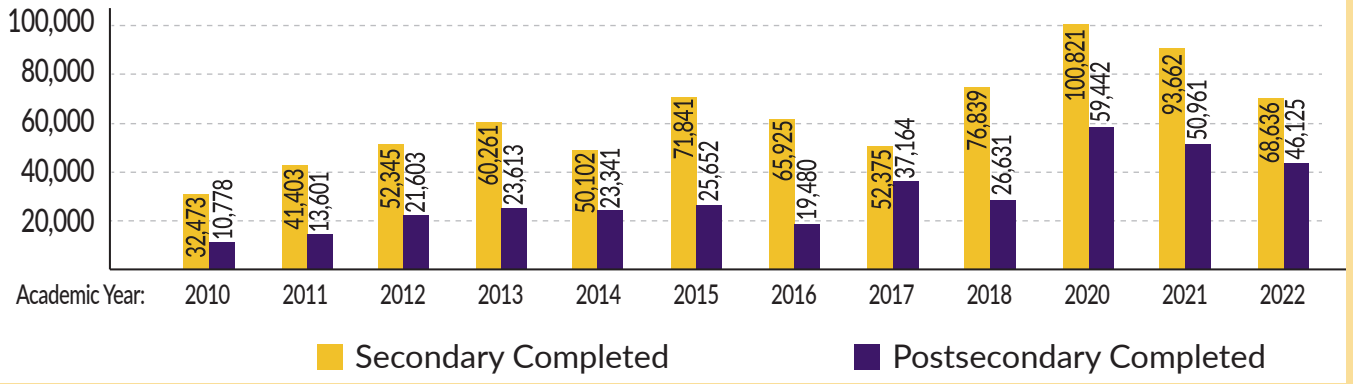
In the end-of-course survey participants reported overall satisfaction with the seminar. Four out of the five (80%) agreed that their knowledge of lightweighting welding increased and that they would recommend the training.

Key Activities

- Upgrades the teaching skills and readiness of welding faculty through professional development
- Enriches student development through internships in welding research
- Promotes quality welding programs through accreditation and instructor certification
- Provides comprehensive resources for the success of students, teachers, and professionals

Enrollment & Completion Data from US Welding Programs





The combined enrollment of secondary and postsecondary students in welding programs increased from 93,259 in 2009-2010 to 263,668 in 2021-22, an increase of 282%. The number of students who completed welding programs increased from 43,251 in 2009-10 to 114,761 in 2021-22, an increase of 265%. (Data collected via phone surveys. 2018-2019 figures absent due to COVID-19.)

"Weld-Ed has provided me access to subject-matter experts who have helped my startup, Welding A2Z, to develop an innovative welding educational methodology, instruction design personalized to the individual students, and customized tools to welding instructors to meet their local industry needs while maintaining the AWS guidelines."

Sree Sanakam, Chief Operations Officer
Welding A2Z, Baton Rouge, LA

Featured ATE Project

Advanced Manufacturing: Girls Can, Too!

Key Activities

- Provides opportunities for middle and high school girls to see industries in action and participate in hands-on experiences
- Fosters an environment of gender inclusivity within industrial employers and schools
- Promotes female leadership within the community

Bluegrass Community and Technical College
Georgetown, KY

https://ate.is/GirlsCanToo

Project Gives Girls Chance to Explore Manufacturing Careers

Girls Can, Too! offers adolescent girls the opportunity to explore industrial maintenance technology careers. The project introduces them to women working in various industries and takes them on tours of advanced manufacturing facilities. Mostly importantly, the Saturday workshops involve the girls in small projects, such as welding samples and problem-solving exercises based on the host company's actual industrial processes.

These first-hand experiences encourage girls to consider an array of careers historically dominated by men.

Partnership with Toyota Provides Students with Career Opportunities

The project has a very successful partnership with Toyota Motor Manufacturing of Kentucky. Company representatives serve on the project's business and industry leadership team (BILT). The company hosted students at a March 2023 event where employees introduced project participants to welding, Toyota's motorsports and vehicle manufacturing, as well its policies and practices in environmentalism.

The company is also sponsoring one of the project's students who enrolled in Bluegrass Community and Technical College's (BCTC) Advanced Manufacturing Program as a high school senior. This student works part time at Toyota while simultaneously attending courses at BCTC. This collaboration not only provides the student with extremely relevant, on-the-job learning experiences but also gives Toyota a fresh perspective of the industry practices taught by BCTC.

A BCTC advanced manufacturing technology instructor explains lockout-tagout procedures to middle school students during a Girls Can, Too! workshop.

Career Skills Program (CSP)

Certificate Programs Help Soldiers Transition to Civilian Advanced Manufacturing Technology Careers

The Army Career Skills Program (CSP) is an established veteran career training program for active-duty soldiers who are within their six-month departure window from the military.

With ATE grant support, Elizabethtown Community and Technical College offers its version of CSP on campus and at US Army Garrison – Fort Knox. Its primary focus is preparing service personnel for civilian careers in advanced manufacturing technology (AMT) to meet regional employers' needs. The project team developed two new certificate programs in 2022: Electrical Construction Level I and Industrial Automation and Robotics.

The project continues to evolve and grow. In 2023 it offered six different certificates that were designed specifically for the CSP and modeled after three pre-existing AMT degree programs.

"The reason I chose the CSP program was because it allows me to learn a trade backed up by a certificate. I have served for 12 years in the US Army and wanted something to make myself more marketable to future employers. I chose the Instrumentation Technician Program because of my maintenance background and a desire to pursue a career in industrial maintenance. This program, I feel, has given me the opportunity to have a leg up on the competition."

US Army Sergeant
Michael McWhorter
CSP Instrumentation
Technician Track
Fort Knox, KY

CSP Enrollment Grew from **4** Students in Spring 2022 to **13** in 2022-2023

8 of 13
CSP Students in 2022-2023 Earned Certificates

90% Were Hired by Advanced Manufacturers or Continued Their Education

Key Activities

- Integrates skills and knowledge from industrial maintenance and electrical technology
- Offers a support system that helps transitioning soldiers complete industry-recognized credentials within six months, tuition free
- Provides highly skilled automation and robotics technicians to fill advanced manufacturing workforce gaps

Elizabethtown Community and Technical College
Elizabethtown, KY

https://ate.is/VetCareerTraining

Featured ATE Project

Improving Access to Career Pathways in Advanced Manufacturing (IACP)

Key Activities

- Promotes and expands high school-to-college dual-credit advanced manufacturing courses across Nevada
- Provides simulations, augmented and virtual reality media for technical education, and mechatronic materials for off-campus instruction at high schools and rural workplaces
- Implements life skills training for technicians to enhance their employability

Truckee Meadows Community College
Reno, NV

https://ate.is/IACP-MFG

Life Skills Course Responds to Employers' Priorities

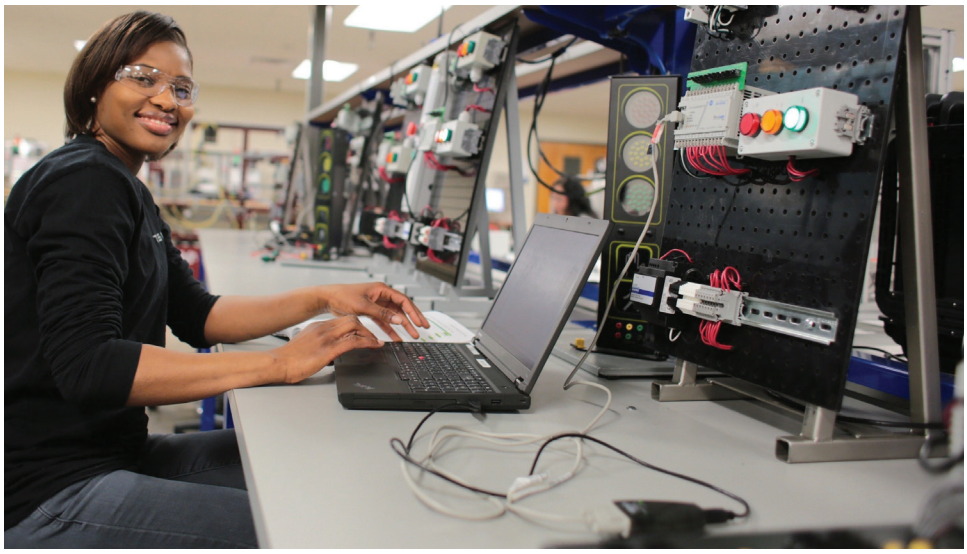
Insights that faculty gained from industry partners on a previous ATE grant prompted them to develop a life skills curriculum for technicians beginning their advanced manufacturing careers. By leveraging the talent and resources of the college career center and instructional materials provided by faculty in various disciplines, the project has developed a sustainable initiative. College personnel also serve as guest speakers and mock interviewers for the content.

The course covers communication skills, business email, job-search basics, résumé and cover letter preparation, along with workplace etiquette such as how to shake hands and call in when ill.

Augmented Reality Increases Students' Familiarity with Manufacturing Equipment

To improve access, the project purchased 10 augmented reality (AR) goggles to use for off-campus instruction. The project is also developing simulations of lessons previously taught in the college's labs. This innovation allows students to learn new skills and practice them off-campus using the AR goggles and then attend the campus labs to complete their testing.

The project team has also generated QR codes and placed them near lab equipment for students to use to access training videos that relate to the tasks technicians do with similar equipment in advanced manufacturing workplaces.



Students find that IACP-MFG lab exercises are not only challenging but also fun and engaging.

Manufacturing, Adjuncts, Partnerships, and Students (MAPS)

MAPS Recruits Industry Personnel to Teach with Supportive Onboarding

Expansion of US manufacturing capacity depends on the availability of a well-trained technical workforce, which in turn depends on knowledgeable faculty to educate aspiring technicians. MAPS helps regional industry leaders understand that full-time faculty cannot complete this mission alone and that subject-matter experts in the classroom are vital to everyone's success.

Between the project's launch in summer 2022 and June 2023, five people with manufacturing experience were onboarded as new adjunct instructors. MAPS is testing a co-teacher model that pairs an industry adjunct with a full-time faculty member. While the adjunct contributes to the course content, teaching and administrative tasks are shared. More industry personnel have responded to the project's recruiting and joined the faculty in late 2023.

Fleet's Strong Support Includes Sanctioning Adjunct Instructor

CB Fleet Co., Inc., has been a strong industry partner of the mechatronics program since it began in 2017. The company provides paid internships for students, plant tours for students, advisory board support, and help with the integration of new technologies at the college laboratory. Best of all Fleet hires the program's graduates. Fleet was first to step up to this project's call for adjunct instructors to provide an instructor for the course on preventive and predictive maintenance. That new industry adjunct instructor, Brad Fitzgerald, used a tour of Fleet Laboratories—where he is facilities manager—to cement the course concepts with students.

Industry Adjunct Brad Fitzgerald demonstrates concepts he taught in class while students tour Fleet Laboratories, where he is facilities manager.

Key Activities

- Grows industry partnerships by providing insight and access to the local technical workforce
- Recruits industry adjuncts by creating symbiotic relationships between community college technical programs and employers
- Strengthens pathways for dual-enrolled students to enter career technical education programs and advanced manufacturing employment

Central Virginia Community College
Lynchburg, VA

https://ate.is/maps

Technician Education Readiness Pathway (ASTERP)

Key Activities

- Improves students' knowledge and skills in science, technology, engineering, math (STEM), and English
- Utilizes guitar-building STEM lessons in connection with music, which is culturally strong in the islands
- Piques students' and teachers' interests by connecting practical skills and education

American Samoa Community College
Malaeimi, American Samoa

https://asterp.org

American Samoa Community College Uses Guitar-Building to Spark Students' Interest in STEM & Enhance Educators' Technical Skills

American Somoa Community College used its ATE grant to establish the Technician Education Readiness Pathway (ASTERP) to meet the critical need for skilled technians in the US territory in the South Pacific.

The pathway offers guitar-building lessons to spark students' interest in STEM and English. By specifically linking mathematics and English skills with something students like doing, ASTERP aims to reduce the need for students to take remedial courses before beginning technician education programs. The guitar-building curriculum was developed by previous ATE grantees on the US mainland.

Most of the students who have built guitars through the ASTERP project report having a greater desire to learn and a greater appreciation of math skills. In pre-program surveys most indicated that they had hardly any prior interest in improving their skills or knowledge in mathematics.

The high school teachers and two administrators were among the eight individuals who learned Computerized Numerical Control (CNC) manufacturing and other technical skills during ASTERP's guitar-building professional development during 2022-2023. All of them reported being excited about creating their own musical instruments. Three teachers, who were from the same high school, started a guitar-building program at their school in fall 2023.

Students adjust attachments before securing them on the guitar during the ASTERP's guitar-building workshop where care and precision are required.

The Robotics/Automation and Cybersecurity Knowledge Sharing Coordination Network (TRACKS-CN)

Project Links ATE Projects & Manufacturing Extension Partnerships

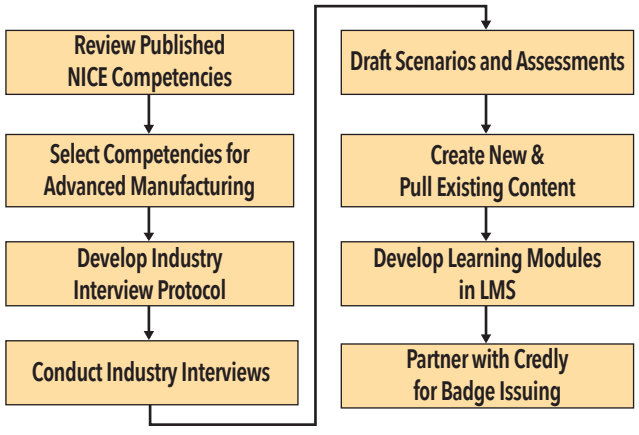
TRACKS-CN connects ATE projects focused on robotics, automation, or cybersecurity with industry via Manufacturing Extension Partnerships (MEPs), which are US Department of Commerce-funded partnerships that provide services to small and medium-sized manufacturers in every state. Partnering with MEPs facilitates community colleges' connections with employers.

Cyber4RAM Digital Badge Signals Technicians' Cybersecurity Awareness

TRACKS-CN developed and broadly shares its Cyber4RAM digital badge, a microcredential that builds cybersecurity awareness among technicians who work in robotics, automation, or mechatronics.

This microcredential is earned by completing 11 modules that teach about cybersecurity competencies in advanced manufacturing workplaces. Learners sign up via Canvas Instructure to complete the no-cost lessons based on 11 National Initiative for Cybersecurity Education (NICE) Framework Competencies. The modules introduce cybersecurity considerations in asset and inventory management, computer languages, data privacy, data security, digital forensics, identity management, incident management, infrastructure design, physical device security, systems integration, and vulnerabilities assessment. A digital badge is issued upon completion of all modules.

Cyber4RAM Microcredential Development Process



Cyber4RAM modules teach valuable content at the convergence of robotics, automation, and cybersecurity to improve technicians' work with cyber-physical systems in modern manufacturing facilities. TRACKS-CN's process for developing them is a model for creating microcredentials.

Key Activities

- Promotes meaningful collaboration between community colleges and Manufacturing Extension Partnerships (MEPs)
- Provides education at the convergence of robotics, automation, and cybersecurity
- Offers the Cyber4RAM digital badge to promote cybersecurity awareness among technicians working in robotics, automation, or mechatronics

North Carolina State University
Raleigh, NC

https://ncmep.org/tracks-cn

ATE @30

Agricultural and Environmental Technologies

https://ate.is/ag-env

Students install solar panels on the pitched roof that is part of the outdoor lab at Madison Area Technical College.

CREATE

Center for Renewable Energy
Advanced Technological Education

Solar Energy Institutes Help Educators In Class

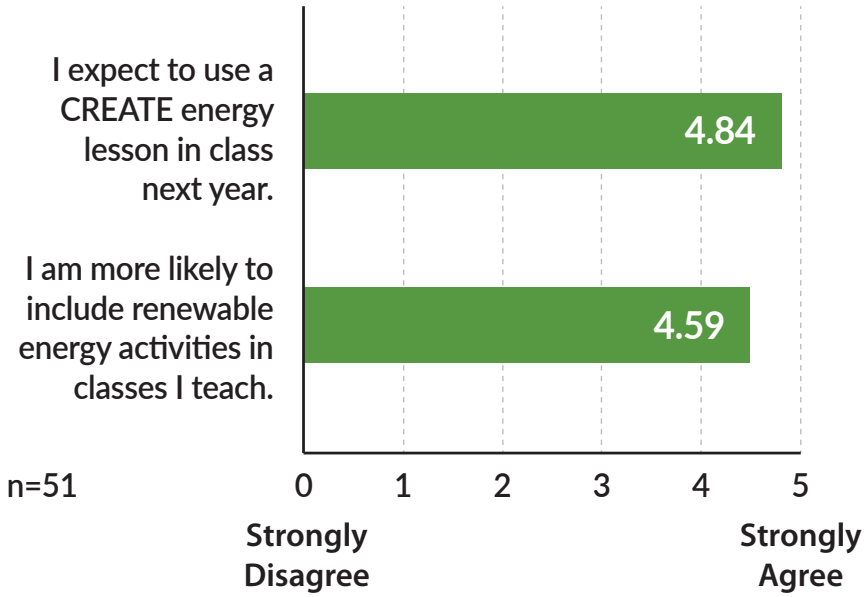
CREATE Energy Institutes educated more than 200 faculty through in-person and virtual workshops during the first six months of 2023.

Develped for educators seeking to gain practical, hands-on experience, the institutes facilitate integration of solar energy and energy efficiency technology and activities into existing courses. Educators who attend CREATE's in-person workshops, held in locations throughout the US, gain knowledge and hands-on experience with equipment. Participating teachers also receive stipends to purchase lab materials so they can apply their newfound knowledge in their classrooms and replicate these experiences with their students.

Key Activities

- Delivers hands-on, data-driven faculty professional development
- Develops accessible curriculum and instructional materials
- Promotes energy education and workforce opportunities
- Highlights career pathways and resources
- Fosters valuable industry partnerships
- Mentors faculty and students

2023 Energy Workshop Ratings



In-person workshop attendees were surveyed and rated CREATE's Energy Institutes on Likert scales ranging from zero to five. The results show strong adoption of lessons and activities. Educators also reported plans to integrate CREATE materials in their STEM courses, which collectively had thousands of students in 2023.

CREATE Links Students to Dynamic Energy Careers

Energy education programs provide technicians with good-paying, family-supporting jobs in STEM careers that cannot be easily exported.

Keri Knorr

How CREATE resources impact students is illustrated in the experiences of Keri Knorr, a 2020 energy management graduate of Delaware Technical Community College (DTCC), where faculty model their programs on the curriculum and outreach activities that they learned at CREATE workshops.

Knorr says her career path was influenced by classroom instruction and volunteering for community energy events organized by DTCC faculty.

Now as Green Energy program manager for Delaware's Department of Natural Resources and Environmental Control, Knorr handles renewable energy rebates and helps low- and moderate-income households obtain free or reduced-cost solar energy systems and weatherization.

"It was eye-opening to participate in the CREATE Solar Institute. The hands-on approach made it much easier to implement the lessons in my classes and use the information."

Rebecca Bestul
Science Teacher
Chippewa Falls Area Unified School District
Chippewa Falls, WI

A student measures the electric potential across a solar photovoltaic disconnect switch, a maintenance task taught in CREATE's curriculum.

A conservation student uses a drip torch to assist with a prescribed burn on a remnant prairie as part of her undergraduate research project.

EARTh

Environmental and Natural Resources Technology Center

EARTh Center Connects Students with Environmental Technology Programs

The EARTh Center serves as a national hub for developing and disseminating information about educational programs in energy, environmental, and water technologies offered at colleges across the country.

Through interactive maps and detailed program listings, the center has made it easy for students to explore diverse two-year degree, certificate, high school, and workforce development offerings. The center is committed to fostering a skilled, sustainable workforce and empowering individuals to pursue rewarding careers in these vital sectors.

The center also provides a variety of professional development opportunities for educators including webinars, Virtual Fellows Institutes, and in-person workshops.

Key Activities

- Develops virtual training simulations to support in-person, hybrid, and remote delivery of environment-related technology education
- Provides Virtual Fellows Institutes and in-person professional development workshops
- Conducts job task analyses to support curriculum development
- Publishes *Defining Environmental Technology* report

A student uses a radio telemetry receiver and antennae to track Blanding's turtles in a marsh near the Mississippi River.

By Leveraging XR with Impactful Pedagogy, EARTh Enhances Students' Learning

The EARTh Center provides an array of services tailored to meet the needs of environmental technology educators and their students.

By leveraging extended reality (XR) technologies, EARTh Center personnel develop interactive and immersive workforce training simulations, bringing concepts to life in engaging ways. The center also provides education opportunities for faculty, emphasizing continuous professional growth.

Each center service aims to enhance students' learning experiences, merging modern technologies with impactful pedagogical approaches. This approach seeks to bridge gaps between academic learning and real-world industry needs, ensuring students are well prepared to meet workforce demands.

"The EARTh Center's unwavering support and mentoring have fostered a positive mindset as we navigated the challenges of garnering support for our New-to-ATE grant. The connections we developed with other network partners to strategize ideas and share best practices are invaluable."

Sheela Vemu
Associate Professor of Biology
Waubonsee Community College
Sugar Grove, IL

Estimated Job Growth in Environmental Technology Occupations

Occupations	Number of Jobs in 2022	Projected Growth from 2022 to 2032
Laboratory (Chemical) Technician	58,000	3%
Conservation Scientist and Forester	36,000	4%
Agricultural and Food Science Technician	38,800	5%
Geoscientist	26,300	5%
Environmental Science and Protection Technician	80,500	6%
Occupational Health and Safety Technician	138,400	13%
Solar Photovoltaic Installer	29,400	22%
Wind Turbine Service Technician	11,200	45%

Source: Bureau of Labor Statistics, Occupational Outlook Handbook. https://bls.gov/ooh

The EARTh Center helps environmental technology educators prepare students for technical careers in a cross-section of environment-related industries including renewable energy, conservation, and agriculture.

VESTA apprentices work directly with winemakers as the season progresses.

VESTA

Viticulture and Enology Science and Technology Alliance

VESTA Adds Sustainability Info in Response to Industry

VESTA continues to expand partnerships and support for community colleges wishing to serve their local and state grape and wine industry by providing industry-validated curricula featuring remote courses to suit students in the workforce.

VESTA has world-class instructors who deliver these courses, which incorporate industry-led practicums and technical workshops. In response to industry's increasing interest in sustainability, VESTA is incorporating sustainable principles and practices into its courses.

Pellissippi State Community College students and faculty practice proper planting methods in the college's research vineyard.

Key Activities

- Supports community college grape and wine programs with online courses, practicums, and workshops
- Creates industry-validated national standards in viticulture and enology
- Promotes US Department of Labor Registered Apprenticeships with VESTA courses for related technical instruction

Practicum Network Provides Real-World Learning Experiences Across the US

VESTA's network of more than 700 industry sites for hands-on learning continues to expand as students identify new industry practicum partners in their communities, making these real-world experiences convenient and geographically relevant for students.

Each partner's practicum site is a commercial location that meets VESTA criteria as a place where viticulture and enology students can gain hands-on skills and workplace experiences. The practicum activities align with VESTA's online courses, which students are simultaneously taking. The added benefit for VESTA's network is that it connects employers with highly motivated and technically skilled students who represent a pool of skilled technical workers for the future.

VESTA Collaborations with Industry Associations Support Apprenticeships & Scholarships

VESTA also works with industry associations, their employer members, and employees to support US Department of Labor Registered Apprenticeships with comprehensive apprenticeship outlines that incorporate VESTA courses as the related technical instruction (RTI) required for apprenticeship completion.

VESTA is committed to supporting and showcasing inclusion and expansion in the industry. For example, VESTA is partnering with the Michigan Wine Collaborative's Inclusion and Expansion Committee, which created The Dream scholarship program to provide educational support to historically underrepresented and marginalized populations. VESTA provides national exposure for The Dream collaboration so that other states can adopt this scholarship program to help increase the diversity of the technical workforce.

"Our ability to grow as a company and as an industry will rely on the current and future skills of our team members. Pellissippi State and VESTA not only listened to our needs, but presented a training and development plan aligned with our business goals in a flexible and cost effective strategy."

Jonathan Ball
Chief Operating Officer
Mountain Valley Winery
Pigeon Forge, TN

From 2003 to 2023

2,222
Students in VESTA-Affiliated Programs from

50
States, Washington DC, and

11
Countries

Had Field Experiences at

700+
Practicum Sites across the United States and around the World

Students who take VESTA's online viticulture and enology courses acquire hands-on skills and workplace experiences at commercial facilities that meet VESTA's standards for practicum sites.

Technology for Innovative Livestock Management (ILM)

Key Activities

- Utilizes geospatial technologies to monitor livestock feed production and grazing
- Irrigates with precision agriculture technologies
- Manages livestock with intensive grazing practices
- Composts animal waste as fertilizer
- Awards Associate in Applied Science (AAS) degrees in innovative livestock management

Snow College
Ephraim, UT

https://ate.is/LivestockMgmt

Snow College Starts Innovative Livestock Management Program with ATE Grant

The Innovative Livestock Management (ILM) Program is the first of its kind in Utah, where the livestock industry is critical to the rural economy. The associate of applied science degree program is now established as a career technical education pathway for agriculture-focused high school students to transition to college. ILM students learn livestock management and technical skills that utilize cost-saving and sustainability practices. For example, students are taught how to manage pasture growth, irrigate efficiently, and utilize grazing practices that regenerate pastures.

Interdisciplinary, Entrepreneurial Approach Capitalizes on Compost

The program also has students develop waste management plans that include composting as an entrepreneurial opportunity to sustain a livestock business. Broadening ILM across disciplines created a collaborative opportunity with business department faculty and students.

ILM students began a new composting process in fall 2022. That semester, teams of students in the social entrepreneurship course worked on different approaches for merchandising the natural product that every farm and ranch has in abundance. They created packaging, designed labels, and developed marketing and pricing plans for the compost the ILM students used grant-funded equipment to process from livestock waste. In November 2022 the students sold the first 16 bags of Snow compost at the college's homecoming football game.

Under the direction of a veterinarian, a student ultrasounds a pregnant ewe to determine if she is carrying a single lamb, twins, or triplets.

Water Developing Resources for Operators (WaterDROPS)

Virtual Reality Simulations Instruct Diverse Learners in Water Operator Programs

Water treatment operators are essential to the environmental services infrastructure, ensuring that the water people consume and put back into the environment is safe. The US faces a labor shortage, with up to half of the nation's treatment operators retiring before 2030.

The immersive learning experiences of the WaterDROPS VR lessons enhance learning by giving students the opportunity to manipulate and troubleshoot water filtration equipment without real environmental consequences. The portable format allows instructors to drop the VR lessons into their courses strategically. The equipment-agnostic format makes the modules easy for both faculty and students to access.

While developing the modules for diverse populations, WaterDROPS utilized the facilities and expertise of CA2VES, an ATE center; the applied learning focus of faculty at two-year colleges; and the collective wisdom of water treatment operators in the field.

This collaboration has fueled the development of VR lessons that bolster the mathematics skills of entry-level operators whose prior schooling insufficiently prepared them to use complex STEM skills for important human health and environmental considerations.

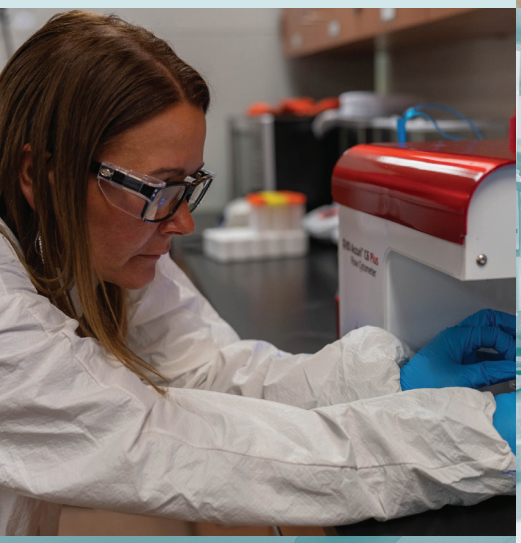
A student works through WaterDROPS's math modules online during a break from his job at a water treatment facility.

Key Activities

- Develops the next generation of education for water treatment operators through virtual reality (VR) simulations
- Provides VR-enabled curriculum resources to water technology educators
- Supports the entry of diverse future operators into the field of water treatment

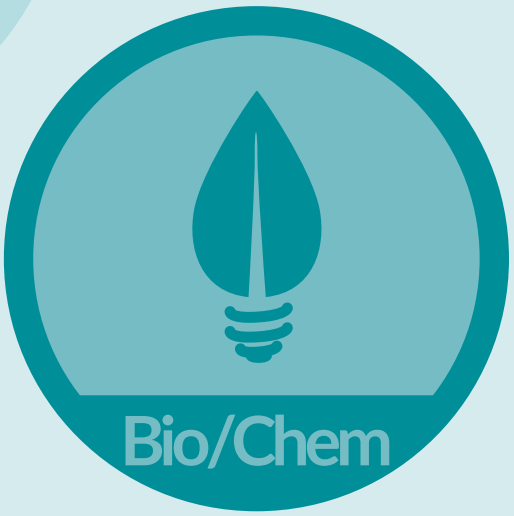
Central Carolina Technical College
Sumter, SC
Clemson University
Clemson, SC
https://water-drops.educateworkforce.com/home

ATE @30



Bio and Chemical Technologies

https://ate.is/bio-chem



InnovATEBIO encourages its community college partners to offer course-based undergraduate research experiences (CUREs) to engage students' attention and broaden their biotech lab skills.

InnovATEBIO

National Biotechnology Education Center

InnovATEBIO Convenes Summit on Bioscience Workforce Needs

In 2023 InnovATEBIO convened the *Envisioning the Next Bioscience Workforce Summit on Industry Trends and Needs*. Esteemed leaders in education, industry, and public policy attended to share ideas about bioscience-driven economic development and critical workforce needs.

Industry and academic leaders spoke about advances in biopharmaceuticals, tissue regeneration, artificial intelligence, bioindustrial manufacturing, and cell-based food technology and about the ways these innovations change employer expectations for technicians.

Teams of representatives from academia, industry, and trade organizations were divided by states to work on action plans for developing the bioscience workforces in their states in collaboration with InnovATEBIO.

The summit also included interactive poster presentations by two-year college biotechnology students and graduates.

Key Activities

- Develops a technician-focused workforce that maintains US leadership in all phases of bioscience endeavors
- Raises awareness of community college-level biotechnology credentials
- Collaborates with academia, industry, and government to incorporate best practices and resources needed to capitalize on future emerging technologies
- Provides faculty with professional development in foundational skills and industry trends

InnovATEBIO's National Network Offers

40 Different Degrees & Certificates *in*

37 States *through*

110 Community College Programs

56 Programs Articulate to 4-Year Colleges or Universities

53 Work with High School Partners

15 Provide Dual Credit Programs for High School Students

In addition to its 110 community college partners, InnovATEBIO's National Network of institutions that are building the biotechnician workforce includes ten universities, five state colleges, and two research institutes.

Expertise of InnovATEBIO Hubs Serve Educators Building Biotech Programs

InnovATEBIO's hubs serve as "go-to" places for expertise in creating and sustaining biotech programs at high schools and community colleges to meet the needs of students and the growing biotech industry.

The Alumni Network Hub connects graduates with professional development opportunities.

The Biotech Careers & Entrepreneurships Hub publicizes career pathways, job descriptions, day-in-the-life-of-a-biotechnician stories, blogs, job boards, and an enormous biotech employer database.

The Genomics Hub supports the incorporation of genomics into community college biotech curricula.

The High School Pathways Hub educates high school teachers to incorporate biotechnology into biology courses and shares best practices for workforce-oriented biotechnology programs.

The Immunotherapy Hub focuses on increasing the number and diversity of skilled technicians entering the immunotherapy sector of the biomanufacturing workforce.

The Industry & Workforce Development Hub catalyzes relationships with partners to develop best practices for professional development and skill standards.

The Student Research Hub engages students in course-based undergraduate research experiences (CUREs).

Students practiced micropipetting and aliquoting during a biotech boot camp at Montgomery College.

The Supply Chain Hub encourages community colleges to offer supply chain projects that provide students with work-setting experiences such as following standard operating procedures to manufacture biotech reagents and kits.

"I have been involved with the ATE community since 2021, and it's been such an impactful experience seeing how these educators are shaping the future of our bioeconomy. It was the first time I was meeting many of my colleagues in person, and it was such a welcoming experience. Thank you to everyone that made this happen."

Miko Mallari
Research Technician, University of California, Berkeley
2022 Graduate of City College of San Francisco
2023 Antibody Engineers Hackathon Participant

Featured ATE Project

Expanding a Multi-Skilled STEM Technician Pipeline to Meet Industry Needs (Bio Blend 2.0)

Key Activities

- Partners with organizations that support individuals on the autism spectrum
- Provides professional development in neurodiversity and the Universal Design for Learning (UDL) framework for college faculty, industry partners, and high school career counselors and teachers
- Hosts and co-instructs a work-preparation boot camp for students on the autism spectrum

Johnston Community College
Smithfield, NC

https://bit.ly/atebioblend

Bio Blend 2.0 Innovations Scale Easily to Add Neurodiversity into STEM Workforce Programs

Bio Blend 2.0 partners with industry, public schools, and autism service providers to increase the number of individuals on the autism spectrum who are employed as biotechnicians.

By applying promising practices from Bio Blend 1.0, a previous ATE-funded project, this project offers distributed controlled software (DCS) instruction on DeltaV™, an automation system used in biomanufacturing. Students who complete DCS instruction earn industry-recognized certificates.

One of the biotech instructors also co-teaches a boot camp developed by TEACCH Autism Program that places students in campus internships.

Meshing its innovations with UDL professional development offered by CAST, a nonprofit organization, the project teaches faculty how to accommodate more diverse learning styles. The project and CAST are also developing an e-folio to increase accessibility for all students.

Community Outreach Includes Autism 101 Course for Employers

Bio Blend 2.0 offers Autism 101, a course that teaches employers how to support individuals on the autism spectrum in the workplace. Industry partners offer workplace tours to Johnston Community College students, high school educators, and high school special population coordinators. They also offer internships.

Biotechnology students learn how to operate distributed control systems such as DeltaV.

Building a Cell Therapy and Flow Cytometry Workforce (Cell Therapy Workforce)

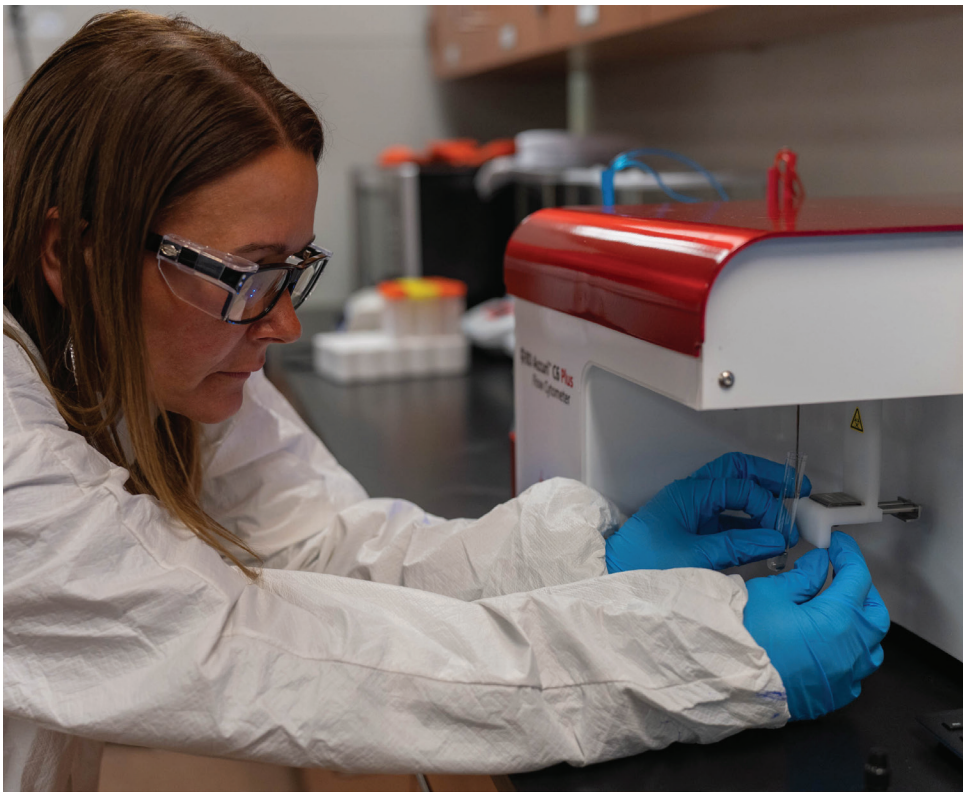
Entry-Level Technicians Gain Specialized Biopharmaceutical Industry Skills

The Cell Therapy Workforce project aims to meet the cell and gene therapy workforce needs, which are growing rapidly in the Mid-Atlantic states. Flow cytometry is an important analytical tool used in the biopharmaceutical industry. As the industry grows, flow cytometry, which had been done by people with graduate degrees in research labs, is moving to biomanufacturing floors.

This project is the first in the nation to focus solely on flow cytometry and to offer an affordable education option for the entry-level technicians that employers want to hire. The project is also building awareness of this transformative field of cell and gene therapy and its career opportunities.

BILT Shapes Workforce-Relevant Curriculum

The cell therapy and flow cytometry course was developed by the project's business and industry leadership team (BILT) of people who are all involved in manufacturing cell therapy products. A subject-matter expert from industry teaches the course and helps students to understand the important aspects of the techniques that are relevant on the job.



A student loads a sample on the flow cytometer.

Key Activities

- Creates an affordable technician education program to meet regional workforce needs
- Builds a pipeline of students ready to enter the technical workforce

Frederick Community College
Frederick, MD

https://ate.is/Cell-Therapy-Workforce

Featured ATE Project

Expanding the Biotech Pipeline to Adults Seeking Reemployment (EBPASR)

Key Activities

- Places 90% to 100% of each student cohort in biotech jobs
- Implements equity and inclusion in the classroom
- Contextualizes soft skills
- Fosters teamwork, self-efficacy, and retention
- Facilitates job offers after on-campus interviews
- Offers a successful classroom-to-career pathway for adults seeking reemployment

Los Angeles Mission College
Sylmar, CA

https://bit.ly/ateebpasr

Dynamic Program Creates Career Pathways for Residents of Economically Challenged Areas

EBPASR's project-based learning curriculum awards stackable certificates leading to an associate degree in biotechnology. By helping students gain employment at biotech companies while continuing their education, the project is creating a career pathway in an economically challenged area. At the same time, employers are benefiting from hiring qualified technicians.

From fall 2021 through spring 2023, 55 of 56 EBPASR students who sought biotech jobs were hired after one semester.

EBPASR Job Placements

Semester	Students Seeking Biotech Jobs	Students Hired
Spring 2021	11	11
Fall 2021	9	9
Spring 2022	10	10
Fall 2022	13	12
Spring 2023	13	13
Total	**56**	**55**

Nearly every EBPASR student who has wanted a biotech job has been hired after earning a certificate upon completion of one semester in the program.

"Grifols Biologicals LLC, with [its] mission to improve the health of people around the world, has partnered with the Los Angeles Mission College Biotechnology Certificate Program for several years. We are proud of the work and dedication that the faculty provide to their students. We count on this program to supply our company with job-ready candidates, and they continue to succeed in that endeavor."

Guillermo "Willie" Zuñiga
Emeritus President, Grifols Biologicals LLC
Glendora, CA

Expansion, Curriculum Evolution, and Enhancement during BioTechnician Training (ExCEEd BTT)

Bio/Chem

Students Quickly Acquire In-Demand Biotech Skills through ExCEEd BTT

ExCEEd BTT expands the successful Biomedical Technician Training Program, which The Wistar Institute and the Community College of Philadelphia have offered since 2000, to students enrolled at other community colleges in Southeastern Pennsylvania and New Jersey.

The 12-week summer program incorporates a novel, project-based curriculum using Wistar cancer research. Students selected for the program must have completed prerequisite courses in biology or biotechnology, and chemistry. After learning in-demand laboratory skills through hands-on experiments in Wistar's Training Lab, the students embark on lab experiences where they apply these skills and learn more advanced techniques.

This accelerated model of the BTT Program replaces the original iteration that required attendance during two consecutive summers. More students at different stages of their education and career can now prepare for positions as laboratory technicians or research assistants in both academic and industry labs.

All 15 of the ExCEEd BTT participants in 2022 completed the program. Seven completers obtained biotech employment; 14 continued their education. The students' self-assessments indicate they made gains in thinking and working like a scientist, in research work, and in learning the skills, attitudes, and behaviors of a researcher.

Community College of Philadelphia students work on calculations for cancer research in the Wistar Training Lab.

Photo Courtesy of The Wistar Institute

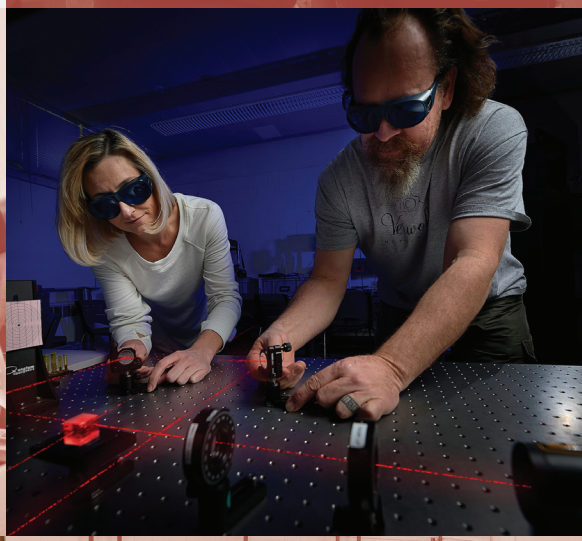
Key Activities

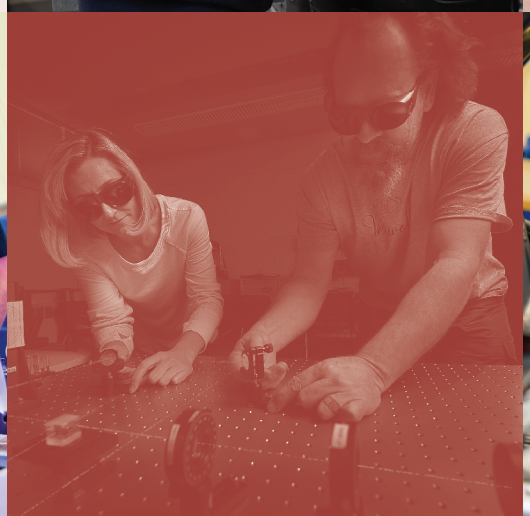
- Expands long-running Biomedical Technician Training (BTT) Program to additional students at more community colleges in the Greater Philadelphia region
- Updates curriculum to use authentic Wistar research to teach biomedical laboratory skills
- Enhances program with experiences in academic, industry, and shared resource labs

The Wistar Institute
Philadelphia, PA

https://wistar.org/education-training/biomedical-technician-training-program

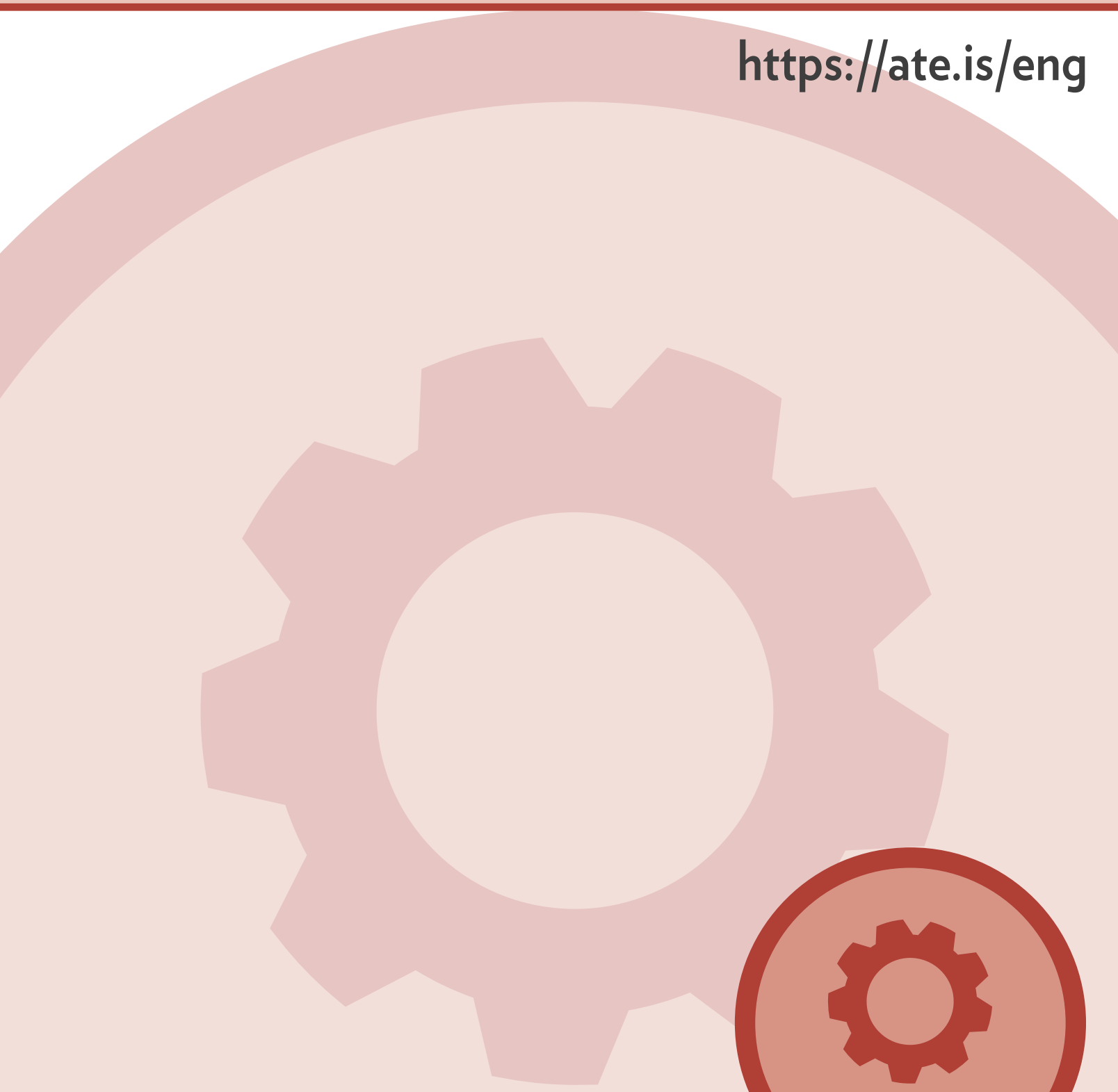
ATE @30





Engineering Technologies

https://ate.is/eng



A facilities maintenance apprentice troubleshoots a building automation controller by using a Bluetooth connection device at Milwaukee Area Technical College, a BEST partner.

BEST

Building Efficiency for a Sustainable Tomorrow Center

Urgent Need to Decarbonize Buildings Places New Demands on Building Technicians & Educators

National, state, and municipal energy codes, ordinances, and policies are pushing residential and commercial building owners to increase energy efficiency and lower the carbon footprint of their buildings. As electricity is substituted for gas and more renewable energy enters the grid, commercial and residential energy users will have to manage energy use in new ways to address imbalances between electricity supply and demand on the grid.

To help faculty prepare students for careers in the building science and engineering sector, BEST provides professional development that addresses policy changes, explores the changing technical landscape, and provides effective instructional practices to support student learning.

BEST workshops and institutes emphasize project-based learning in building automation systems, advances in heat pump technology and electrical load management, and the implications of decarbonization on workforce development.

Students at Milwaukee Area Technical College, which uses BEST's curriculum, install a pressure switch to determine if an air filter is dirty.

Key Activities

- Supports development of project-based learning strategies in building automation systems (BAS); commercial heating, ventilation, and air conditioning (HVAC); and energy management technical education programs
- Collaborates with national labs, industry partners, and college faculty to disseminate technical, policy, and workforce-based developments impacting building technician education
- Offers national professional certification in high-performance building operations
- Promotes recruitment of students and faculty from underserved communities

BEST Launches High-Performance Building Operations Professional Certification

BEST launched the High-Performance Building Operations Professional (HPBOP) certification in spring 2023. The certification meets International Standards Organization (ISO) 17024 requirements as well as the accreditation guidelines of the American National Standards Institute (ANSI). By hitting these benchmarks, the credential sets the national standard for the knowledge, skills, and attitudes (KSAs) required for building technicians to operate and maintain high-performance commercial buildings for safety, health, and sustainability.

BEST is completing curriculum guidance to help two-year colleges align their programs with the certification.

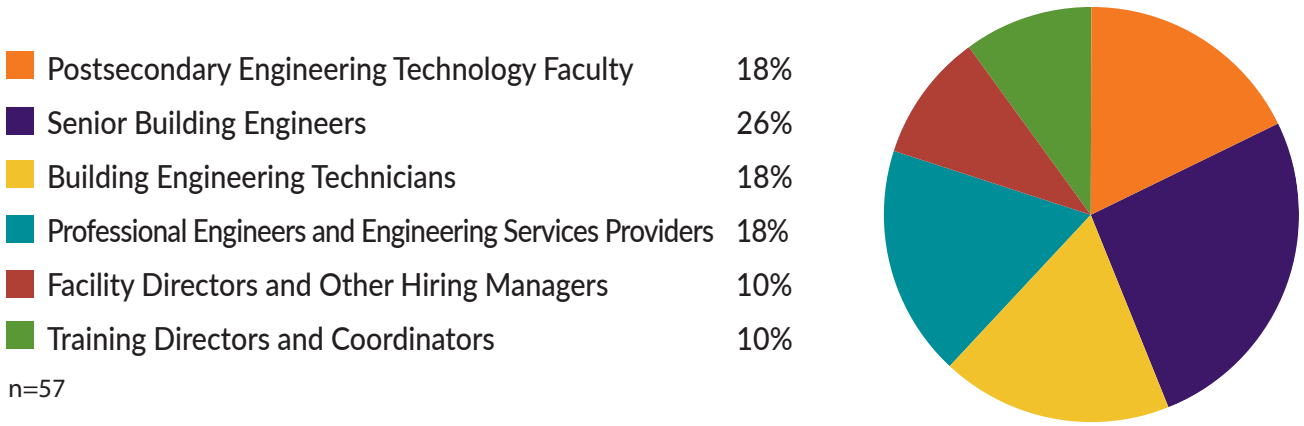
HPBOP Certification Pilot Attracts Cross-Section of Technical Professionals

The HPBOP candidate eligibility criteria allow a wide range of technical professionals to qualify for the exam and to earn the certification. As a result, applicants for BEST's pilot test have come from diverse educational and work backgrounds. They include practitioners with two- or four-year college degrees, tradespeople, facility managers, educators, and others. The broad appeal can potentially reinforce the need for this vital credential.

"The HPBOP certification can provide important benefits. For the environment, high-performing buildings will have a smaller carbon footprint to reduce the impact on climate change. For owners, improved performance will lead to reduced operating costs and improved tenant satisfaction. For technicians, greater opportunities for advancement and wage growth are possible."

Rodney Schauf
Director of Engineering
Sheraton Grand Hotel
Seattle, WA

Qualified Applicants for HPBOP Certification



The chart identifies the various groups and percentages of practitioners who in mid-2023 qualified to test for and obtain the High-Performance Building Operations Professional certification.

Building and programming robots are key activities at CAAT's STEAM Career Camps.

CAAT

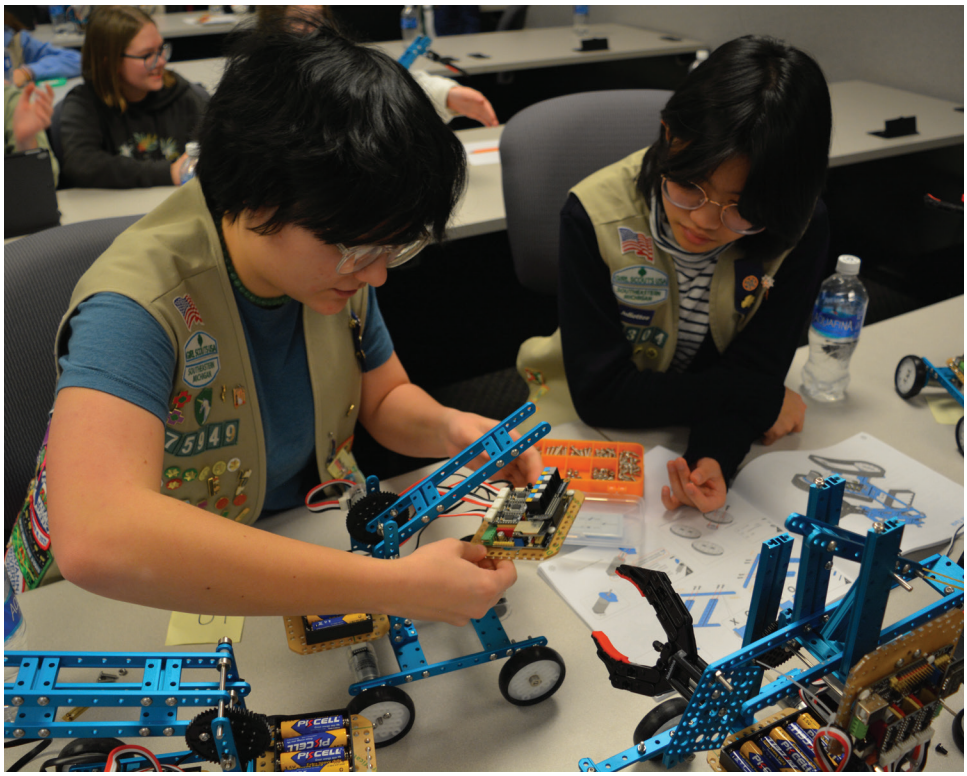
Center for Advanced Automotive Technology

CAAT Offers STEAM Interactions Early in the Career Decision-Making Process

In response to research that students, particularly girls, make career decisions in middle school, CAAT offers young adolescents weeklong summer camps and briefer mid-winter workshops to learn about science, technology, engineering, art, and mathematics (STEAM) careers.

In February 2023 CAAT collaborated with the National Center for Autonomous Technologies (NCAT) and Texas Instruments Education Technology to provide interactive, hands-on activities for middle school students at a two-day STEAM Career Camp.

Also in February 2023 CAAT hosted a workshop where 40 Girl Scouts in grades five to nine designed, built, and programmed their own robots. The workshop concluded with the girls demonstrating what they programmed their creations to do.



CAAT partners with the Girl Scouts and other organizations on programs that introduce young adolescents, particularly girls, to engineering technology careers.

Key Activities

- Develops and distributes open source, industry-approved curricula for electric vehicle technician education, including workforce training modules crafted from degree program courses
- Connects industry, academia, and government agencies to ensure that education programs meet employers' needs and expectations for technicians in multiple automotive industry sectors

CAAT Helps with Skill Standards

To help develop curriculum and training standards for automotive technicians working on high-voltage, electrified vehicles (EV)—including fuel cell vehicles—CAAT partnered with Central Oregon Community College and Rio Hondo College on the Northwest Engineering and Vehicle Technology Exchange (NEVTEX), another ATE project. NEVTEX materials can be accessed from CAAT's website and resource library.

> *"Macomb-CAAT has been singled out as a significant player by many of our partners in EV and Mobility in the Detroit region. We appreciate the effort you put into EV Jobs Academy."*
>
> Bernard Swiecki
> Vice President, Mobility & Research
> Detroit Regional Partnership

CAAT Reconfigures EV Courses for Workforce Training

Original equipment manufacturers, who have long partnered with CAAT, requested that the center rework aspects of the EV technician degree curriculum it developed about 10 years ago into modules for workforce training. In 2023 CAAT began offering its new Electric Vehicle Safety Program to upskill service technicians employed by Denso, GKN Automotive, Borg Warner, and others. Modules designed for quick, flexible delivery are utilized in the 64 hours of instruction that helps technicians transition from mechanical-based automotive work to electrical system-based automotive work.

Unique Partnership Provides Students with Research Opportunities

CAAT partners with Wayne State University, which built an Advanced Technology Education Center adjacent to Macomb Community College's South Campus. This center is the site for a unique collaboration that offers students the opportunity to participate in research on electric vehicle and automotive battery technologies. Instructors from both institutions lead the research projects.

CAAT Responses to Automotive Industry Needs

Year Priorities Identified	Technicians With	New Program & Year Launched
2016 & 2017	Mechanical, Electrical & Software Skills	Vehicle Engineering Technician Associate of Applied Science Degree (2018)
2019	Embedded Microcontroller Programming Skills	Automotive Cybersecurity Course (2020) Embedded C Programming for Automotive Systems Course (2020)
2021	Electrified Powertrain Knowledge	Hybrid Electric Vehicle Course (2022)
2022 & 2023	Battery Electric Vehicle Maintenance Skills	Electric Vehicle Safety Certificate Program (2023) High-Voltage Vehicle Courses (Coming in 2024)

With information from its academic and automotive industry partners, CAAT develops programs to educate technicians for new and emerging technologies.

Indian River State College students demonstrate laser systems to US Congressman Brian Mast during the Optics and Photonics Symposium convened by LASER-TEC.

LASER-TEC

Center for Laser and Fiber Optics Education

LASER-TEC Provides Open Resources & Mentors Faculty

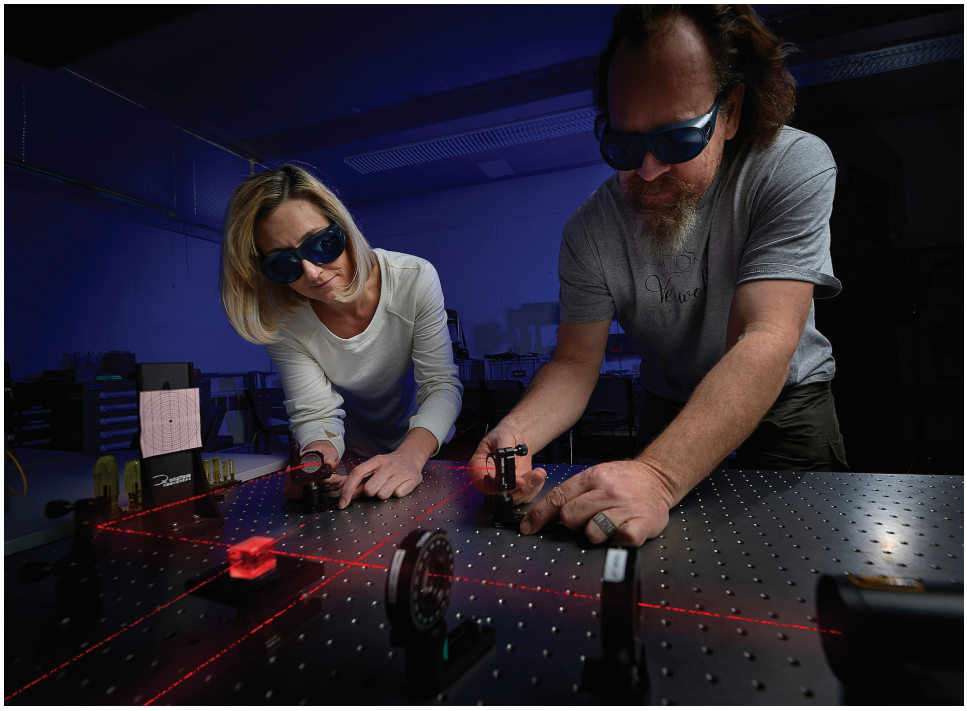
LASER-TEC focuses on broadening and improving photonics educational resources for two-year colleges, K-12 schools, and industry training programs. The center achieves that by providing open access to more than 80 educational resources—including complete course materials, textbooks, lab books, teaching guides, and video lectures—through its Library of Open Educational Resources.

LASER-TEC mentors faculty and college administrators to help launch optics and photonics technician programs. To help with costs, it distributes its low-cost LASER-TEC experiment kit with instructional guidance materials.

The center also provides a platform for upskilling photonics technicians in emerging fields such as wide band gap (WBG) semiconductors and quantum technologies. LASER-TEC has partnered with Manufacturing USA Institute Power America to develop three educational modules on WBG technologies suitable for the two-year college curriculum. In addition, LASER-TEC is supporting development of training facilities for future photonics quantum technicians in partnership with NSF ATE project EdQuantum.

Key Activities

- Supports the expansion of the photonics technical workforce by leveraging legislative, industry, and academic partnerships
- Curates and distributes photonics open educational resources
- Develops instructional materials to align photonics education to the current industry needs



Gallatin College uses LASER-TEC's curriculum, which includes lab exercises on aligning laser systems.

LASER-TEC Fosters Ecosystem to Grow Photonics Workforce

LASER-TEC fosters an ecosystem to recruit and educate individuals to be technicians who can maintain, test, and troubleshoot photonics components and systems. It brings together educators, legislators, and representatives of professional organizations and industry clusters to address challenges in building the photonics workforce.

LASER-TEC leads these critical dialogs to help shape national partnership initiatives and college photonics student support programs. For example, with assistance from LASER-TEC, photonics and optics professional societies joined by individual companies launched a pilot program in 2023 to award tuition assistance to two-year college students who enroll in optics and photonics degree program that lead to technician careers.

LASER-TEC also convened the Optics and Photonics Symposium at Indian River State College in April 2023 to provide an engaging platform for stakeholder collaboration. More than 100 attendees from industry, academia, and government throughout the United States—including leaders from the International Optics and Photonics Society, OPTICA, AmeriCOM, and senior representatives from the Lawrence Livermore National Lab—met to discuss photonics and optics technologies. This dialogue about the impact of these technologies on space exploration, defense, energy, advanced manufacturing, telecommunications, and healthcare brought a spotlight on the optics and photonics talent shortage. The attendees pledged their support to LASER-TEC and the center's initiatives to expand the workforce pipeline.

"LASER-TEC's strategic and collaborative synergy with the photonics industry illuminates the much-needed path to progress, where innovation and expertise converge to carve a brighter future for photonics technology and workforce development. LASER-TEC's efforts and resources have paved the way for the next generation of a skilled photonics workforce that is extremely important as national security and modern industry rely heavily on this emerging technology."

Justin Jensen
Sales Manager, InfraTec Infared
LASER-TEC National Visiting Committee Member

LASER-TEC Open Educational Resources

3	6	6	6	10	21	27
Experiment Kits	Complete Courses	Textbooks	Laboratory Manuals and Teacher Guides	Classroom and Support Materials	Informational Materials	Educational Modules

The open educational resources created and curated by LASER-TEC, which are shared from its website library, were developed by subject-matter experts. They were peer-reviewed to ensure they are complete, relevant, and accurate. Currently, there are 31 colleges with optics and photonics programs, and they all use LASER-TEC curricula.

Increasing participation of historically underrepresented populations and providing students with access to ocean technology professionals are core goals of the MATE ROV Competition.

MATE II

MATE Inspiration for Innovation

ATE Funding Supports Community College Participation in MATE ROV Competition

While it has evolved and expanded over time, the MATE organization remains committed to providing access to opportunities for community and technical college students. With the support of ATE, the MATE ROV Competition has developed resources and facilitated access to mentors—from experienced faculty to working professionals—to increase community and technical college participation in the program.

MATE developed a new competition class—PIONEER—specifically for first-time competitors from community and technical colleges. This is similar to what MATE did with other NSF support to develop middle and high school teams, which compete in the NAVIGATOR class. These classes accommodate students' needs and serve as stepping stones between the beginner and intermediate levels of the competition.

In addition to the SeaMATE "Eagle Ray" starter kit with ROV parts and instructional materials, MATE provides two-year college teams with travel support to attend competitions.

Key Activities

- Engages students and faculty via the MATE Remotely Operated Vehicle (ROV) Competition
- Supports community college participation in the MATE ROV Competition
- Provides professional development for faculty
- Offers career management resources for students

Companies like Saildrone that partner with MATE II benefit from direct access to students with technical and employability skills like those developed through participation in the MATE ROV Competition.

MATE II & Marine Technology Society Join Forces to Inspire the Next Generation of Ocean Leaders

In 2023 MATE II became part of the Marine Technology Society (MTS). For both organizations the merger enhances opportunities to coordinate on synergistic efforts.

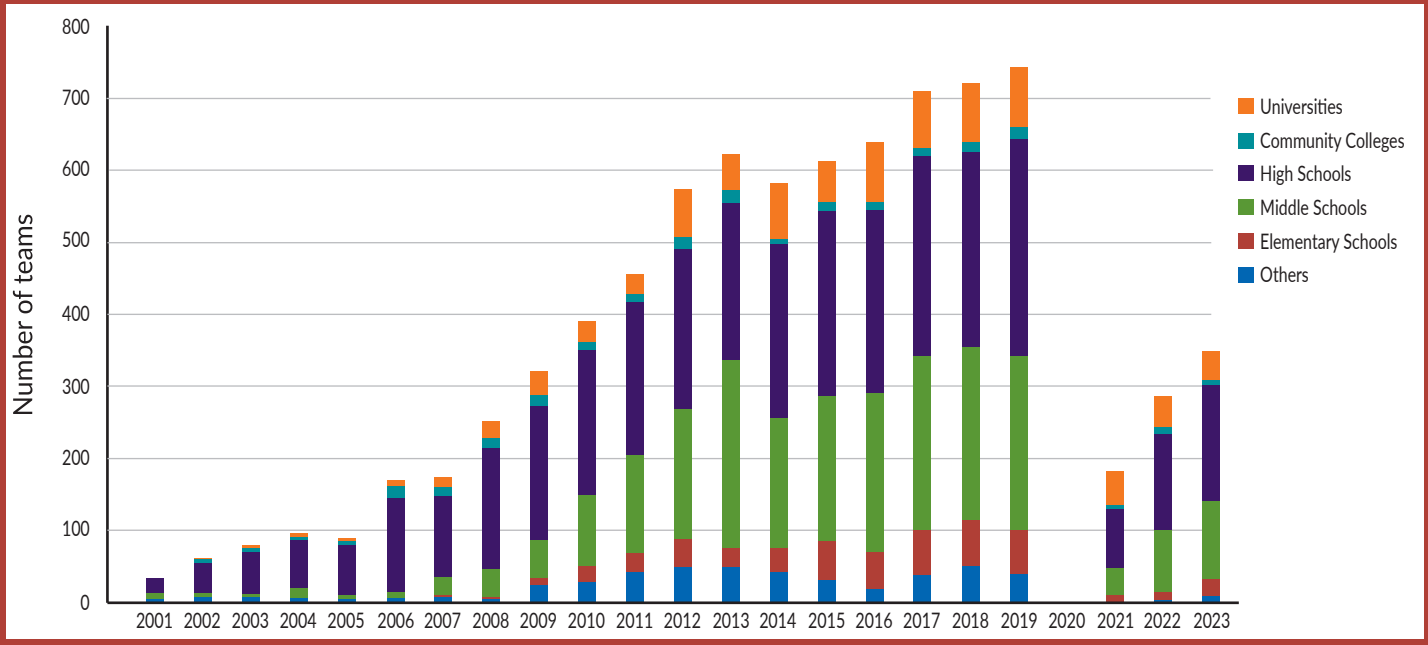
MATE and MTS have a long history of working together. In 2000 they collaborated to design the MATE ROV Competition as a workforce development platform for the maritime industry. The competition became a key outreach activity for MATE, which began as an ATE center in 1997 at Monterey Peninsula College. In 2016 the principals of the MATE Center formed MATE II as a nonprofit organization to sustain the education activities initiated by the MATE Center.

Now as part of MTS, MATE has increased capacity to expand and grow its impact on students and the technical workforce. For example, connecting MATE regional programs with MTS professional sections is creating regional marine technology ecosystems or "hubs" that include a workforce development pipeline. Hub participants generate ideas and feed innovation to advance both technical education and technologies that address global challenges.

"As an older person I have been thoroughly impressed by what the MATE family has created and nurtured over the past couple of decades. Seeing it up close was an eye-opening experience. MATE is getting kids interested in STEM, hopefully paving the way for them to rectify some problems from my generation's apathetic response to global warming."

Kevin Brooks
2023 Southwest Virginia Community College Graduate
Cedar Bluff, VA

Participation in MATE ROV Competitions by Academic Sector 2001 to 2023



Participation in the MATE ROV Competition is rebounding from the disruptions of the COVID-19 pandemic.

Students at Northland Community and Technical College, NCAT's host institution, learn about drone assembly and maintenance from a college instructor who is an NCAT team member.

NCAT

National Center for Autonomous Technologies

NCAT Creates a Model for Academia & Industry Collaboration

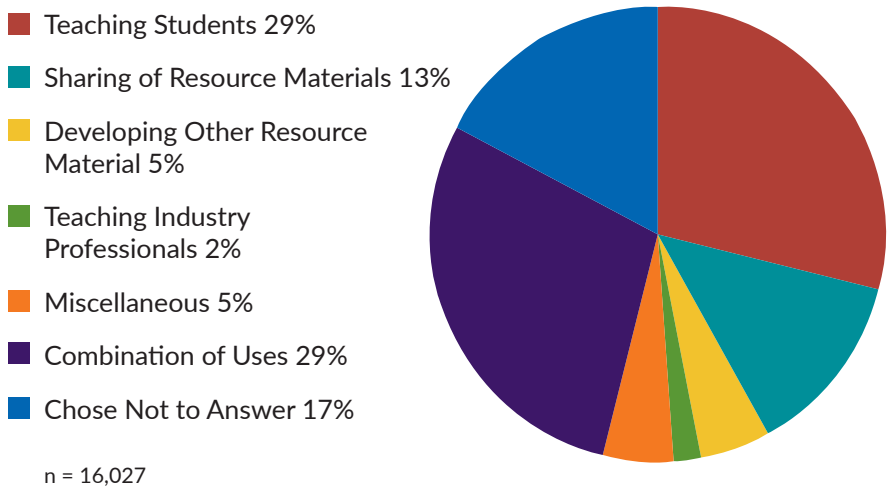
NCAT collaborated with the Colorado School of Mines Center to Advance the Science of Exploration to Reclamation in Mining (CASERM), the North Dakota State College of Science, and the Nebraska Indian Community College to locate geological markers for precious metals in areas of Arizona and Nevada. Two-year college students, who are majoring in uncrewed aircraft systems, along with their instructors, operated a drone equipped with hyperspectral imaging that generated data for CASERM graduate students and professors. NCAT plans to continue working with CASERM on future projects.

NCAT is developing this highly valuable learning experience into a model for collaboration between two-year technical colleges, industries, and public research universities. When the model is complete, NCAT will promote it to the 120 institutions participating in the Federal Aviation Administration Unmanned Aircraft Systems Collegiate Training Initiative.

Key Activities

- Defines skill standards and offers professional development opportunities for educators and industry professionals
- Promotes and provides support to encourage engagement in STEM and autonomous technologies in secondary and postsecondary education, particularly in underserved areas
- Engages workforce and community stakeholders, generating added value in programs and the workplace through opportunities using autonomous technologies
- Provides the educational resources for curriculum interactive content, application, and exchange of ideas for teaching about autonomous technologies across the country

Intended Uses of Downloaded Curricula



n = 16,027

As a hub for autonomous technology curricula, the NCAT website provides educators, students, government agencies, and professional and non-profit organizations with downloadable educational materials about autonomous vehicles that operate in air, land, or sea. Between July 2022 and June 2023 there were 19,310 curricula downloads from NCAT's website. A survey about intended uses of the curricula had 16,027 responses.

Core Standard Developed by NCAT Guides Preparation of Students for Careers Utilizing Air, Land & Sea Autonomous Systems

Since 2021, NCAT has led a national effort to define the knowledge, skills, and abilities of autonomous vehicle technicians. This effort generated the autonomous systems technician core standard, which defines the common competencies for technicians across air, land, and seagoing systems. Part of the development of the core standard requires examining current certification exams and other requirements in place for one autonomous domain and determining if they are applicable to the other domains. By using this cross-domain core standard, educational institutions can properly prepare students for multiple career pathways.

Experience STEAM Framework Focuses on Underserved Populations

NCAT also created Experience STEAM, its experiential learning framework. With rigorous attention to the needs of historically underserved populations, this framework utilizes non-traditional outreach settings and methods to inspire students and to encourage discussions about education and technical career pathways.

In August 2022 NCAT teamed up with Mall of America to promote technology and technician career fields. Twenty-six ATE projects and centers and 31 other entities—corporations, nonprofit organizations, and academic institutions—participated in the four-day program at the Minnesota mall.

"With the increased investment and focus on advanced aviation, the leadership in AAM [Advanced Air Mobility] initiative will play a significant role in the next three to five years as training standards and programs are being developed. Incorporating industry feedback at this early stage will mitigate a delay that might be seen related to technical careers as we approach the projected timeline for the integration of these systems."

Keely Griffith
Vice President, Strategic Programs
Association for Uncrewed Vehicle Systems International
Arlington, VA

In February 2023 NCAT held Experience Northland to raise awareness of autonomous technology careers among the residents of the rural communities served by its host institution, Northland Community and Technical College. Both events provided diverse groups of teens and adults with insights into exciting career opportunities in autonomous technology.

NCAT and partners from Nebraska Indian Community College and two research universities use drones with hyperspectral cameras to search for precious metals to be mined. Another drone captured an aerial photo of the collaboration, which NCAT promotes as a model.

Access to Careers in Advanced Building Technology (ACABT)

Key Activities

- Conducts workshops targeting underserved communities
- Participates in community outreach events to increase awareness of the building automated systems (BAS) program
- Leverages partnerships with internal and external stakeholders
- Develops a business industry leadership team (BILT) advisory model to strengthen industry partnerships

Milwaukee Area Technical College
Milwaukee, WI

https://ate.is/ACABT

ACABT Connects with Underserved Populations through Hands-On Workshops at Local Organizations

ACABT reaches out to residents of underserved urban communities within Milwaukee County to inform them of career opportunities in advanced building technology. ACABT workshops are coordinated with established community-based organizations (CBOs) that are already providing aligned services to the project's target audience. Successes include increasing enrollment of individuals from underserved areas and raising awareness of the BAS program in the community. Also, by leveraging contacts of the local CBOs, the ACABT team has identified additional cohorts, such as veterans associations, that are interested in the BAS program.

Leveraging MATC's Internal Teams Yields Positive Results

By tapping into the strengths of Milwaukee Area Technical College's (MATC) internal teams, the ACABT project has realized multiple positive outcomes. The college's pathway advisors attend ACABT workshops and help individuals who want to enroll do so immediately. Recruiters participate in open houses, providing prospective ACABT students with info about student support services. ACABT students also benefit from Career Hub specialists posting relevant job opportunities on Handshake, MATC's online job site.

ACABT teaches students a wide array of skills, including how to check control signals to verify a motor's operating speed.

Building Equity for Aerospace Training (BEAT)

BEAT Helps Educators Recruit Underrepresented Populations to Aerospace

Building Equity for Aerospace Training (BEAT) is increasing the confidence and capacity of educators and advisors to encourage young women to enter and persist in aerospace education.

Professional development for educators is providing equity-based teaching strategies that will increase access and achievement for students underrepresented in STEM fields. Summer institutes offer educators both hands-on experiences with aerospace companies and curriculum to increase instructor understanding and confidence.

Female Aerospace Employees Share Their Stories at Girls in Aviation Day

March 2023 saw BEAT and Everett Community College host Girls in Aviation Day. Employees of Erin Air, Boeing, Aviation Technical Services, and Hobart Machined Products shared their experiences as women in the aerospace industry. Speakers provided insights about overcoming challenges, the lessons they have learned, and how they have succeeded in a male-dominated industry.

In the afternoon the girls completed hands-on projects. Using clippers and pliers, they assembled metal airplane models and planned how parts fit together. The day concluded with the girls flying drones on a challenging course in the college's hangar.

An aircraft maintenance technology student inspects and adjusts an airplane engine.

Key Activities

- Encourages young women to enter aerospace education pathways
- Trains educators in equity-based teaching strategies
- Introduces students to female role models in aerospace
- Provides hands-on aerospace projects for girls

Everett Community College
Everett, WA

https://ate.is/BEAT

Featured ATE Project

Expanding Regional Capacity for Training in Engineering Technology and Data Center Operations (DCO Tech)

Key Activities

- Delivers an engineering technology bridge program that provides secondary students with college credit, an industry certification, and industry site visits
- Provides externships for K-12 teachers, counselors, and administrators to expand their knowledge of regional engineering technology pathways
- Prepares students for internships with a career development program

Northern Virginia Community College
Annandale, VA

https://nvcc.edu/dcotech

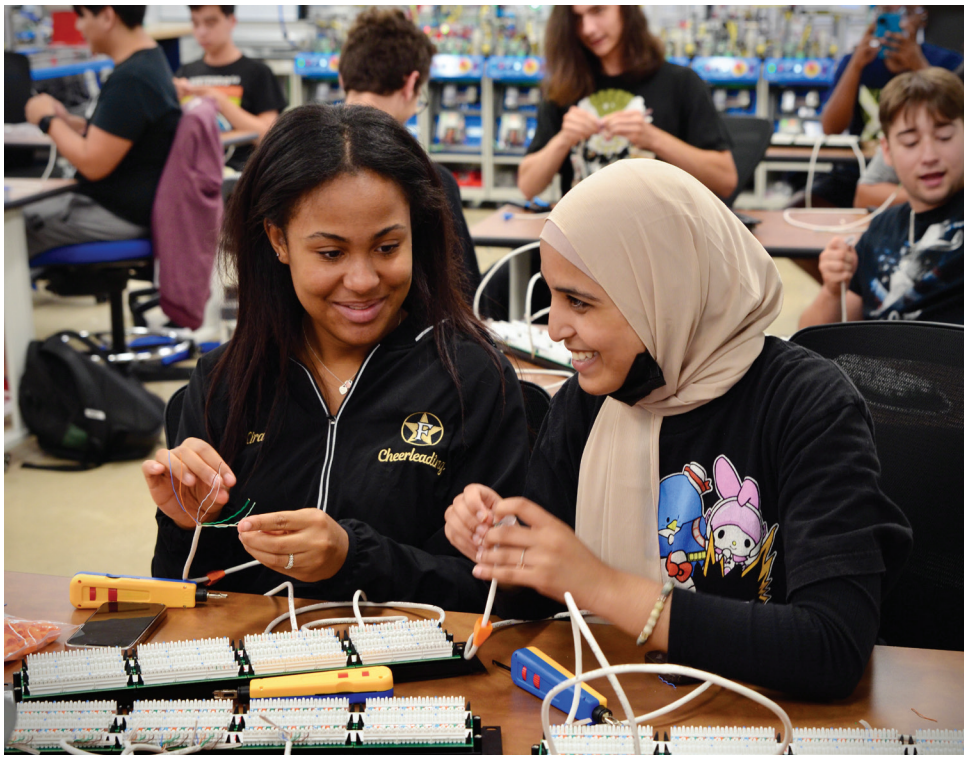
DCO Tech Helps Students, Educators & Employers

DCO Tech improves regional pathways for students in data center operations and engineering technology fields. By fostering collaboration between employers, K-12 educators, and the college's faculty, this project builds community awareness and prepares students for in-demand careers. DCO Tech strengthens relationships between these stakeholders, setting the stage for increased cooperation to support a rapidly growing field.

Industry Partners Offer Data Center Learning Experiences

Employers are active partners in student recruitment and educational programming. Partners Micron Technology, Inc., and STACK Infrastructure support high school summer bridge programs, collegiate career development activities, and educator externships. Sixty-four educators participated in the externships between fall 2021 and spring 2023.

Micron hosts six tours of its advanced semiconductor fabrication facility annually, introducing students and teachers alike to this critical manufacturing field. In addition to tours, college personnel teach two days of the Engineering Technology Bridge Program at STACK, allowing students to work hands-on in an operational data center.



DCO Tech students learn to wire and configure modern communication systems.

Hybrid Curriculum for Upskilling Photonics Technicians in Quantum Technologies (EdQuantum)

Eng

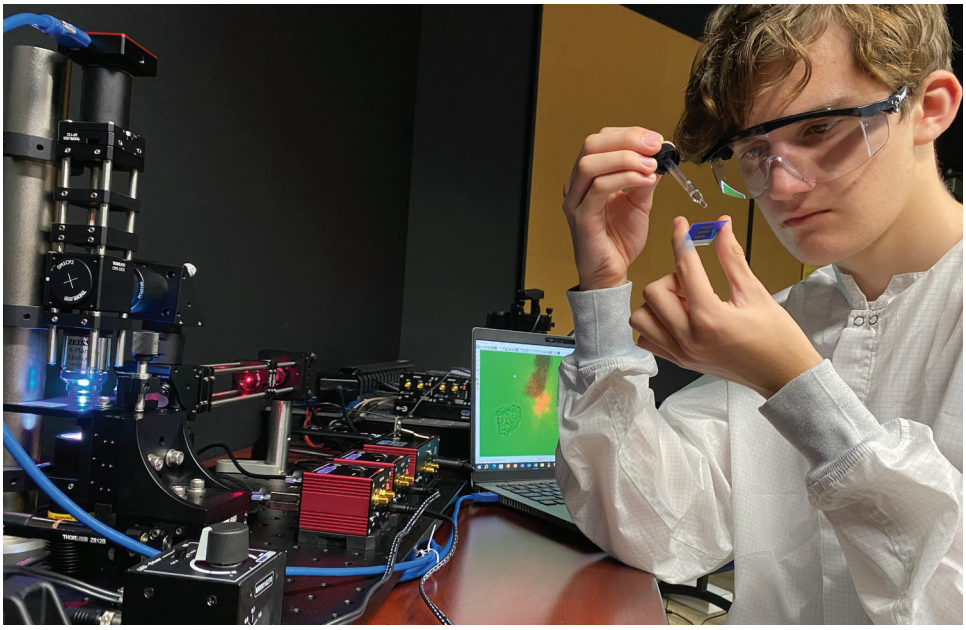
EdQuantum Helps Colleges Add Instruction in Emerging Field

EdQuantum pioneers the introduction of the complex subject of quantum science into advanced technological education programs. The quantum curriculum will be delivered through an open-access platform to reduce geographic barriers between colleges, students, and companies making quantum research-enabled products. This approach aims to add diversity to the skilled technical workforce, remove social barriers, foster equal economic growth across the nation, and help ensure US leadership in this emerging field.

Experts' Responses Shape Curriculum for Quantum Technicians

The project surveyed 24 professionals from industry and academia with quantum science expertise. Their responses identified the skills and competencies quantum technicians need to know and were reported in the Journal of Optical Engineering.

EdQuantum used the survey results to create a comprehensive quantum curriculum framework that combines theory and hands-on activities. Parts of the curriculum have been piloted at Central Carolina College (Lillington, NC), Samueli Academy (Santa Ana, CA), and the SPIE Defense + Commercial Sensing Conference (Orlando, FL).



A student prepares a sample for an optical tweezer that manipulates cells and other microscopic particles for biophysics, nanotechnology, and microfabrication processes.

Key Activities

- Partners with industry experts to conduct competency gap analysis in quantum technologies
- Builds a framework for a cohesive hybrid curriculum in quantum technologies to meet industry needs
- Develops content and materials for quantum science courses
- Creates a sustainable and open-access, technology-enabled learning environment for online delivery of quantum science lessons

Indian River State College
Fort Pierce, FL

https://edquantum.org

Flexible Learning for Industrial Technology Education (FLITE)

Key Activities

- Offers an open lab for industrial-based equipment with reconfigured instructional design for students to complete hands-on portions of online and hybrid classes
- Incorporates innovative student success resources, such as coaching and supplemental instruction
- Adapts curriculum to meet student, program, employee, and employer needs

Heartland Community College
Normal, IL

https://ate.is/FLITE

FLITE's Open Lab Complements Online & In-Person Instruction

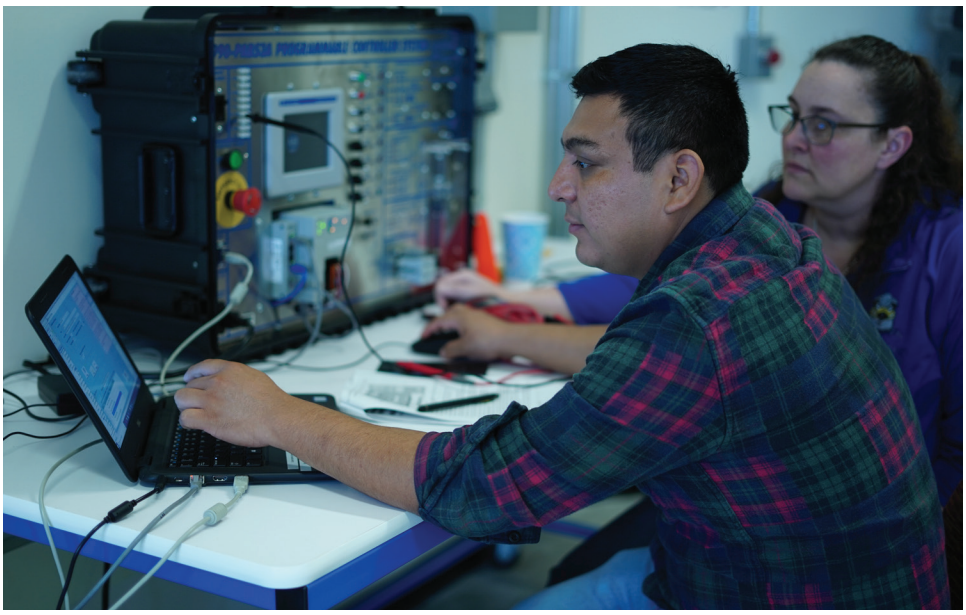
FLITE combines time-flexible, open-access labs for six courses. The courses cover industrial systems, building and industrial electricity, fluid power and mechanical systems, electrical wiring and maintenance, mechatronics, industrial and building controllers, and mechanical systems.

Students enrolled in face-to-face and online courses reported in focus groups and interviews that they like working at their own pace independently in the open-format lab. They like having extra time to do hands-on activities with face-to-face support from instructors and peer leaders when they need it.

FLITE Links Recruitment with Persistence Support

FLITE promotes equity through educational access by working with the Workforce Equity Initiative (WEI) to attract and retain previously underserved students. It also provides students with success coaches to help them persist.

FLITE increases awareness of industrial technology career opportunities at community events and recruitment visits to high schools. It also works with industry partners and its advisory committee members on dual credit, secondary school partnerships to enhance workforce pipelines and to promote career pathways.



Students learn to program mechatronics equipment and do other advanced manufacturing skills in the FLITE lab.

National Electric Vehicle Consortium (NEVC)

NEVC Aims to Help US Regain EV Edge

Thanks to more than 100 years of innovations, the EV industry is accelerating. However, the lack of a skilled EV workforce and several other factors mean the United States has fallen behind in this emerging transportation technology. NEVC is helping the United States regain the lead in EVs by bringing together a critical mass of academic, industry, and agency organizations to identify and address workforce education needs.

ATE Assets Help Launch EV Programs Quickly

The EV industry is an amazing example of converging fields that encompass manufacturing and mechatronics; autonomous elements built with lasers and photonics; energy storage; automotive maintenance repair and operations; environmental elements such as lithium mining and recycling; as well as a host of cybersecurity and other safety concerns. NEVC brings together the best of the ATE community so that existing technician education products can be repurposed rather than reinvented, and EV programs can be easily and quickly launched. NEVC partners include seven ATE centers, three ATE consortiums, and eleven ATE projects.

Hudson Valley Community College, an NEVC partner, cross-trains students in automotive technician and electrician programs to prepare them for the rapidly growing field of electric vehicle charging station design, installation, and service.

Key Activities

- Provides a venue for national collaborations across all electric vehicle (EV) sectors
- Supports the creation of industry standards and both industry and academic certificates
- Facilitates the convergence of technologies, such as lasers and global positioning systems, into EV education programs and with fields affected by EVs
- Aligns academia with the needs of the EV industry and addresses gaps
- Shares and replicates best practices

Indian River State College
Fort Pierce, FL

https://ate.is/NEVC

ATE @30


Enviroments
Computer Guts – Individual? Tutor
World
Car
Browser Window


MENARD'S
RIT


Network/Security
RIT


Enviroments
Computer Guts – Individual? Tutor
World
Car
Browser Window


MENARD'S
RIT


Network/Security
RIT

General Advanced Technological Education

https://ate.is/gen

Resources for teaching a wide array of advanced technology skills—from welding to nanotechnology—are freely available in ATE Central's resource collection, which provides access to content developed by ATE projects and centers.

ATE Central

Supporting Advanced Technological Education

ATE Central Collects & Utilizes Data to Broaden Impacts & Support Collaboration

As part of its mission to support and amplify the work of ATE grantees, ATE Central not only aggregates data about those funded by the ATE program, but also collects, catalogs, manages, and archives the innovative resources created by the community. This underlying data and metadata are utilized by the project team to showcase and share information about grantees and their work. This helps ATE projects and centers, as well as educators beyond the community, find collaborators in their field or geographic region.

ATE Central provides grantees and other educators with a rich storehouse of data and resources from the ATE community. From the map on the project's website to the ATE Fact Sheet, which provides a continuously-updated program overview, to the archiving service, ATE Central makes it possible for grantees' work to live on after their funding sunsets. The project continues to grow this critical body of data in order to share and showcase the work of ATE projects and centers, and support the growth of the United States' technical workforce programs.

Key Activities

- Promotes adoption and adaptation of innovative ATE resources by educators and industry partners
- Ensures long-term access and extended impact of the valuable deliverables created with National Science Foundation funding
- Fosters knowledge sharing, communication, and collaboration within and beyond the ATE community

Just as CREATE encourages educators at its Energy Institutes to work together during a hands-on lesson, many of ATE Central's services and resources provide opportunities for collaboration and support in the ATE community and beyond.

ATE Central Provides Cross-Cutting, High-Quality Resources & Services

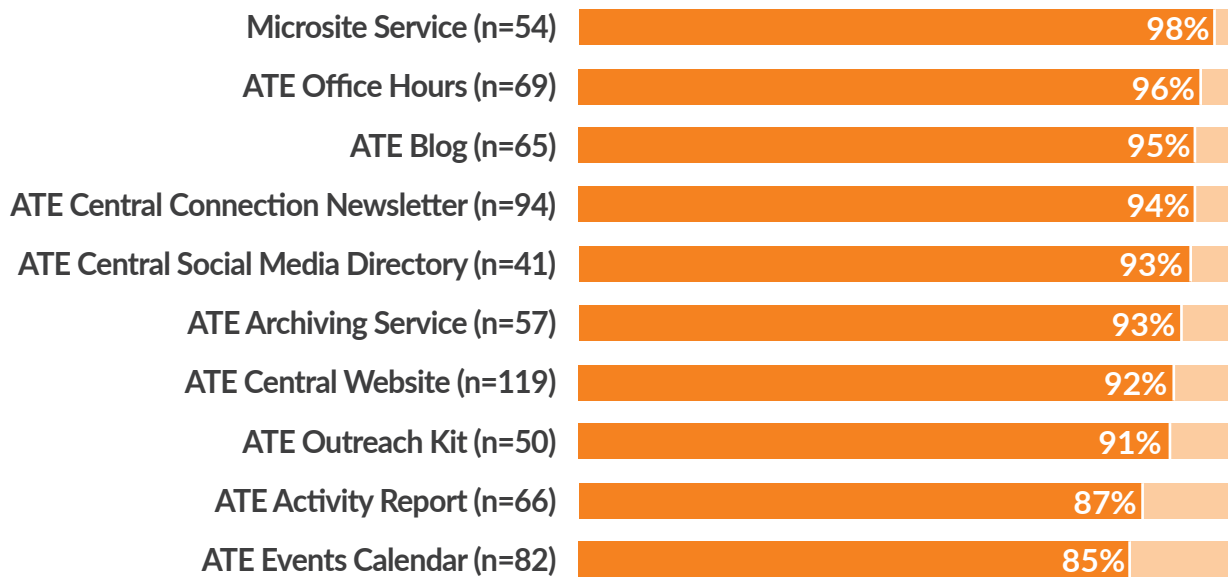
In its role as information hub for the ATE community, ATE Central provides grantees with access to a variety of information, resources, tools, publications, and services that can help amplify the innovative work of their projects and centers and ultimately strengthen the STEM technical workforce.

Many of the of the services and resources created by the ATE Central team are cross-cutting in that they speak to issues that impact all ATE grantees, regardless of the technical field, region of the country, or specific focus of their grant. These include areas like sustainability, outreach, data management, and accessibility.

Online and in-person events created by the project allow grantees to dig into topics, discover solutions, and find new partners and collaborators. Whether focused on specific issues like social media or archiving or broader topics like collaboration and data management, ATE Central provides grantees, as well as other educators and stakeholders, with access to a diverse set of high-quality cross-cutting services, resources, and events.

> *"By connecting with ATE Central, we were able to reach exactly the audience we were in search of: community college educators looking to learn about and discuss new resources for their classrooms and bring new opportunities to their students."*
>
> Kelly Sturner
> Learning Center Program Coordinator
> Institutional Partnerships
> Argonne National Laboratory
> Lemont, IL

Survey Respondents' Ratings of ATE Central Community Services



Data from ATE Central's Community Services Survey show that among those in the ATE community, satisfaction with ATE Central's products, tools, and services is high, as reflected in perceived quality ratings from respondents. In 2022, at least 85% of those ATE community members who responded rated every resource as "excellent," "very good," or "good" (dark orange). "Fair" and "poor" ratings are combined (light orange).

Deaf college students share their experiences with learning math at DeafTEC's National Math Conference.

DeafTEC

Technological Education Center for Deaf and Hard-of-Hearing Students

DeafTEC & AHEAD Expand Use of Best Practices

In partnership with the Association on Higher Education And Disabilities (AHEAD), DeafTEC is broadening professional development opportunities for faculty, specifically focusing on developing equitable higher education experiences for students with disabilities.

RIT
National Technical Institute for the Deaf
DeafTEC

DeafTEC supports community college teams to attend AHEAD's Equity & Excellence: Access in Higher Education Conference. The teams, consisting of a STEM faculty and a staff member from disability services, attend the conference to form a network of colleagues to share ideas and discuss issues and experiences in STEM programming for students who are deaf or hard of hearing as well as those students with other disabilities.

The conference concurrent session includes a DeafTEC track of eight presentations on issues regarding service provision and best practices for working with D/HH students and student veterans with hearing loss.

DeafTEC also partners with the National Technical Institute for the Deaf (NTID) Regional STEM Center to offer a national mathematics conference with the goal of bringing together educators from middle schools, high schools, and community colleges to collaborate on strategies and resources for teaching mathematics to D/HH students. Ninety-seven math educators attended the fourth DeafTEC-supported math conference in 2022.

CompTIA A+ boot camp participants learn hands-on computer support skills.

Key Activities

- Provides online resources for creating accessible and inclusive classrooms for deaf and hard-of-hearing (D/HH) students and student veterans with hearing loss
- Develops employers' awareness of D/HH individuals as potential employees and how to create inclusive work environments for D/HH employees
- Offers professional development to educators and employers online, in person, and through partnerships with national conferences
- Partners with ATE centers to provide professional development and best practices to support student veterans with hearing loss in STEM programs

DeafTEC Partners with CompTIA to Diversify the Tech Industry

In partnership with CompTIA, the leading provider of vendor-neutral information technology (IT) certifications in the world, DeafTEC offers a full-time 10-week, hands-on boot camp on the Rochester Institute of Technology (RIT) campus for non-matriculated D/HH individuals. Lessons are taught in American Sign Language.

Boot camp participants learn technical skills such as repairing and maintaining computer equipment, networks, and operating systems as well as key workplace skills such as professional communication and problem-solving. After completing training, participants sit for CompTIA A+ certification exams.

Upon successful certification, participants receive direct job placement assistance from CompTIA's career services staff and receive credit for three courses that are part of the applied computer technology associate degree program of the National Technical Institute for the Deaf (NTID). These individuals can then pursue an associate degree at NTID or transfer nine credits to other colleges across the country.

All 12 participants of the first boot camp in 2023 completed the program. Ten earned CompTIA A+ certification, five found employment (four in technology positions), and two are pursuing more education. They are enrolled in NTID's applied computer technology associate degree program.

"CompTIA is honored to partner with DeafTEC, unlocking potential for our deaf and hard-of-hearing community, and opening doors to lucrative careers in tech. DeafTEC's administrators, instructors, and programs are second to none, setting their students up for success and life-changing opportunities."

Nancy Hammervik
Chief Solutions Officer,
Technology Industry Workforce
CompTIA
Downers Grove, IL

Survey Results from Equity & Excellence Conference Community College Team Members

Statement	Strongly Agree
I learned practical things at the AHEAD Conference that will help me teach/support D/HH students.	85%
I learned practical things at the conference that will help me teach/support students with disabilities in general.	81%
I feel confident that I will be able to implement one or two things I learned at this conference.	69%

n=28

The community college STEM faculty and disability services staff teams left the AHEAD Conference with "Plan for Change" action items to improve learning for D/HH students on their campuses. Plans included involving colleagues in improving accessibility, captioning all course items, and establishing processes for D/HH students to submit assignments in their native language.

EvaluATE survey data indicate that improvements to ATE evaluations led to better ATE initiatives.

EvaluATE

Evaluation Hub of the Advanced Technological Education Program

EvaluATE Facilitates Innovation through Evaluation

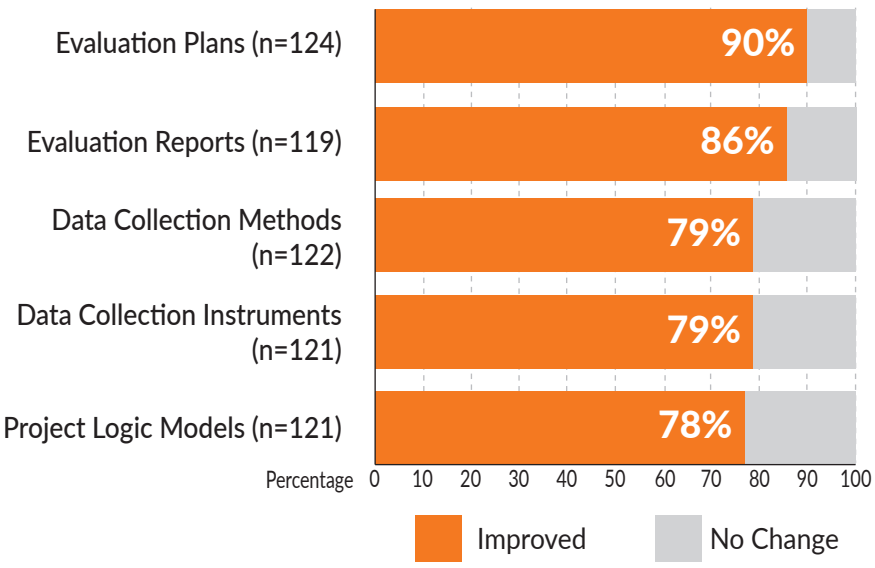
Effective project evaluation helps to enhance the impact of ATE projects and centers and provides evidence for what works to improve technician education. EvaluATE supports the ATE mission by encouraging high-quality ATE project evaluations.

As the evaluation hub for the ATE program, EvaluATE provides resources, webinars, and coaching to enhance the quality and utility of evaluations. Through events and presentations, it fosters a healthy evaluation community and facilitates innovation through evaluation. All of EvaluATE's resources and events are free and open-access. ATE principal investigators, project staff members, and grants professionals are able to leverage their evaluation for project or center improvement.

Key Activities

- Improves ATE evaluation by providing open-access resources and professional development about evaluation
- Communicates the importance of project evaluation to principal investigators (PIs) and project staff to increase the impact of ATE initiatives
- Conducts research to advance ATE evaluation practice
- Gathers and analyzes data about ATE projects and centers

Improvement in Evaluation Practices as a Result of EvaluATE



ATE evaluators and project staff indicated that they experienced improvements in several evaluation aspects over the last 12 months, which they attributed to the insights acquired from their engagement with EvaluATE.

EvaluATE Attracts Extensive Audience

In 2022 EvaluATE made significant strides in expanding its reach and serving the ATE community. With approximately 50,000 website users and close to 100,000 page views, EvaluATE's reach was extensive. Although primarily accessed by users in the United States, the website attracted visitors from all over the world. The most popular sections were the resource library, webinar library, and the *EvaluATE* blog, indicating the demand for evaluation-related content and resources.

EvaluATE's monthly webchats played a vital role in fostering a robust ATE evaluation community, with nearly 160 participants in 2022, including PIs, project staff, evaluators, grant specialists, and proposal submitters. These webchats served as a platform for collaborative discussions and knowledge sharing. Additionally, EvaluATE hosted five webinars throughout the year, covering diverse topics such as evaluation questions and practical evaluation tools. These webinars attracted more than 640 attendees, further contributing to the dissemination of evaluation knowledge and best practices.

Overall, EvaluATE's efforts in 2022 demonstrated its commitment to expanding its reach, facilitating community engagement, and providing valuable resources and webinars to enhance the practice of ATE evaluation.

"Evaluation, along with tools and support from EvaluATE, has provided our PI team multiple opportunities to assess and reflect on our progress with a critical but positive lens, think more deeply and clearly about our goals, and gain insights on where we should focus our energy going forward."

Karen Leung
Biotechnology Instructor and
Internship Coordinator
City College of San Francisco
San Francisco, CA

Students in an EARTh Center-affiliated program are gathering data for a fish survey. Evaluators of ATE projects and centers are expected to gather and analyze data about initiatives' efforts. By making comparisons to grant targets, past performance, and national benchmarks, evaluators draw conclusions about effectiveness and impact.

Community College Presidents' Initiative in STEM (CCPI-STEM)

Key Activities

- Fosters STEM education enhancements
- Encourages participation in the ATE program through regional networks led by community college presidents
- Establishes a cadre of CCPI-STEM Fellows who aspire to community college leadership
- Creates curriculum modules focused on STEM and ATE for graduate programs and leadership institutes

Prince George's Community College
Largo, MD

https://ccpi-stem.org

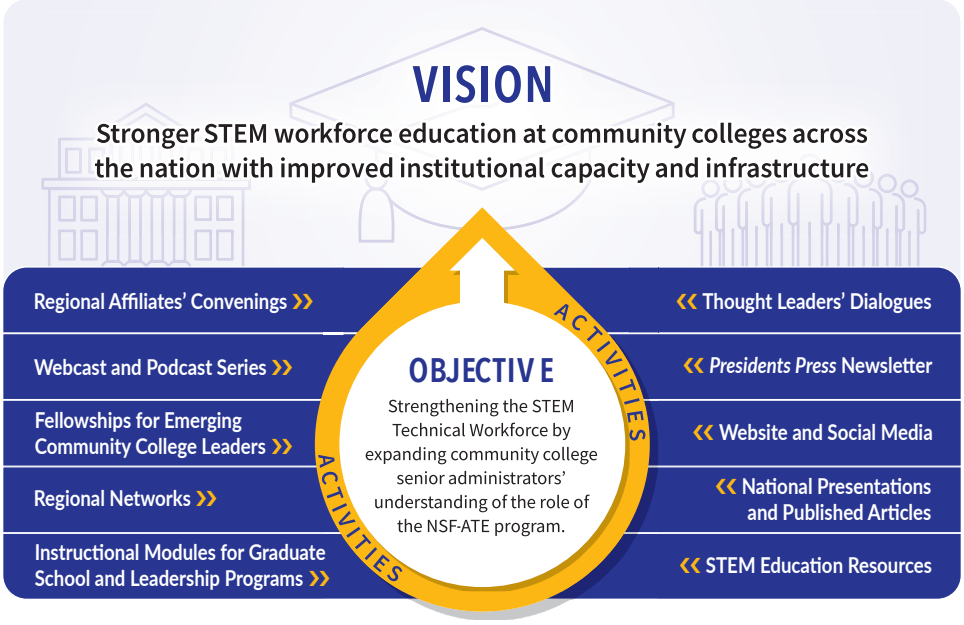
CCPI-STEM Expands Community College Presidents' Understanding of ATE

CCPI-STEM activities focus on STEM education and strengthening community college presidents' understanding of the ATE program. The project's webcasts explain various aspects of the ATE program and usually attract more than 100 participants. At meetings of CCPI-STEM Regional Affiliates, senior administrators of community colleges learn about ATE proposal submission processes and how to incorporate ATE projects into strategic plans.

Fellows Program Cultivates New Generation of STEM Education Leaders

The CCPI-STEM Fellows program provides stipends to selected community college faculty and administrators who aspire to be STEM education leaders. The first six fellows, selected in 2022, are pursuing graduate degrees and research related to STEM education and workforce development. As ambassadors of the ATE program, CCPI-STEM Fellows present their research findings at forums, publish their results, share their research with the broader community, and mentor other college professionals.

CCPI-STEM has also developed modules for graduate programs and institutes for prospective community college leaders about the importance of STEM programs at community colleges, STEM technical career opportunities for community college students, and NSF-ATE funding.



CCPI-STEM's multi-faceted approach promotes STEM technician education, raises awareness of the ATE program, and builds institutional capacity for STEM initiatives.

Power of Us: Increasing Female Enrollment and Retention in Career and Technical Education Programs

General

Speaker Series Encourages Pursuit of Careers in Male-Dominated Fields

Monthly discussions led by female industry leaders inform and motivate female and non-binary students to pursue careers in male-dominated fields. Power of Us speakers share information about their career and educational pathways, and talk candidly about how they have dealt with microaggressions and biases.

The female industry leaders who address the students are also paired with student mentees whom they encourage toward career goals.

Summer Camp Facilitates Exploration of STEM Careers

Week-long camps with hands-on activities, projects, and lab demonstrations help female and non-binary students in grades 10 to 12 discover career options and transfer pathways in information technology, electrical systems technology, computer-integrated machining, automotive systems technology, biomedical equipment technology, and welding.

Cisco Employees Invest Themselves in Power of Us

Senior engineers from Cisco Systems, Inc., assist the Power of Us project by serving as guest speakers, mentors, and advisory committee members. They have also conducted Lego Robotic workshops and seminars. Plans for 2024 include more interactive programs.

Lisa Kowite, a graduate of Durham Tech's automotive technology program and owner of Fired Up Automotive, enjoys teaching women basic automotive maintenance and safety. She also mentors female students.

Key Activities

- Encourages female and non-binary students to pursue careers in male-dominated fields
- Offers a camp for students in grades 10 to 12 to explore STEM technical careers
- Hosts Welcome and Get-to-Know-You events for students
- Offers Taste of Industry events with memorable hands-on activities for career counselors

Durham Technical Community College
Durham, NC

https://durhamtech.edu/power-of-us

Featured ATE Project

Technician Workforce Immersive Teaching and Learning Resource (TWITLR)

Key Activities

- Promotes college faculty use of immersive technologies—including virtual reality, augmented reality, mixed reality, and 360° photography and videography—in technician education
- Develops and deploys immersive technology boot camps for two-year college technician educators
- Creates and fosters communities of practice for technician faculty using immersive technologies in the classroom

St. Cloud Technical & Community College
St. Cloud, MN

https://immersivelearning.academy

Innovative Approach Results in Strong Design for Immersive, Cross-Discipline Technology Integration

TWITLR provides faculty professional development resources to accelerate immersive technology integration into technician education. It offers resources on finding and implementing commercially made products, as well as direct instruction for faculty to build personalized experiences.

TWITLR's flexible boot camp structure leverages both distance and face-to-face environments to optimize faculty engagement and learning. The project encourages ongoing learning and collaboration by fostering discipline-specific communities of practice to support participants in their immersive technology integration efforts.

The innovative practices at TWITLR's boot camp include brainstorming sessions with faculty and students from many different disciplines to develop educational immersive experiences. The sessions focus on designing an adaptable framework for various disciplines with content that is course- and level-specific. The many different perspectives in the development process both expand and narrow focus at different points. The opportunity for instant feedback and improvement has resulted in a stronger design and experience outcome.

A TWITLR boot camp instructor conducts personalized instruction for students after a class session on 360° photography and videography.

Working Partners Project & Workshops

General

Working Partners Workshops Build & Grow Education-Industry Partnerships

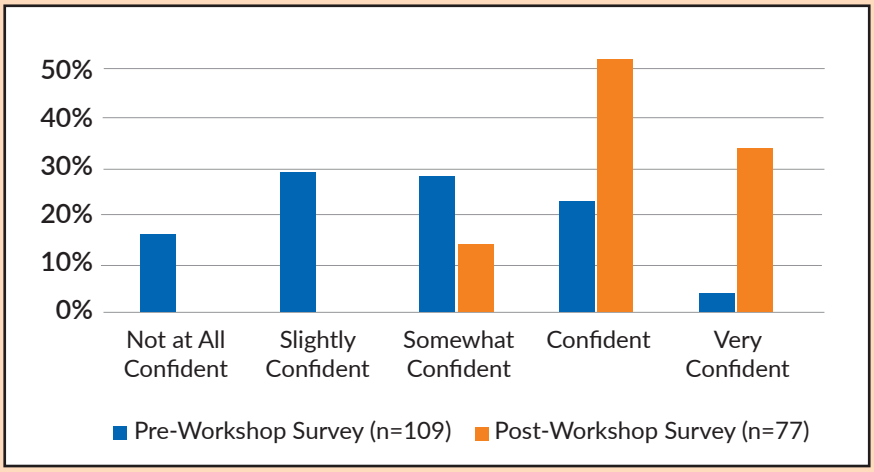
Working Partners Workshops address a critical gap uncovered during the Working Partners Research Project, a previously funded ATE initiative that analyzed ATE grantee partnership practices. Survey data showed that 78% of 141 principal investigators were receiving little to no guidance on establishing and growing relationships with industry.

Participants of the virtual synchronous/asynchronous hybrid workshops are guided through the collection, prioritization, and analysis of industry-related project goals. This is followed by the creation of specific and actionable items toward their goals. Each of the eight weekly meetings culminates with short assignments that contribute to the action plans of each college.

Guest speakers and live activities, as well as sharing and brainstorming with the other participants, deepen knowledge and skills for initiating and sustaining partnerships with industry.

Pre- and post-workshop data show significant improvements in participant capacity and confidence with all aspects of managing industry partnerships. In addition, 79% of the 98 participants who completed workshops and exit surveys prior to May 2023 reported a very high and consistent level of satisfaction with the experience.

Pre- and Post-Workshop Participant Confidence Initiating and Managing Industry Partnerships



The majority of Working Partners Workshop participants from June 2021 to March 2023 report increased confidence initiating and sustaining industry partnerships.

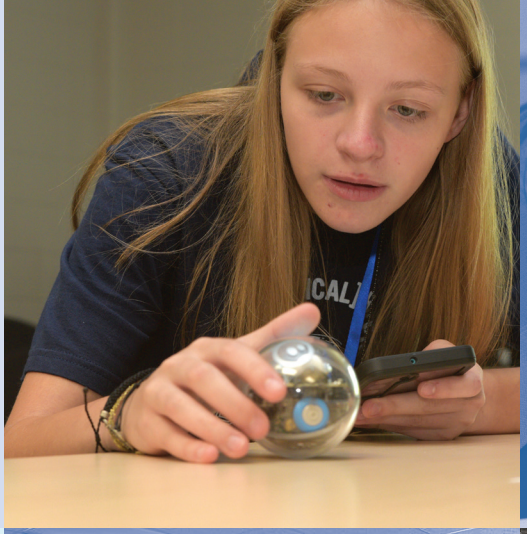
Key Activities

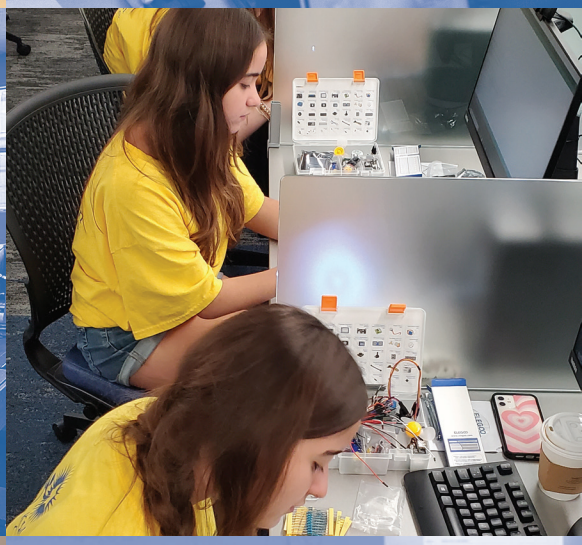
- Strengthens education-industry partnerships by providing educator workshops and resources for building strong, functional relationships
- Facilitates exploration and application of partnership research findings
- Promotes partnership assessment and evaluation by providing planning guides and structure
- Fosters ATE community connections through collaborative brainstorming and peer-to-peer strategies

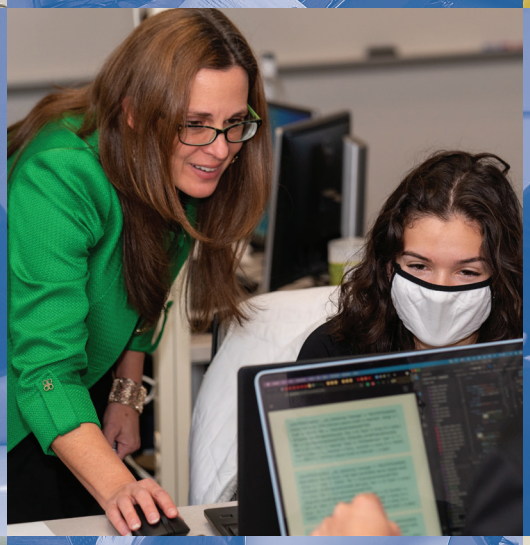
Bellevue College
Bellevue, WA

https://workingpartnersproject.org

ATE @30







Information and Security Technologies

https://ate.is/info

CyberWatch promotes skill development with cyber competitions, games, and security breach simulations for individuals and teams.

CyberWatch

National CyberWatch Resource Center

Personalized Instruction & Coaching Help Students Embark on Cybersecurity Careers

Instructional resources developed by CyberWatch's Competency-Based Mastery Learning (CBML) Curriculum Standards Panels were initially tested with 37 students in a pilot program conducted in partnership with Accenture.

These resources were then incorporated in the Cyber Ready Professional Skills to Succeed Coaching Program, which personalizes instruction using diagnostic assessments of any impediments to attain proficiency, competency, or mastery of the capabilities required to perform cybersecurity functions. The resulting Individual Capability Profiles are shared with the individual student and a personal coach certified by the International Coaching Federation.

Completing this 16-week program enabled more than two-thirds of students to obtain a cybersecurity career position. Over a three-year period, 209 students participated in the program and their completion rates increased to 85% from the baseline course completion rate of 15%.

At Cyber Education and Career Symposia students explore demonstration sessions and interact with employers.

Key Activities

- Creates, assembles, validates, and disseminates evidence-based practices that increase the readiness of students and professionals to learn, become certified, and masterly perform cybersecurity functions
- Facilitates collaborations among industry, academia, and government to advance cybersecurity education and strengthen the cybersecurity workforce

Reverse Apprenticeship Program Addresses Employers' Requirements

CyberWatch's focus on increasing the readiness of workers and students also addresses the challenge of some employers requiring five years of experience for entry-level cybersecurity jobs.

Through its national network and regional Skill Up to Scale Up partners, CyberWatch is delivering a reverse-apprenticeship program that raises the capability of incumbent workers and eases the transition of postsecondary graduates into the workplace.

Skill Up to Scale Up enables students to gain real-world experiences in each and every course they take. Then during the CyberWatch Talent Fair students are able to showcase these experiences with prospective employers and share their Individual Capability Profiles, which document their readiness to perform cybersecurity job responsibilities.

Notable outcomes include incumbent information technology workers being upskilled and promoted into high-demand cybersecurity specialist roles. There have also been instances of associate degree recipients—with less work experience but enhanced proficiency in cybersecurity—replacing individuals with bachelor's or master's degrees.

Residency Programs Help Aspiring Entrepreneurs

Residency programs, akin to medical school residencies, also help students progress from competency to professional mastery of cybersecurity skills. Residents are students who are interested in starting their own cyber businesses. They do rotations at companies that assess and mitigate cyber vulnerabilities. The experiences prepare students to work as contractors for small and midsize enterprises that do not employ in-house cybersecurity specialists.

CyberWatch Organizations Foster Career Growth

National CyberWatch Student Association

7,034 members

National CyberWatch Community on LinkedIn

1,178 members

Through its student association and LinkedIn community, CyberWatch makes people aware of cybersecurity technological trends, employer needs, and critical issues. National CyberWatch Student Association members receive notification of internships, scholarships, mentoring opportunities, job postings, conferences, and training programs to expand their professional networks and cybersecurity industry connections.

"The cybersecurity sector is a national security and economic imperative, and CyberWatch has and will continue to impact this issue. The National Visiting Committee applauds CyberWatch's approach to 'readiness' as the primary mission and approach."

Gaby Hawat, EdD
Senior Vice President for Higher Education
Kauffman Hall
Washington, DC
Chair of CyberWatch National Visiting Committee

The curricula for uncrewed aerial systems developed by ATE centers emphasize safety procedures such as pilots inspecting vehicles prior to every flight, wearing bright-colored safety vests, testing vehicles in enclosed areas, and utilizing a key to disable propellers until people are a safe distance from the aerial data collection device.

GeoTech Center

The National Center for
Geospatial Technology of Excellence

New GeoEdC Certification Addresses Educators' Needs

The GeoTech Center has developed the Geospatial Education Certification (GeoEdC) for educators who need credentials to teach geospatial courses. Traditional educator preparation programs have struggled to fit rapidly changing geospatial technologies into their programs.

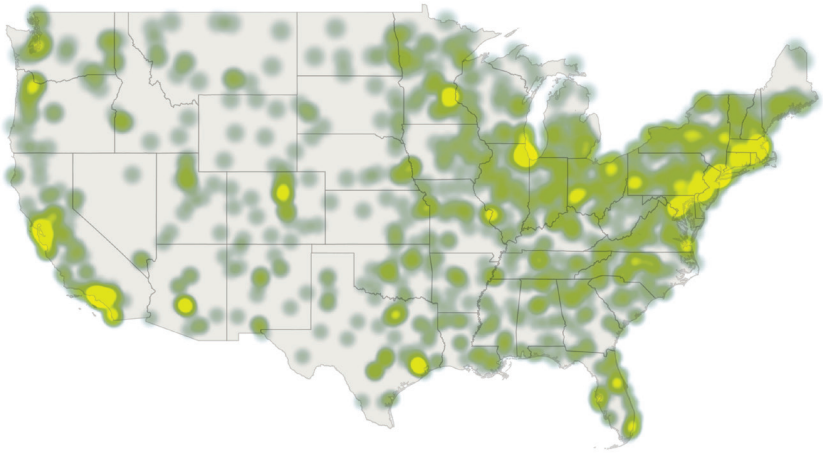
GeoEdC program courses cover both contextual and pedagogical knowledge. The program also requires educators to demonstrate their GST skills and abilities through a series of projects.

The first GeoEdC cohort began in fall 2023 with 20 educators from secondary schools, community colleges, and universities; 50 people had applied. Two more free pilot versions of the certification program will be offered in 2024. Going forward GeoTech plans to offer the virtual, eight-week certification program three times a year for a fee.

Key Activities

- Provides the GeoEdC educator certification program
- Works with the US Department of Labor to update the Geospatial Technology Competency Model (GTCM)
- Contextualizes modular curricula to focus on modern geospatial technologies (GST)
- Recruits underrepresented populations
- Offers a student honor society

Two-Year and Four-Year Institutions Offering Courses on Geospatial Technologies



GeoTech develops and distributes maps and other illustrations of geographic data to help students find education resources and to help educators start, expand, or sustain programs.

GeoTech Updates Geospatial Technology Competency Model for US Department of Labor

While revising the Geospatial Technology Competency Model (GTCM) for the US Department of Labor, GeoTech personnel initially sought input from professional organizations, the center's National Visiting Committee, social media contacts, and the 500 subscribers of the center's newsletter. The team then developed the curriculum using a structured process for gathering information from 100 geospatial practioners, who identified the competencies in the existing model that needed to be reworded or removed and the competencies that needed to be added. This work had the added benefit of helping GeoTech select activities to stay at the forefront of all things geospatial.

Educators Customize Courses to Engage Students' Attention While Building GST Competencies

Twenty educators attended the Modern GST and Diversity, Equity, and Inclusion Workshop the center offered in Gettysburg, PA. During the five-day workshop the high school, community college, and university instructors utilized the Civil War battlefield for field data collection and learned to structure their teaching to reach a wider array of potential technicians.

A student flies an uncrewed aerial vehicle to practice data collection for a geospatial program at West Valley College.

The workshop augments GeoTech's modularized courses, which use societal issues and social justice. This combination provides up-to-date content with instructional guides to engage students' interest in careers that utilize geospatial technologies. Educators can customize their courses by choosing which competency they want to teach and align content with actual workplace examples.

> *"The GeoTech Center has provided numerous opportunities for members of the Kentucky Association of Mapping Professionals to grow their skills ... For the new professional to the seasoned, they provide virtual and hands-on learning that is invaluable. As a water utility GIS manager, I've been able to leverage the knowledge I've gained in many of our daily applications."*
>
> Kenny Ratliff
> President, Kentucky Association of Mapping Professionals
> GIS Manager, Oldham County Water District
> LaGrange, KY

A group of IT Flexible Apprenticeship students works on a cybersecurity project during a Capture the Flag event in a Columbus State lab.

NITIC

National Information Technology Innovation Center

NITIC Expands Access to IT Career Pathways

The primary goal of NITIC is to strengthen the pipeline of interested and skilled individuals pursuing education in IT pathways. NITIC expands access to programs with targeted efforts for underserved populations. Its outreach efforts include amplifying success stories that feature women and veterans.

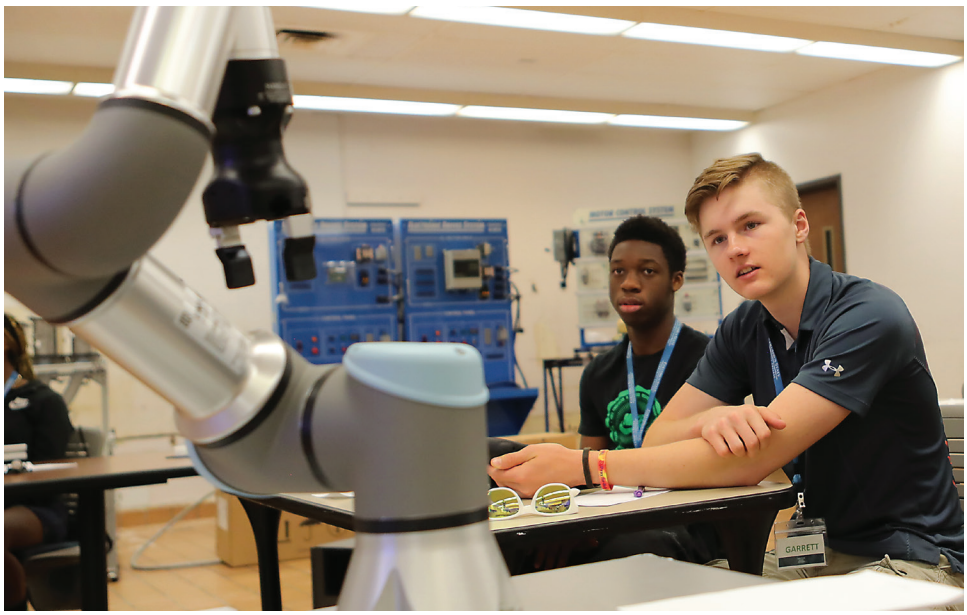
In addition to encouraging enrollment, NITIC is benchmarking model programs for offering services that help students complete certificates and degrees. The center creates and promotes opportunities for professional development for faculty. It also positively influences public perception of IT careers, and provides clear, attainable career pathways.

Key Activities

- Maintains online information technology (IT) materials clearinghouse
- Hosts a national business and industry leadership team (BILT) and focused sub-BILTS on specific disciplines
- Offers the IT Innovation Network community of practice to engage, share, and learn
- Provides IT-focused professional development opportunities for faculty and staff

"Technology changes and Columbus State keeps up. Their graduates are ready to work."

Jennifer Savage
Senior Manager, Talent Acquisitions
Worthington Industries
Columbus, OH



Two students test code they wrote for a robotic arm; their project was part of a collaboration between the Columbus State's IST and manufacturing departments.

NITIC Utilizes a National Network of IT Employers & Educators

NITIC works with employers and community colleges across the country to help more students complete academic credentials and become highly skilled technicians. Columbus State's education partners include Collin College and Lone Star College, both in Texas, the Maricopa Community Colleges in Arizona, and Sinclair Community College in Ohio.

Technology Teams Share Resources & Monitor Workforce Needs

In its first year of operation NITIC will organize technology teams (TTs) to focus on future technologies while also identifying exemplary IT programs to contribute to a clearinghouse of resources from previously funded and current Advanced Technological Education projects. These resources will include best practices, curriculum, and model programs. TT leaders ensure coordination, integration, and dissemination among community colleges across the country.

In partnership with the national BILT, TTs also identify emerging trends and skill gaps through partnerships and surveys with the industry. By conducting gap analyses and gathering insights from industry partners, TTs will identify IT workforce needs, compare them with current academic outcomes, and help educators adjust their programs toward emerging technology trends.

Information Systems Technology (IST) Enrollment Five Years Prior to NITIC Formation

Program (ATE Projects)	2019	2020	2021	2022	2023
Cybersecurity (CYBER[1], ITFA[2])	258	324	335	385	492
Software Development (ITFA[2], CLOUD[3])	353	340	304	354	361
IT Support Technician (ITFA[2])	155	150	108	127	116
IST Department	1,187	1,153	1,107	1,195	1,309

Indicative of its potential for leading a national IT center, Columbus State had stable or increased enrollment in its three top-performing IT programs and across the IST Department since 2015 when it received several IT-related ATE project grants. The projects included 1) CYBER - the Ohio Region Cybersecurity Technician Training Pipeline, 2) ITFA - Information Technology Career Pathways through a Flexible Apprenticeship Model, and 3) CLOUD - Building an Industry-Aligned Pathway to Careers in Cloud Computing.

NCYTE's curriculum incorporates cybersecurity across all disciplines.

NCyTE

National Cybersecurity Training and Education Center

Key Activities

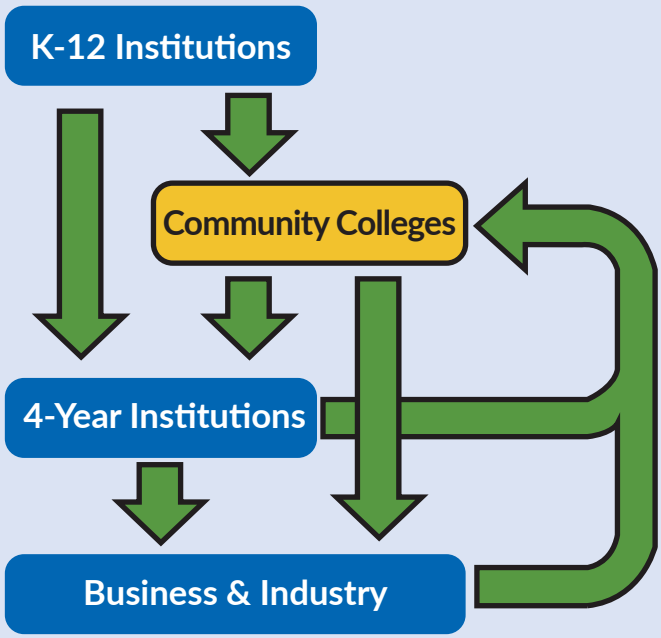
- Expands cybersecurity education pathways and program diversity to meet the nation's cybersecurity needs of tomorrow
- Disseminates efforts to improve current and future directions of cybersecurity education in the US
- Develops and implements leading-edge curricula
- Incorporates cybersecurity across all disciplines
- Cultivates industry engagement and career opportunities
- Supports faculty and leadership development, including a faculty fellowship and faculty externship program with industry
- Supports student cybersecurity competitions and a National Cybersecurity Career Fair

Community College Cybersecurity Strategic Summit

NCyTE gathered leaders and stakeholders in cybersecurity education from the Northwest to examine the essential role community colleges play in cybersecurity education, to identify key skills that technicians need to know, and to consider how federal programs could help stimulate initiatives and strategies.

During the two-day meeting in December 2022, some of the most influential minds in cybersecurity education made presentations and participated in discussions. Recommendations from the summit helped to inform the development of a National Strategy for Cyber Workforce and Education by the Office of the National Cyber Director, an agency that advises the US president on cybersecurity policy.

Community Colleges at Nexus of Career Pathways



This diagram from NCyTE's Future Directions 2022 Summit report illustrates the position of community colleges in the American educational ecosystem where they are sources of cybersecurity instruction for students and professional development for educators.

Summer Academies Prepare Faculty for Industry Certification Exams

In the summer of 2023, NCyTE hosted a variety of free virtual faculty development programs attended by 70 educators from approximately 60 community colleges.

The academies are designed to help faculty expand their cybersecurity knowledge base, earn their choice of one of six industry certifications, and strengthen their ability to incorporate new cybersecurity content into their community colleges' curricula. Participants who pass a certification exam receive stipends toward the certification costs. Academy topics and associated industry certifications were Certified Information Systems Auditor; Security+; Certified Information Systems Security Professional; Certified Information Security Manager; and Certified Ethical Hacker.

NCyTE Cultivates Potential Community College Cyber Instructors

NCyTE offers workshops that give community college and university students in their final year of their cybersecurity program the opportunity to explore teaching cybersecurity at community colleges. Twenty students participated in the first cohort of the program during the summer of 2023. This fellowship boot camp covered pedagogy, creation of lesson plans, and more practical teaching skills. All the participants were placed in teaching assistant positions, and they taught lessons with actual students in the presence of a faculty mentor. Several have been hired as full-time faculty members.

"My education at WCC [Whatcom Community College] and the support I have received have allowed me to realize my aspirations ... I was able to make a career change into the IT industry and to begin applying the lessons I've learned at WCC as a professional. I began working for a software development company as an intern and have since accepted a position [initially] as a junior systems administrator."

Mark Morton
Systems Administrator
Cornerstone Systems Northwest
Lynden, WA

High school students engaged in learning coding basics on their Raspberry Pis at the Whatcom Community College GenCyber Camp 2023.

Featured ATE Project

Appalachian Solutions in Cybersecurity Innovation Initiative (ASCII)

Key Activities

- Offers a two-year cybersecurity degree program with eight embedded certificates
- Created and uses a cybersecurity business and industry leadership team (CyberBILT) to collaborate with industry partners who inform curricula updates and facilitate student internships
- Creates pathways from high school to cybersecurity program with transfer opportunities
- Hosts GenCyber cybersecurity camps for high school students and teachers
- Facilitates faculty earning industry-recognized cybersecurity credentials

Big Sandy Community and Technical College
Prestonsburg, KY

https://bit.ly/ateascii

Project Starts Cybersecurity Program in Rural Eastern Kentucky

ASCII has created a robust pathway to cybersecurity technician careers. It starts at rural secondary schools and extends to the new cybersecurity degree program at Big Sandy Community and Technical College (BSCTC) with transfer options to four-year institutions.

BSCTC students who earn associate degrees in the network defense track qualify to work as penetration testers, information security engineers, digital forensics analysts, and information security analysts.

Outreach Activities Engage Teens & Teachers

ASCII builds on the interest that GenCyber camps spark among high school students and teachers. The summer academies, which are hosted on campus with other federal agency support, teach cybersecurity skills to teachers in multiple disciplines and to diverse student populations.

The ASCII team also reaches out to high school and middle school teachers, administrators, and students at their schools. During the 2022-2023 academic year alone project personnel interacted with more than 1,000 students during 21 site visits.

ASCII recruiting events for high school and middle school students utilize a mobile cybersecurity escape room. These challenges engage students in teams to work through scenarios using steganography, cryptography, and multi-factor authentication to save a fictional friend.

GenCyber Academy students learn to program a Sphero BOLT to move while referencing the confidentiality, integrity, and availability (CIA) triad.

Cybersecurity for Advanced Manufacturing Organizations (CAMO)

CAMO Creates & Tests Virtual Cybersecurity Instructional Scenarios for Manufacturing Technicians

CAMO's virtual training scenarios teach cybersecurity skills in the situations that technicians typically need to use them in advanced manufacturing environments. The scenarios cover topics such as network monitoring, common security tools, virtual private networks (VPNs), and intrusion detection systems. Each consists of an overview, background material, video, lab, and worksheet. The scenarios and the virtual environment are freely available to download in multiple formats.

The scenarios created by CAMO have been used in multiple training sessions to teach not only technicians who are currently working in industry but also high school students and students at both two-year and four-year colleges.

In 2023 the scenarios were tested with eight technicians, each employed at one of four manufacturers. After the four-day training session, surveys of the technicians' cybersecurity knowledge showed significant improvement over their pre-training knowledge of information technology (IT) security concepts such as the packet capture analyzer Wireshark, the network scanner Nmap, and VPN technology.

CAMO scenarios are also being used in traditional academic classrooms at multiple institutions. Post-training surveys completed by 20 of these students found significant improvement over their pre-training knowledge of operational technology (OT) and hardware and software tools such as programmable logic controllers (PLCs), Modbus protocol, and human-machine interfaces (HMIs).

Test Groups' Knowledge of OT Concepts and IT Security Pre- and Post-Training

	Not At All Familiar	Slightly Familiar	Somewhat Familiar	Moderately Familiar	Extremely Familiar	Improvement
Before taking CAMO's general industry technology class, what level of previous experience did you have with OT concepts?	7	11	3	4	3	
After taking this class, what level of experience do you have with OT concepts?	1	2	11	7	7	**78%**
Before taking CAMO's information security class, what level of previous experience did you have with IT security concepts?	10	4	10	3	1	
After taking this class, what level of experience do you have with IT security concepts.	1	4	7	11	5	**92%**

Tests of CAMO's scenarios in traditional academic courses and industry training found significant improvements occurred in knowledge of general OT concepts and IT security for both types of participants. *n=28*

Key Activities

- Advances the cybersecurity knowledge of advanced manufacturing organizations
- Lowers the cybersecurity silhouettes of advanced manufacturing organizations
- Promotes advanced manufacturing knowledge among cybersecurity technicians

Northwest State Community College
Archbold, OH

https://www.nl.northweststate.edu/camo

Featured ATE Project

Expanding Pathways to a Data Science Career by Developing a Certification in Data Science and Analytics

Key Activities

- Creates a 16-credit certificate in data analytics
- Develops new courses in Python, R programming, and Tableau
- Creates pathways to associate in science and associate in applied science data science degrees
- Offers credentials that articulate to a four-year institution's data science program
- Recruits underrepresented populations

County College of Morris
Randolph, NJ

https://ccm.edu/ate-grants

New Courses & Transfer Agreement Give Students Smooth Path to Data Analytics Careers

The County College of Morris Data Analytics Certificate closes the skills gap in data science and provides students with the acumen to enter the workforce in this field. The curriculum aligns with recommendations from an industry advisory board consisting of members from several different industry sectors. Its newly created courses teach students the foundational data science technologies of R, Python, and Tableau.

A 2+2+1 articulation agreement the project developed with Ramapo College of New Jersey gives graduates a seamless transfer option to bachelor's and master's degrees in data science. The agreement is the first of its kind in New Jersey.

Data Course Shifts Thomas Ortega's Gaze, then Career Plans

Thomas Ortega was the first County College of Morris student to earn a certificate in data analytics. Ortega enrolled in the first data analytics course to synthesize sunspot and Earth temperature data that he had gathered as an astrophysics major. By the time he finished the 16-credit data analytics certificate—a cross-disciplinary initiative of the math, computer science, and business departments—Ortega had changed his career plans. After graduation from the County College of Morris, he transferred to Ramapo College to pursue a degree in data science. In 2023 he was employed as a data analyst at UPS.

Students learn R programming, which is widely used for data analysis, in the Introduction to Data course.

Supporting Diversity to Increase Innovation (SDII)

Minority CIS Professionals Share Their Career Stories with Students

SDII aims to increase high school students' interest in CIS with the intent to grow the pipeline of women and individuals from minority populations who enter the information technology (IT) workforce.

By providing opportunities for minority industry professionals to share their personal stories and their typical day-in-the-life workplace experiences with adolescents, the project aims to help more high school students see themselves in CIS careers.

Collaboration with High Schools Raises Interest in CIS Careers among Underrepresented Populations

SDII enlisted four high schools with students from populations historically underrepresented in IT fields to attend workshops at Central New Mexico Community College (CNMCC). Faculty designed the workshops to spark teens' interest in technology by providing hands-on experiences in various areas of computing technology such as programming, cybersecurity, networking, and the Internet of Things.

In post-event surveys, the high school students reported that the campus workshops made a positive impact. Responses from students indicate 71% were interested in computer information systems after the workshop presentations and activities. Overall data from 20 female participants with no interest in IT prior to the workshops indicate 25% were interested after the workshops.

The Effect of Workshop Participation on Student Interest in IT

	Yes Respondents	Total Respondents	Percentage of Yes Respondents
Interested in IT Before the Workshop	55	91*	60%
Interested in IT After the Workshop	74	104	71%

n=104 *13 students did not answer the question prior to the workshop

Overall, SDII workshops increased interest in IT among students. There was a significant increase in interest among male students who were not interested in IT prior to the workshop. The impact on the 79 students of color is even more pronounced: both male and female students of color reported substantial increases in interest.

Key Activities

- Offers workshops designed to generate teens' interest in computer information systems (CIS) technology careers
- Provides venues for CIS technicians from government and private industry to discuss their current jobs and to share background information about their career paths

Central New Mexico Community College
Albuquerque, NM

https://ate.is/sdii

Featured ATE Project

Using Cloud Technologies to Develop the Data Analysis Skills of Community College Students (UCTDDAS)

Key Activities

- Provides professional development opportunities for faculty and students
- Offers students summer boot camps to learn Python fundamentals
- Introduces students to database and machine learning management skills
- Prepares boot camp participants for an industry certification exam
- Offers undergraduate research experiences

Queensborough Community College, City University of New York
New York, NY

https://www.qcc.cuny.edu/nsfGrants/nsf-ate.html

Project Offers Data Analyst Skills to Urban Community College Students

To create a pipeline of technicians with skills to meet the demand of entry-level data analyst jobs in New York City, UCTDDAS worked with its business and industry leadership team (BILT) to develop an extracurricular program for community college students.

To increase awareness and skills in data science and data analysis (DS/DA), UCTDDAS offers presentations and panel discussions for faculty and students. To enhance the diversity in the pipeline of people entering DS/DA careers, project leaders recruit students from underrepresented populations to participate in summer boot camps.

Summer Boot Camps Teach In-Demand Skills

The goal of the four-week summer boot camps offered in 2022 and 2023 was identical: to provide students with useful job skills by offering them an amalgamation of lessons in data science and cloud computing technologies. In addition to teaching high-demand skills, the camps prepared students to take the exam for AWS Certified Cloud Practitioner, an industry-recognized credential.

Evaluation data from 16 students who participated in the 2022 boot camp and 23 who attended the 2023 boot camp indicated that the students were highly satisfied with the boot camps' structure, instructors, and community environment. Boot camp completers were invited to engage in year-long research projects in DS/DA. Four students did research after the 2022 boot camp. Up to 15 students from the 2023 boot camp will conduct undergraduate research projects thanks to supplemental funding the project received from the National Science Foundation.

Summer boot camp students learn in a Queensborough Community College computer lab with guidance from two instructors.

Women Reinvigorating Industry Support and Empowerment (Women RISE)

Women RISE Empowers Women to Pursue & Persist in High-Tech Fields

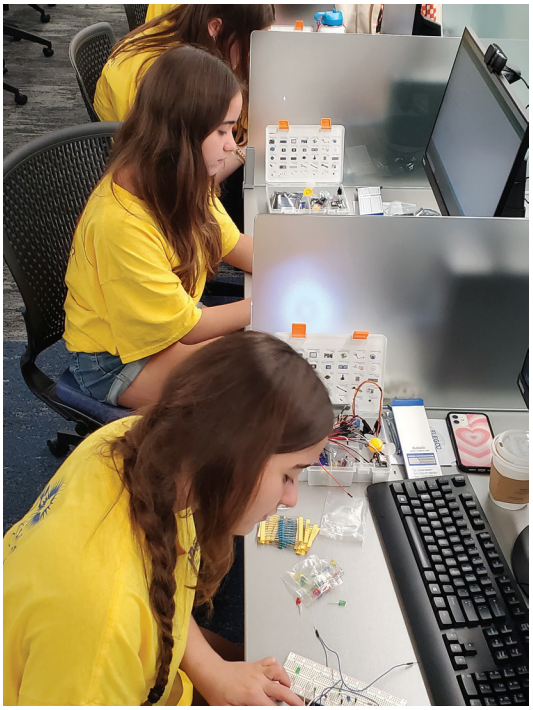
Women RISE empowers women to pursue and persist in high-tech fields of study, including artificial intelligence, cloud computing, cybersecurity, Internet of Things (IoT), and data analytics.

Among the stakeholders engaged in this project are enrollment committees of faculty, advisors, and recruiters who receive specialized training on best practices for recruiting and retaining more women in IT-related technical programs. Enrollment data in the targeted associate degree programs showed a 43% increase in female student enrollment, starting from fall 2021 with 112 female students enrolled to fall 2022 with 160 female students enrolled.

With the support of the Community Alliance for Women in Technology, an organization established by this project, 27 mentees were paired with 23 mentors during the virtual mentoring program in the first two years of the project. During the second year, 30 female students earned industry certifications and two were provided with internships.

Summer Program Prepares Teens to Succeed in Technology Degree Programs

The All Hands on Tech summer program (also known as the Tech Immersion Summer Program) offers high school students the opportunity to learn about exciting, new technologies and various high-tech careers. In post-program surveys, 74% of the 23 student respondents reported having an increased interest in technology. Moreover, 86% of the students reported understanding the available career options in the tech industry, and 50% of them expressed a desire to pursue a college degree in technology after high school.



High school students practice basic Internet of Things skills during the All Hands on Tech summer program.

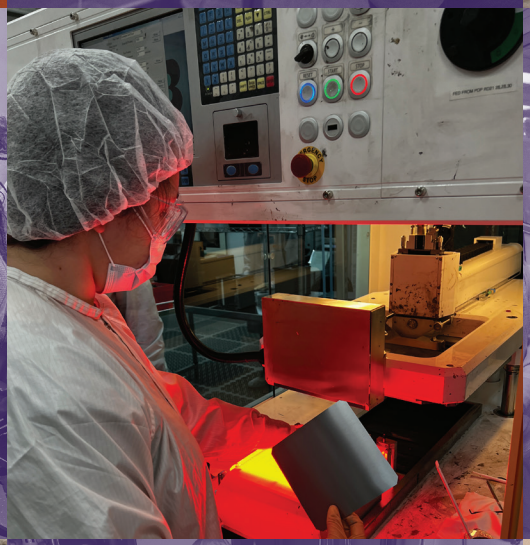
Key Activities

- Establishes the Community Alliance for Women in Tech to engage, develop, and advance women in technology
- Implements the All Hands on Tech summer program
- Fosters the Women in Tech Student Organization
- Provides mentoring to female information technology (IT) students

Miami Dade College
Miami, FL

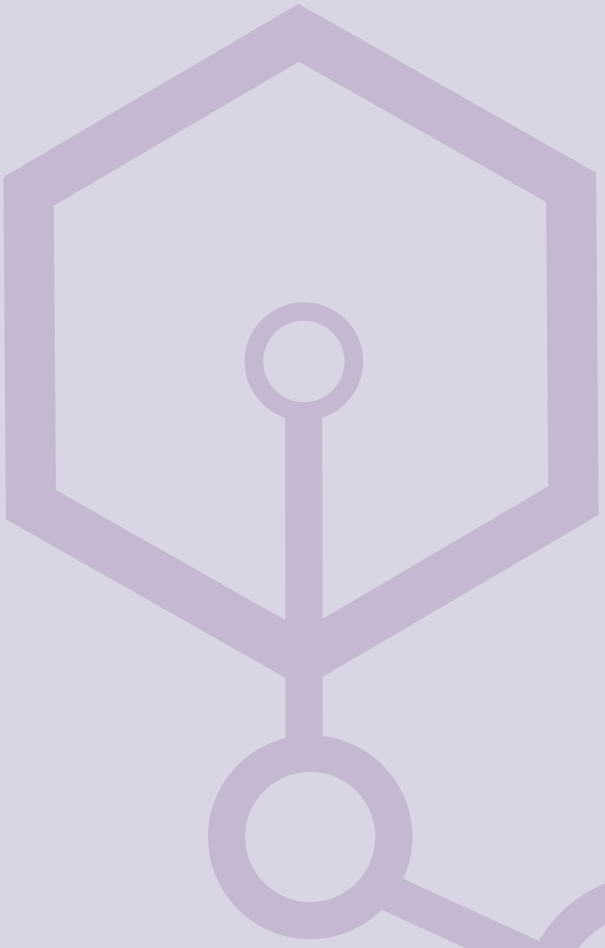
https://mdc.edu/entec/grants/womenrise.aspx

ATE @30



Micro and Nanotechnologies

https://ate.is/nano



MNT-CURN students participating in the nanomedicine workshop at University of North Texas learn to use a 3D bioprinter to produce biomaterial hydrogels.

MNT-EC

Micro Nano Technology Education Center

Students Gain Nanotech Skills through Research & Academic Competitions

MNT-EC places a high priority on providing authentic research and hands-on learning opportunities for community college students to build their nanotechnology skills. The center has provided more than 100 students from across the country with authentic research experiences through its Micro Nano Technology Cooperative Undergraduate Research Network (MNT-CURN) program. It also facilitates students' participation in conferences, writing for publications, acquisition of skills through academic competitions, and pursuit of scholarships.

Students enrolled in MNT-EC programs have excelled. Four students have received prestigious Barry Goldwater Scholarships, a team of four won the 2021 Community College Innovation Challenge, and a team of 14 students earned the second place award in the Pioneer Division of the 2023 MATE Remotely Operated Vehicle (ROV) World Championship.

A guided particle systems technician, who is a Pensacola State College graduate, installs a new control board to a NAVI end effector.

Key Activities

- Collaborates with employers through a business and industry leadership team (BILT) for micro- and nanotechnologies (MNT)
- Implements the Micro Nano Technology Cooperative Undergraduate Research Network (MNT-CURN) for technician education students
- Produces *Talking Technicians*, a podcast that features graduates of two-year technical programs sharing their career experiences
- Publishes the *Journal of Advanced Technological Education*, a peer-reviewed journal of research by technician educators

MNT-EC Promotes Community College Micro and Nanotechnology Programs

MNT-EC leaders' advocacy for community college students to have a fair share of CHIPS and Science Act funding for workforce development highlights that community and technical colleges are the nation's best source for technician education.

MNT-EC assists community colleges in starting micro- and nanotechnology programs. For example, it has provided guidance to Columbus State Community College as it develops the Ohio Semiconductor Collaboration Network with Ohio's 23 community colleges. This network aims to meet the needs for skilled technicians at Intel's new semiconductor chip fabrication facility in Central Ohio.

Similarly, MNT-EC fosters collaborations among other ATE micro- and nanotechnology centers and projects to build on their strengths and increase the use of their curricula and other innovative instructional materials.

MNT-EC has added to these resources with the publication of *Microsystems Process Technician Knowledge Skills & Abilities*. MNT-EC personnel created this guide with input from MNT-EC BILT members to help community college faculty develop programs that prepare students to meet employers' expectations.

"This was our first attempt crafting an ATE grant proposal, and MNT-EC provided guidance on the solicitation along with some helpful resources and recommendations for developing a strong proposal. We were recently awarded our ATE grant, and MNT-EC continued to provide support throughout the NSF onboarding process."

Ashlee Spannagel
Dean of Career and Technical Education
& Workforce Development
Southeastern Community College
West Burlington, IA

Most Frequent Faculty Uses of MNT-EC Resources

Develop or Improve Labs	56%
Improve or Increase Usage of Lab Equipment	35%
Develop or Improve Lectures	50%
Develop or Improve Student Projects	53%
Engage in Undergraduate Research	47%

Most Frequent Student Impacts of MNT-EC Resources

Increased Exposure to Micro Nano & Related Technologies	74%
Increased Awareness of Micro Nano & Related Technologies	62%
Increased Understanding of Micro Nano & Related Technologies	71%
Increased Ability to Apply Knowledge of Micro Nano & Related Technologies	56%
Increased Understanding of Research Opportunities	53%

n=34

Respondents to MNT-EC's User Survey included 34 educators who ranked the top five ways that faculty use MNT-EC resources and how they impact students.

Many of the teaching assistants employed by the Nanofabrication Manufacturing Technology Program are graduates of the program's partner institutions, most of which are community colleges.

NACK

Nanotechnology Applications and Career Knowledge Resource Center

NACK Facilitates Alumni-Employer Networking

Building College-University Partnerships for Nanotechnology Workforce Development

Instructing students on the concepts, processes, and equipment involved in the nanomanufacturing and microelectronics industry is only one part of meeting the workforce demands. Connecting these qualified individuals with the companies who need them and providing them with professional development and resume-building is just as important.

NACK's National Nanotechnology and Semiconductor Manufacturing Network on LinkedIn (https://www.linkedin.com/groups/5050428) connects alumni from nanotechnology and semiconductor educational programs from across the country with industry personnel. All members of the industry are welcome to join in order to network, share experiences, see job postings, and read interesting industry updates.

Key Activities

- Provides remote access to key instrumentation used in nanotechnology characterization to educators and students across the country
- Connects industry and program alumni through LinkedIn networking group
- Promotes industry-backed stackable ASTM International certificates
- Guides curriculum updates and provides educational resources

Nanofabrication Manufacturing Technology Program students learn about the latest industry trends with hands-on learning experiences in the state-of-the-art facilities at the Penn State Materials Research Institute Cleanroom.

Updated Programs Prepare Students to Thrive in Nanofabrication Careers & Related Industries

A skilled workforce in semiconductor manufacturing and microelectronics is in great demand. Students with these skills can work in fabrication facilities and related industries needed to keep these facilities operational. NACK has been working with its industry partners to update the curriculum of its Nanofabrication Manufacturing Technology Program (for Pennsylvania community college students) and its Nanomanufacturing and Microelectronics Certificate Program (for military veterans in four regions across the US) to include the key skills needed to thrive in the semiconductor industry. Program attendees gain a diverse hands-on skill set in nanofabrication and nanocharacterization techniques that will allow their knowledge and skills to transfer to any facet of the semiconductor manufacturing, microelectronics, or nanotechnology fields.

"A lot of work was put into this event [NACK Hands-on-Site Workshop] and it shows. My students will benefit as I am planning to incorporate some of this material in one of my fall courses. I am so excited to share my wonderful experience with my students."

Kelly Reed
Assistant Professor, Electronics
Harrisburg Area Community College
Harrisburg, PA

NACK Helps Develop 3 ASTM International Certificate Exams

The ASTM International workforce certificates can be used by industry to assess a potential employee's knowledge base. The certificates are based on the six Nanotechnology ASTM International Standards created by a panel of industry experts, nanotechnology educators, and NACK personnel. The three stackable certificates are Health and Safety in Nanotechnology; Nanotechnology Workforce Characterization; and Workforce Certificate for Nanotechnology Workforce Fabrication and Related Infrastructure. These pass/fail certificates are available for novice and experienced technicians to complete.

Remotely Accessible Instruments for Nanotechnology (RAIN) Network Sessions and Student Participants

Year	RAIN Sessions	Student Participants
2015	8	68
2016	48	771
2017	89	1,869
2018	79	1,189
2019	135	2,978
2020	92	1,175
2021	129	3,100
2022	66	1,744
2023	44	1,354
TOTAL	**690**	**14,248**

The RAIN Network allows students to access and control powerful microscopes and analytical tools to examine nanoscale objects from classroom or home computers. Students manipulate the tools via the Internet with the assistance of an experienced engineer, who offers guidance during real-time video conferences.

Cleanroom technicians inspect data from a tool operating in a cleanroom at the Albany Nanotech Complex.

NEATEC

Northeast Advanced Technological Education Center

NEATEC Supports Paid Internships

In 2023 NEATEC expanded its experiential learning partnerships for community college interns at the Air Force Research Laboratory (AFRL) in Rome, NY. Beginning with students from Mohawk Valley Community College in Utica, NY, NEATEC funded nine paid internships with AFRL and will expand to offer 18 more over the next two years.

NEATEC also offers experiential learning programs at NY CREATES and the National Institute of Standards and Technology in Gaithersburg, MD, where it has underwritten nine community college interns. NEATEC resides within NY CREATES, the technological economic development agency that is a unit of the Research Foundation of the State University of New York at the Albany Nanotech Complex.

Key Activities

- Provides paid internships to community college students pursuing micro- and nanotechnology degrees
- Develops and distributes lectures, labs, and custom-designed training equipment for nanotechnology programs at two-year colleges
- Enhances the skills and knowledge of incumbent technicians employed by semiconductor manufacturers
- Offers professional development to community college and high school educators

Individuals Impacted by NEATEC Workforce Programs in 2022-2023

Transitioning Veterans Completing NEATEC VET STEP SkillBridge Program	34
GlobalFoundries Technician Apprentices Receiving Instruction Using NEATEC Education Content	105
Tokyo Electron Ltd. Service Engineers and Technicians Completing NEATEC Advanced Education Program	108

Transitioning veterans who completed NEATEC's VET STEP program have been hired as technicians and engineers at Tokyo Electron Ltd., Wolfspeed, Inc., Universal Display Corporation, KLA Corporaton, Microchip Technology, Inc., NXP Semiconductors, and NY CREATES.

NEATEC Successfully Launches VET STEP

The VET STEP (Veteran Semiconductor Training & Experience Program) SkillBridge program, which NEATEC launched in 2022, had 40 transitioning military veterans participate in its first 14 months. Ninety percent of the 34 individuals who completed it have transitioned into high-tech industry; most received multiple job offers.

VET STEP (https://ny-creates.org/vetstep) is the only Department of Defense SkillBridge Program that supports the national advanced manufacturing and semiconductor workforce. The 80-hour, two-week experiential training program is offered each January, April, and September at the Albany Nanotech Complex. The veterans who complete this intense hands-on training are then placed in eight-week, full-time internships at one of several national semiconductor companies.

NEATEC Curriculum Repurposed for Apprenticeship Program

NEATEC has deployed its Advanced Workmanship Training curriculum to Hudson Valley Community College to provide educational content for a registered technician apprenticeship program with GlobalFoundries in Malta, NY. More than 100 registered apprentices used this content by the end of 2023. NEATEC is also working with NY CREATES to offer a new apprenticeship program for promotion-ready cleanroom operators at its 300mm silicon wafer fabrication facility in Albany, NY.

"NEATEC's help and support in bringing their training expertise, curricula, and training equipment to our new technician training program with Arizona State University [ASU] were absolutely critical. They hosted our ASU instructor and introduced him to their hands-on approach to technician training. NEATEC has been an excellent partner, and we hope to introduce their content to our other college partners in the Southwest US to support semiconductor technician training."

John Cain
Training Program Manager
NXP Semiconductors
Austin, TX

Technicians input operation instructions into a cleanroom tool at the Albany Nanotech Complex.

A graduate student instructs a community college student on the proper use of personal protective equipment at an SCME workshop.

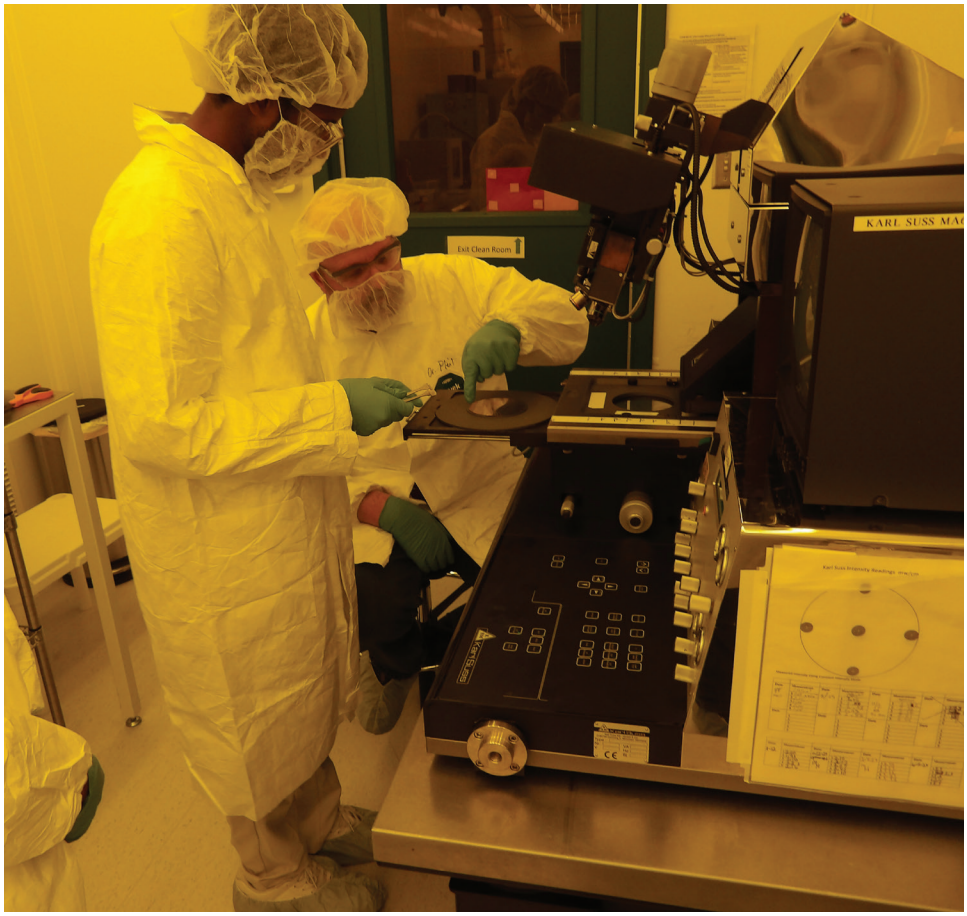
SCME

Support Center for Microsystems Education

SCME Offers Cleanroom Experiences for Students & Educators

SCME provided cleanroom workshops to 100 community college students and 31 educators from 2018 to 2023. Altogether students received 5,000 hours of in-person instruction in microsystems fabrication in SCME's cleanroom in the UNM Manufacturing Training and Technology Center.

During the workshops faculty and students learn together, gaining hands-on experience fabricating and characterizing MEMS. While teaching at Ivy Tech Community College Caitlin Cramer wrote, "This opportunity has been genuinely life-changing for several graduates who now work in MEMS." Thomas Johnson, a vacuum technology instructor at Normandale Community College, reported "I was able to take my experience working in the cleanroom and pass that working knowledge on to my students."



An SCME instructor teaches a student how to load and use the contact aligner.

Key Activities

- Provides authentic cleanroom experiences with fabricating microelectromechanical systems (MEMS) for students and their instructors
- Offers online short courses, hands-on kits, and instructional videos
- Leads the Micro Nano Technology Education Special Interest Group (https://mntesig.net)
- Collaborates with Micro Nano Technology Education Center's business and industry leadership team (BILT)
- Supports the integration of microsystems and biotech education

SCME Provides Open Educational Resources

To reach educators and students who do not have access to a cleanroom, SCME offers webinars, YouTube videos, and modules. The 37 micosystems modules include instructor guides, PowerPoint slides, lab and homework activities, reading materials, and assessments.

Of the 40 educators who completed the 2023 survey, 95% reported SCME materials had a high impact or moderate impact on students; 88% indicated they received increased exposure to microsystems technologies; and 68% reported they increased awareness of microsystems technical careers.

SCME Helps Community Colleges Build MNT Workforce

SCME founded the MNTeSIG group, which has evolved into a collegial network of community colleges and micro- and nanotechnology (MNT) education centers and projects. SCME also collaborates with numerous educational groups and ATE centers, including MNT-EC, to ensure community college curricula are infused with the real-world knowledge, skills, and abilities that the rapidly growing MNT workforce needs.

SCME partners with Lone Star College on innovative biomems educational resources and experiences with labs that blend biotechnology and microsystems for nanopore sequencing applications.

Several community colleges that SCME has assisted have been awarded ATE grants to expand their MNT programs, including Santa Barbara Community College, Rio Salado College, and Ivy Tech Community College.

Distribution of SCME Materials
From 2013 through 2023

850,000
Downloads
by
100,000+
Individuals
of
37 Modules
on Microsystems Topics

1.4 million
YouTube Views
of
92
Microsystems Videos
with
5,000+
YouTube Subscribers

SCME's video content includes lectures, webinars, and animations, which supplement the module materials used by instructors and students.

"Our semiconductor training program is directly modelled after SCME's hands-on training, and would not exist if it weren't for the years of effort SCME put into developing and refining their semiconductor cleanroom trainings. Our region now has a significant momentum building towards hands-on semiconductor training (at the K-12 through four-year levels) that is in large part due to the success of replicating SCME's training for community colleges in our region."

Demis John
Process Scientist Manager
University of California, Santa Barbara
Santa Barbara, CA

Featured ATE Project

Central Coast Partnership for Regional Industry-Focused Micro-Nanotechnology Education (CC-PRIME)

Key Activities

- Builds micro- and nanotechnology industry visibility and relations in the local community
- Provides faculty and students with lessons and experiences in manufacturing in a cleanroom facility
- Creates an industry-vetted student educational pathway to acquire semiconductor manufacturing jobs

Santa Barbara City College
Santa Barbara, CA

https://ate.is/ccprime

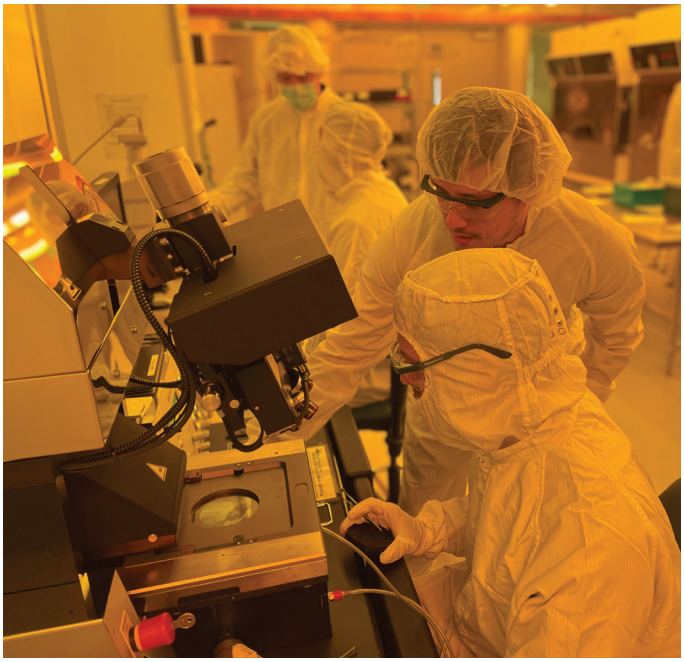
CC-PRIME Raises Awareness of Nanotech Career Opportunities

CC-PRIME is increasing awareness among California Central Coast residents, particularly among faculty and students at the community college, about the region's micro- and nanotechnology industry and its workforce needs. Industry tours, networking events, extensive industry and faculty collaboration on curriculum development, and outreach initiatives—such as the high-tech industry pavilion during the college's annual Science Discovery Day—highlight the excellent career opportunities at the highly successful companies in the region.

Demand Is High for Cleanroom Instruction that Partners Make Available to Students, Educators & Incumbent Technicians

The core academic component of CC-PRIME is the cleanroom instruction it provides for faculty and students at the California NanoSystems Institute (CNSI) facility at the University of California, Santa Barbara. These hands-on learning experiences are due to the strong collaborations of the project's partnering educational institutions and micro- and nanotech employers. The industry partners set the learning outcomes of the curriculum, which the community college educators then designed lessons to meet.

CC-Prime's initial cleanroom instruction has been positively received by industry, faculty, and students. High demand has led to it being offered more often than anticipated. This initial success has led to expansion efforts for developing additional instructional modules and for upskilling incumbent technicians who are employed at nearby micro- and nanotechnology companies.



Santa Barbara City College faculty gain real-world experience with semiconductor manufacturing processes in a cleanroom at the California NanoSystems Institute, a CC-PRIME partner.

Flexible Technology Education to Upskill/Reskill for a Vacuum Technician Career (FlexTechEd)

Nano

FlexTechEd's Modularized Courses include Supportive Interventions

FlexTechEd meets advanced manufacturers' needs for skilled technicians with cross-disciplinary STEM skills for today and in the future. The project is simultaneously testing strategies to improve access through modularized courses with multiple entry points along with interventions specifically designed to attract and support adult learners. Together, these strategies address industries' needs for skilled technicians while broadening access to technician education for adult learners from diverse backgrounds.

Graduate's URE Work and AAS Degree Lead to a Promotion

Jason Rear joined Polar Semiconductor, LLC, in an entry-level operator role. He enrolled in Normandale Community College's Vacuum and Thin Film Technology Associate in Applied Science (AAS) degree program. Jason completed courses on a part-time basis while continuing to work full time at Polar.

As a student, Jason developed a human-machine interface (HMI) for a vacuum equipment trainer system as part of an undergraduate research experience project. His HMI helps other students learn about vacuum system operation. After Jason earned his AAS degree, Polar Semiconductor promoted him to a process technician position.

Alumnus Jason Rear demonstrates the automated operation of a vacuum equipment trainer system using his HMI program.

Key Activities

- Develops and delivers courses that address automation and control skills
- Deconstructs semester-long courses into modular components that students can complete in shorter time periods
- Provides more pathways that support timely completion of the credential
- Implements student support strategies that increase student persistence and completion especially for nontraditional students

Normandale Community College
Bloomington, MN

https://normandale.edu/VacTech-FlexTechEd

Featured ATE Project

Microelectronics and Nanomanufacturing Veterans Partnership (MNVP)

Key Activities

- Provides microelectronics and nanomanufacturing (MN) instruction to military veterans, spouses, and dependents
- Offers hands-on instructional experiences with various types of equipment and processes used in semiconductor device fabrication
- Fosters collaboration between neighboring community colleges and universities
- Introduces program participants to partnering employers
- Mentors veterans on building resumes, interviewing, and making presentations

Penn State University
University Park, PA

https://cneu.psu.edu/military-ed

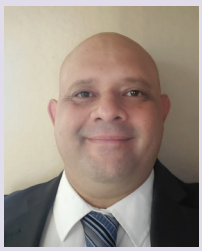
Combined Resources of Community Colleges & Universities Deliver Nanomanufacturing Instruction to Military Veterans

MNVP builds on two previous NSF-funded initiatives to foster collaborations between community colleges, universities, and employers to meet the growing demand for microelectronics and semiconductor technicians. The pairs of community colleges and universities in four regions work with their local semiconductor-related employers to recruit veterans to be technicians, specialists, and engineers.

The partnering institutions are Rio Salado College and Arizona State University; Southwestern College and University of California, San Diego; Georgia Piedmont Technical College and Georgia Institute of Technology; and Tidewater Community College and Norfolk State University.

Penn State's Center for Nanotechnology Education and Utilization faculty provide live-stream lectures and other instructional content, while mentoring the community college educators about recruiting, advising students about nanotechnology careers, and establishing their colleges' own certificate programs. Each university partner provides the students with access to cleanroom facilities for intensive, hands-on learning experiences.

Military veterans enrolled in Southwestern College's MNVP program learn hands-on semiconductor fabrication techniques in the cleanroom at the University of California, San Diego.



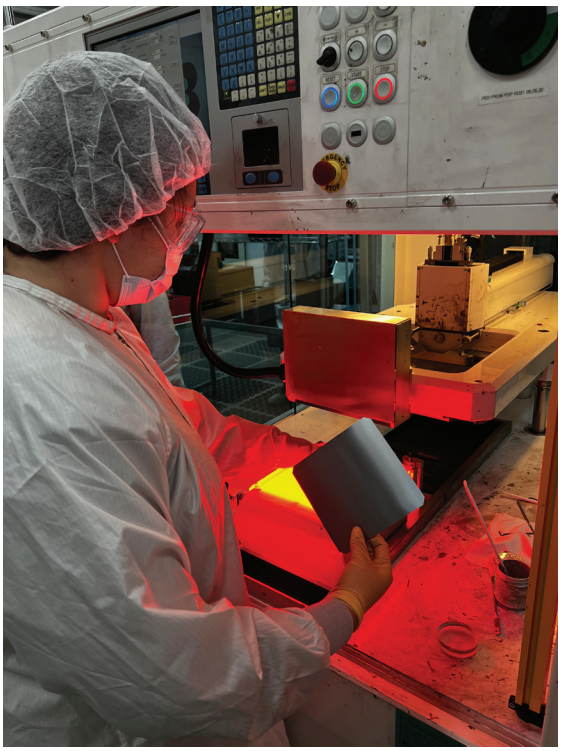
"Allowing students to get hands-on experience with the tools actually used in the industry was invaluable! Also gowning up multiple times for approximately 30 hours in the cleanroom is [an] experience I don't think you can find anywhere else. The industry presentations are invaluable. I really appreciate the opportunity to hear directly from hiring personnel in the industry."

Jarrell Matos
Security Officer and Emergency Medical Technician
Allied Universal
Rio Salado College Student
MN Certificate, 2023

Hybrid Delivery Flexes to Meet Diverse Student Needs

The hybrid nature of Nano Knows No Limits allows it to serve diverse student populations inclusively in all phases of their academic and career journeys at a time when the Arizona micro- and nanotechnology industry is booming. Industry partners are strategically involved to inform students of employers' expectations.

The project's partnership with Arizona State University (ASU) includes a one-week Solar Cell 101 workshop that introduces students to photovoltaic cell and battery storage system manufacturing.



Students learn about photovoltaic manufacturing during the Solar Cell 101 workshop.

Collaborations with three high schools introduce students to new micro- and nanotechnology careers in two formats:

1) online lectures with in-person labs at Rio Salado College or ASU; and

2) in-person lectures and labs.

"The Nano Knows No Limits program allowed students to image a gecko foot and zoom in to see how nanotechnology can be used in biomimicry. Our engineering program has embraced the amazing virtual scanning electron microscope in our classroom to expand the nanotechnology curriculum."

Denise Cantu
Engineering Teacher
Desert Ridge High School
Mesa, AZ

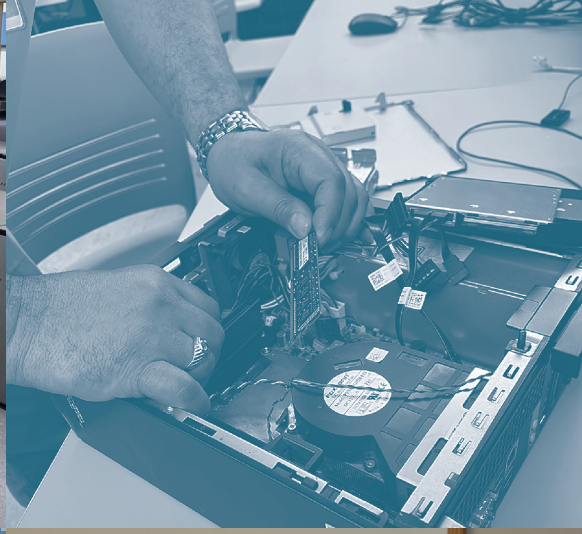
Key Activities

- Develops innovative curricula in micro- and nanotechnology for industry, college, and high school partners
- Supports students from diverse backgrounds in a wide variety of modalities
- Increases outreach efforts to nontraditional students
- Enables access to state-of-the-art solar cell manufacturing and other workshops with industry partners

Rio Salado College
Tempe, AZ

https://bit.ly/atenanoknows

ATE @30

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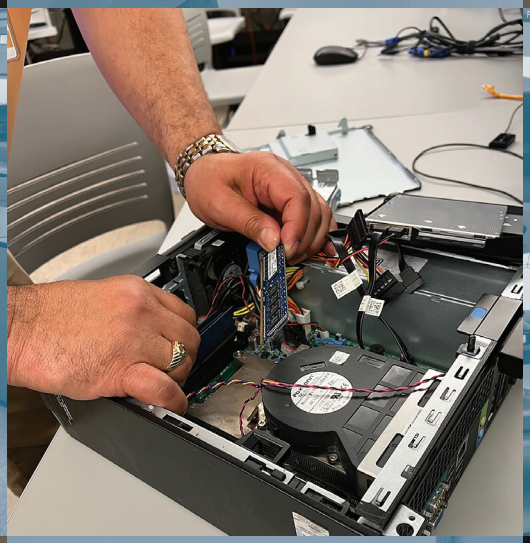


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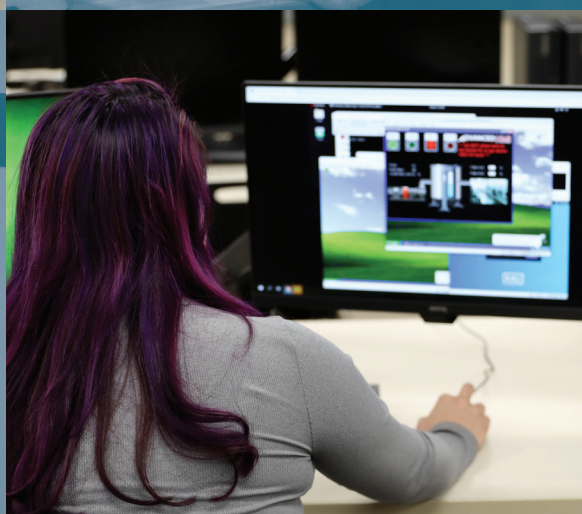
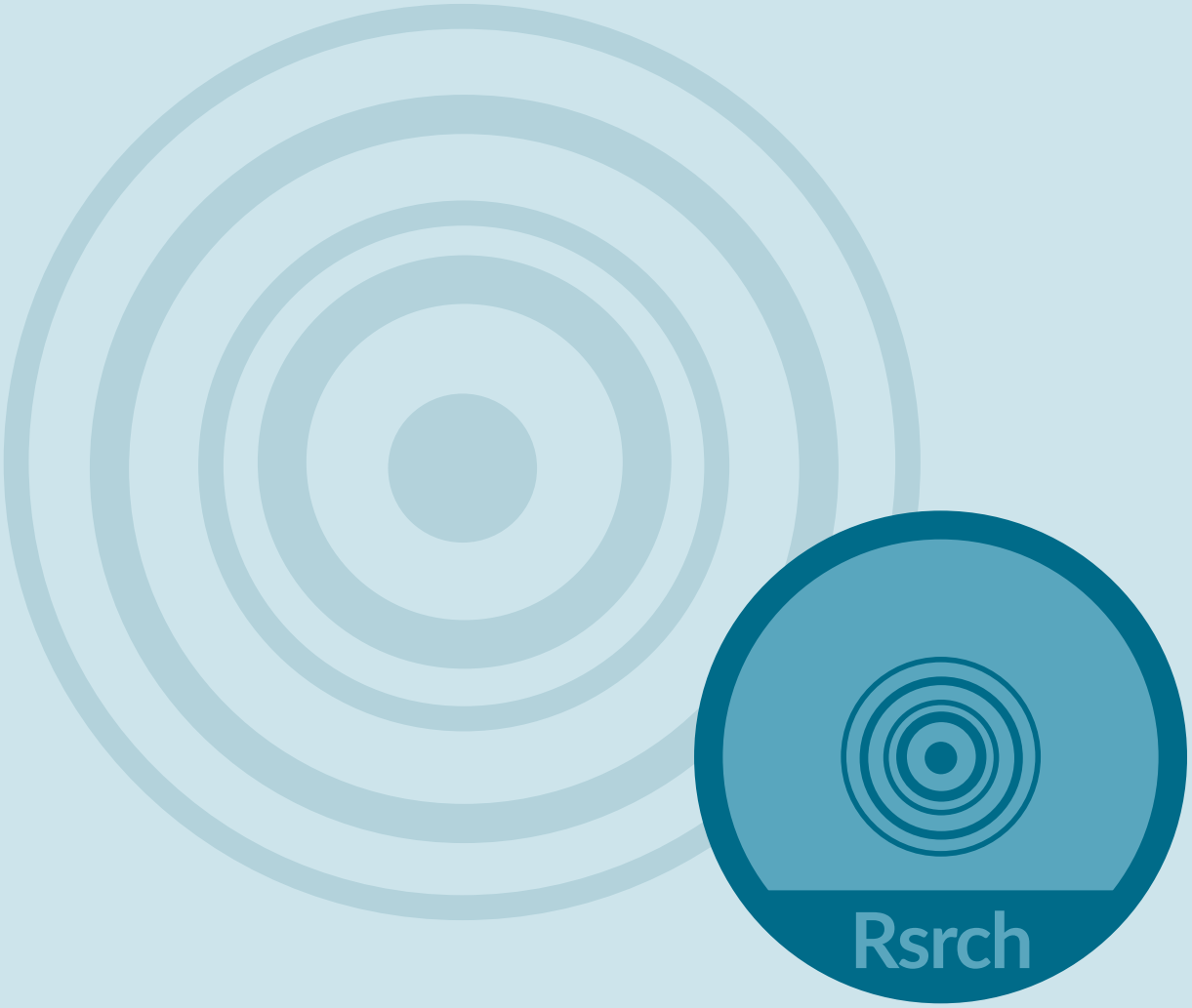


Applied Research Projects

https://ate.is/rsrch



Crisis as Catalyst for Change and Innovation (CCCI)

Key Activities

- Documents and analyzes change within ATE programs since the COVID pandemic
- Identifies key patterns and priorities, with particular attention given to the most vulnerable populations
- Broadens understanding regarding how institutional stakeholders engage with change and immediate and enduring impacts

University of Wisconsin-Madison
Madison, WI

https://ccci.wceruw.org

Study of Colleges' Responses to COVID Finds Promising Ideas & Persistent Challenges

The CCCI research team which includes Madison Area Technical College faculty, uses innovative mixed-methods research to identify key patterns in innovations, best practices, and adaptations that ATE grantees made during the COVID pandemic.

The project relies upon the connectedness within the ATE community and the willingness of the community's partners to dive into these topics during more than 100 qualitative interviews. In addition to the interviews, CCCI uses text mining combined with qualitative analysis of available online news and publications from the Wisconsin Technical and Community Colleges.

As a result, CCCI is uncovering both promising ideas and persistent challenges in the learning experiences and outcomes among students and faculty as a result of various instructional adaptations made in response to COVID. As one interviewee stated, the pandemic created a "changing and uneven landscape" for colleges to navigate.

CCCI uncovered themes of access and flexibility, holistic support for students, community focus, and agility to innovate underlying these adaptations. It also found that colleges demonstrated their overall commitment to students by supporting them holistically. The researchers' findings also pointed to a critical need to address faculty and staff development and supports, as well as the imperative for sustained diversity, equity, and inclusion efforts.

CCCI Recommendations to Support More Equitable Technical Education Experiences

- **Create spaces for conversation and collaboration.**
- **Maintain transparent and open communication.**
- **Maintain flexibilities in place for faculty and staff.**
- **Remove barriers to student access and progress.**
- **Give credit for prior coursework and work experience.**
- **Generate and use evidence to guide equity-minded decision-making.**

CCCI research team's analysis of data about technical college educators' innovative responses to COVID led to recommendations of practices that should be maintained for more equitable technical education experiences.

Collaborative Research: Developing Business Communication Skills in Manufacturing Technician Education

Students Hone Their Business Communication Skills within VR Scenarios

Drawing on the long-standing partnership between the host institutions, the interdisciplinary project team developed and tested an adaptive virtual reality (VR) program to help manufacturing technology students acquire business communication skills.

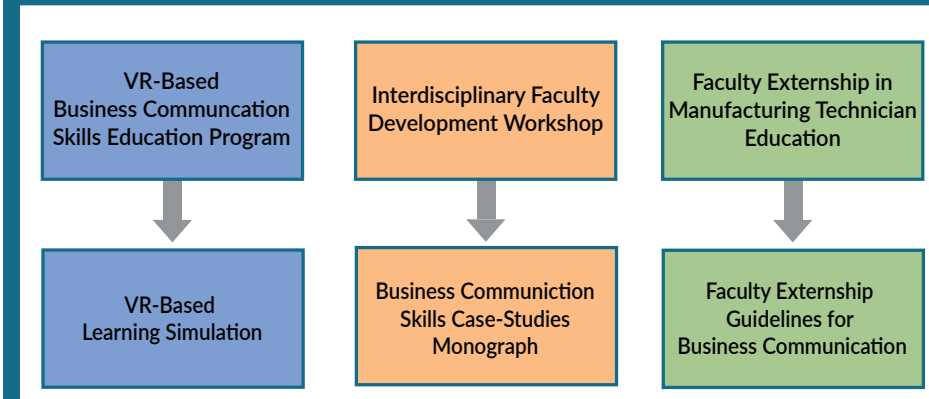
Tests of the interactive platform indicate it provides valuable space for practicing skills to engage with supervisors, colleagues, and customers. Through these scenarios, students develop the ability to communicate in ways that effectively resolve conflicts, foster collaborations, demonstrate sensitivity toward cultural differences, and exhibit traits such as open-mindedness and adaptability. Moreover, they gain practical experience in displaying emotional intelligence, allowing them to navigate various communication scenarios with skill and empathy.

Project Offers Faculty Externships & Case Studies Monograph

The project is supplementing Ivy Tech Community College instructors' knowledge with externships that place them with industry partners to learn about advanced manufacturing trends, business communication skills requirements, tools, and career opportunities.

A monograph of case studies based on the academic and life experiences of interdisciplinary faculty will be published for supplementary instruction.

Conceptual Model of Developing Business Communication Skills in Manufacturing Technician Education



The project's research team uses this conceptual model to study how business communication skills can be effectively developed for manufacturing technician education.

Key Activities

- Develops an adaptive virtual reality (VR)-based business communication skills education program for manufacturing technician students
- Uses information gathered at an interdisciplinary faculty development workshop to enhance curriculum
- Creates educational materials—including a monograph of case studies—for teaching business communication skills in a manufacturing context
- Offers an externship program for faculty in manufacturing technician education

Ivy Tech Community College
Indianapolis, IN

Purdue University
West Lafayette, IN

https://polytechnic.purdue.edu/nsfate

Featured ATE Project

Collaborative Research: Professional Development for Culturally Responsive Technician Education (HSI ATE Hub 2)

Key Activities

- Provides faculty professional development that translates research-based theory to culturally responsive practices aimed at improving Latinx student success
- Fosters peer-sharing among community college educators to implement and disseminate asset-based, culturally responsive practices in technician education programs throughout the Hispanic-serving institutions (HSIs) in the Advanced Technological Education (ATE) community

Westchester Community College
Valhalla, NY

Arizona State University
Tempe, AZ

https://ate.is/hsiatehub

Culturally Relevant Instruction Improves Faculty-Student Connections for Better Workforce Skill Development

The HSI ATE Hub 2 develops awareness and capacity among educators at community colleges for culturally responsive practices that create a sense of belonging for underserved students in STEM. This pedagogy, developed with support from previous ATE grants, helps faculty gain students' trust and develop their agency and voice.

The research team has found that by meeting the students where they are and developing an understanding of their background and communities, faculty can better assist students in developing the necessary skills to fit the demands of today's technical workforce.

> *"Doing the collage gives you the chance to really tell your story. This caused me to be more engaged in class and instilled confidence. Seeing another person like me that's Puerto Rican, first going to college, inspired me. Professor Rodriguez pushed me to do more. He told me to go take the A+ certification test and I passed. Now it's leading me to push other students to go take their tests—they can pass too."*
>
> Adalynn Martinez
> Westchester Community College
> Student

A Westchester Community College instructor uses a collage about his interests to introduce himself and welcome students to the new semester. Sharing a personal collage is a culturally responsive practice that the HSI ATE Hub 2 team has found builds trust with students and facilitates their engagement in learning.

Targeted Research on Needed Math

Survey Data Prompts Rethinking of Mathematics Competencies to Be Taught

The Needed Math research team distilled more than 500 survey responses to identify what mathematics is deemed to be most important to industrialists, technical educators, and mathematics educators. The team's comparison of responses looked for points of consensus, along with where significant differences occur, between educators and industrialists.

Guided by its belief that industry's needs should influence the mathematics taught in two-year college technical programs, the Needed Math team is sharing its compelling data and analyses with ATE colleagues nationally. These colleagues are assisting the researchers as Collaborative Working Groups. The groups are helping to develop scenarios that contextualize the math competencies deemed to be most important by survey respondents. The groups are also working with the researchers to recommend ways for mathematics reforms, based on regional employers' needs and constraints, to align with wider industry needs.

A mid-project finding was that some of the mathematics concepts commonly taught in technician education programs are rarely used by technicians in advanced technology workplaces. This information has stimulated discussions in the Collaborative Working Groups and is prompting educators to rethink mathematics curricular choices.

Top 10 Math Skills Technicians Need to Know

1. Take measurements using physical tools or instruments. n=313
2. Use blueprints, diagrams, drawings, flow charts, or schematics.
3. Use metric or International System of Units (SI) prefixes.
4. Make estimates (for example, of measurements, quantities, production runs).
5. Work with ratios or rates.
6. Read, document, and/or interpret sensor data.
7. Do work that requires accuracy to a specified tolerance.
8. Use data to troubleshoot problems.
9. Make conversions between units of measurement.
10. Make conversions between different ways of expressing numbers.

Preliminary results from the Needed Math project's survey of math educators, technical educators, and industrialists identified these as the most important for technicians to know.

Key Activities

- Conducts site visits to observe and interview manufacturing technicians to learn about the math they actually use
- Surveys industrialists and two-year college technical and mathematics educators to compare perceptions about the math skills that technicians need
- Develops scenarios to illustrate math used in manufacturing

Hofstra University
Hempstead, NY

https://neededmath.org

Legend

Advanced Manufacturing

Centers

Featured Projects

Agricultural & Environmental

Centers

Featured Projects

Bio & Chemical

Centers

Featured Projects

Engineering

Centers

Featured Projects

General Advanced Technological Education

Centers

Featured Projects

Information & Security

Centers

Featured Projects

Micro & Nanotechnologies

Centers

Featured Projects

Applied Research Projects

Map of ATE Centers and Featured Projects

For an interactive map of all current ATE projects and centers, please visit **https://atecentral.net**

Internet Scout Research Group (https://scout.wisc.edu) is home to ATE Central, which acts as an information hub and archive for the ATE community. Please visit ATE Central (https://atecentral.net) to access materials and services that showcase the work of the Advanced Technological Education program. Internet Scout Research Group is part of the Computer Sciences Department of the University of Wisconsin–Madison, located at 1210 West Dayton Street, Madison, WI 53706.

The US National Science Foundation was established in 1950 as an independent federal agency. It supports science and engineering in all 50 states and US territories, chiefly through a competitive grant process like that used with the Advanced Technological Education (ATE) program.

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Project Directors: Rachael Bower and Edward Almasy
Content Editor: Madeline Patton
Graphic Designer: Julie Schroeder
Project Coordinator: Ray M. Perry

Help us gather data about ATE's impact. Please tell us how you use this publication by completing a brief survey at https://ateimpacts.net/booksurvey

ATE Impacts 2024-2025 showcases the innovative efforts of **Advanced Technological Education** (ATE) centers and projects recently funded by the National Science Foundation. These cutting-edge **technician education** initiatives are primarily led by educators from two-year **community and technical colleges**. By **partnering with industry** and collaborating with educators and researchers across sectors and disciplines, these ATE projects and centers create an array of materials, from educational modules, to entire degrees for students, to professional development for faculty, all designed to strengthen the **skilled technical workforce** for the high-technology fields critical to our nation's long-term prosperity and security.

Advanced Manufacturing
Agricultural and Environmental
Biological and Chemical
Engineering
Information and Security
Micro and Nanotechnologies

Instructional materials and other resources developed by ATE centers and projects can be found on the websites listed inside or via **ATE Central** (**https://atecentral.net**).

ATE student success stories, ATE program innovations, and more information about other outcomes are available on the **ATE Impacts** blog (**https://ateimpacts.net**).

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