



ADVANCED TECHNOLOGICAL EDUCATION
ADVANCED TECHNOLOGICAL EDUCATION
ADVANCED TECHNOLOGICAL EDUCATION

IMPACTS

2022-2023



Strengthening the Skilled Technical Workforce

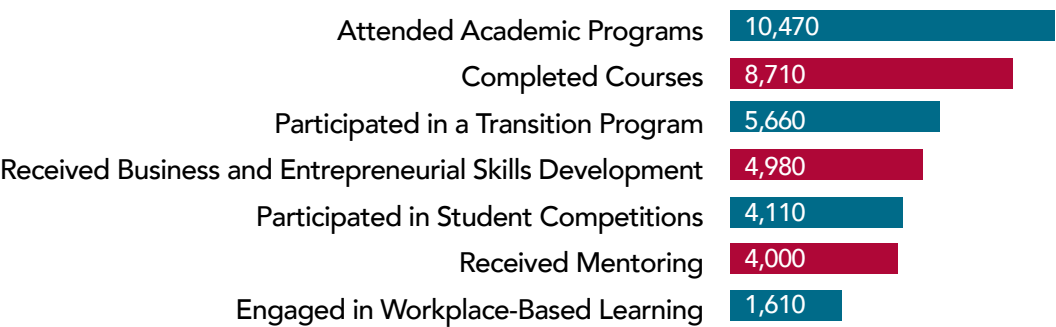
Advanced Manufacturing
Agricultural and Environmental
Biological and Chemical



Engineering
Information and Security
Micro and Nanotechnologies

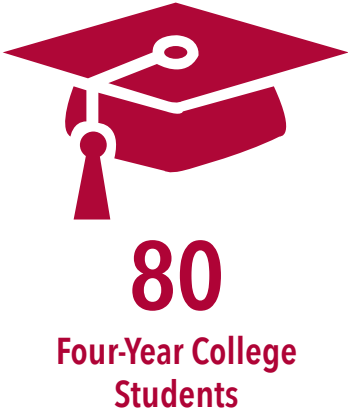
ATE by the Numbers

Served 39,500+ Students in 2020



Due to the structure of the survey questions, the total number of students served may not represent a count of unique students.

Mentored 4,000 Students in 2020

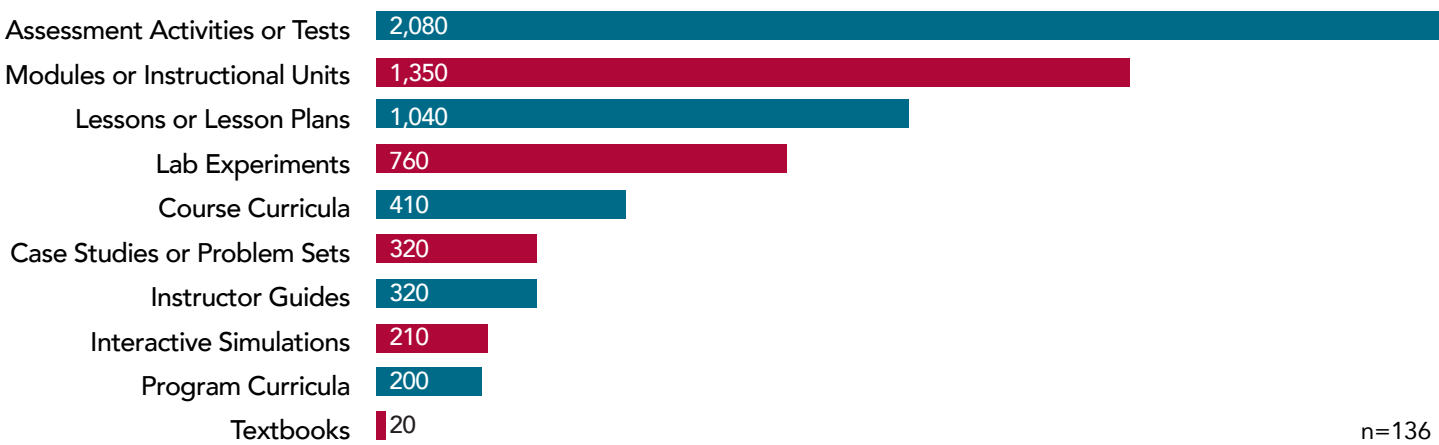


Twenty-one percent of ATE initiatives provided mentoring for students.

Types of Institutions with ATE Grants



Developed or Updated 6,000+ Materials in 2020

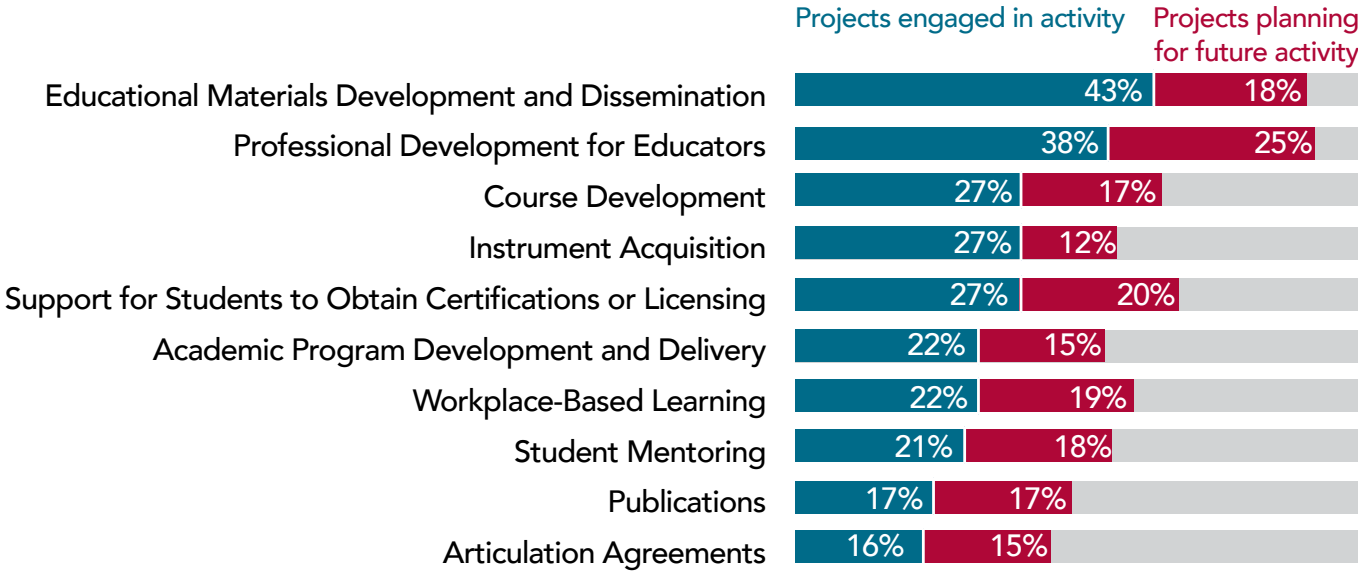


n=136

Provided Professional Development to 8,620 Educators



Top 10 ATE Activities to Improve the Skilled Technical Workforce



ATE by the Numbers

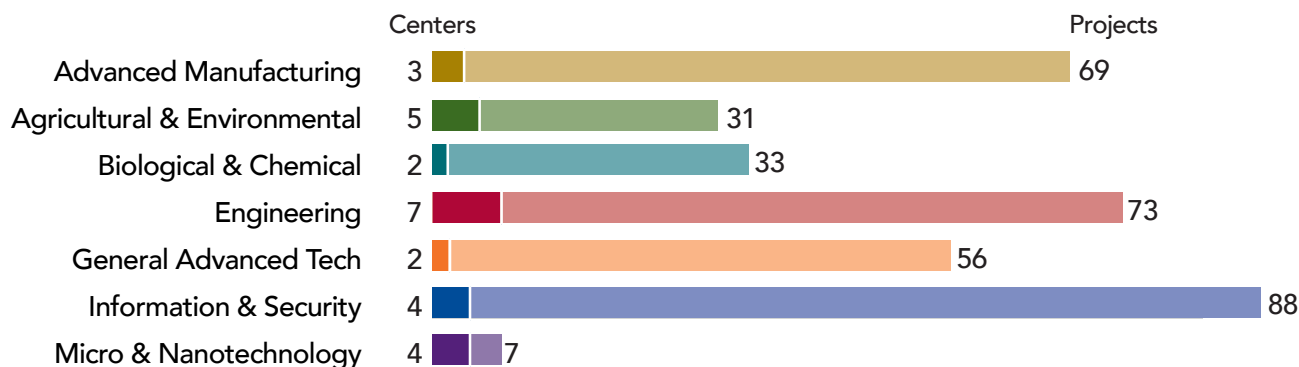
Our nation's economy and prosperity depend on a skilled technical workforce. The National Science Foundation's Advanced Technological Education (ATE) program awards grants to support a wide array of efforts to improve technician education in fields ranging from advanced manufacturing and engineering, to nanotechnology and biotechnology, and to agriculture and environmental sciences.

Educators at two-year community and technical colleges have leadership roles in ATE initiatives and work in partnership with employers in many fields and with educators in secondary schools and universities. The results are dynamic collaborations that focus on preparing individuals for careers in the applied science, technology, engineering, and math (STEM) sectors that are critical to a competitive US economy and a resilient technical infrastructure.

In addition to supporting the development of robust associate degree programs, ATE initiatives foster students' lifelong learning. This in turn helps grow scientifically literate citizens who understand and embrace the importance of science both at work and at home.

The data and infographics on this page and the preceding two pages highlight the major STEM technical workforce development activities and key resources created by ATE centers and projects.

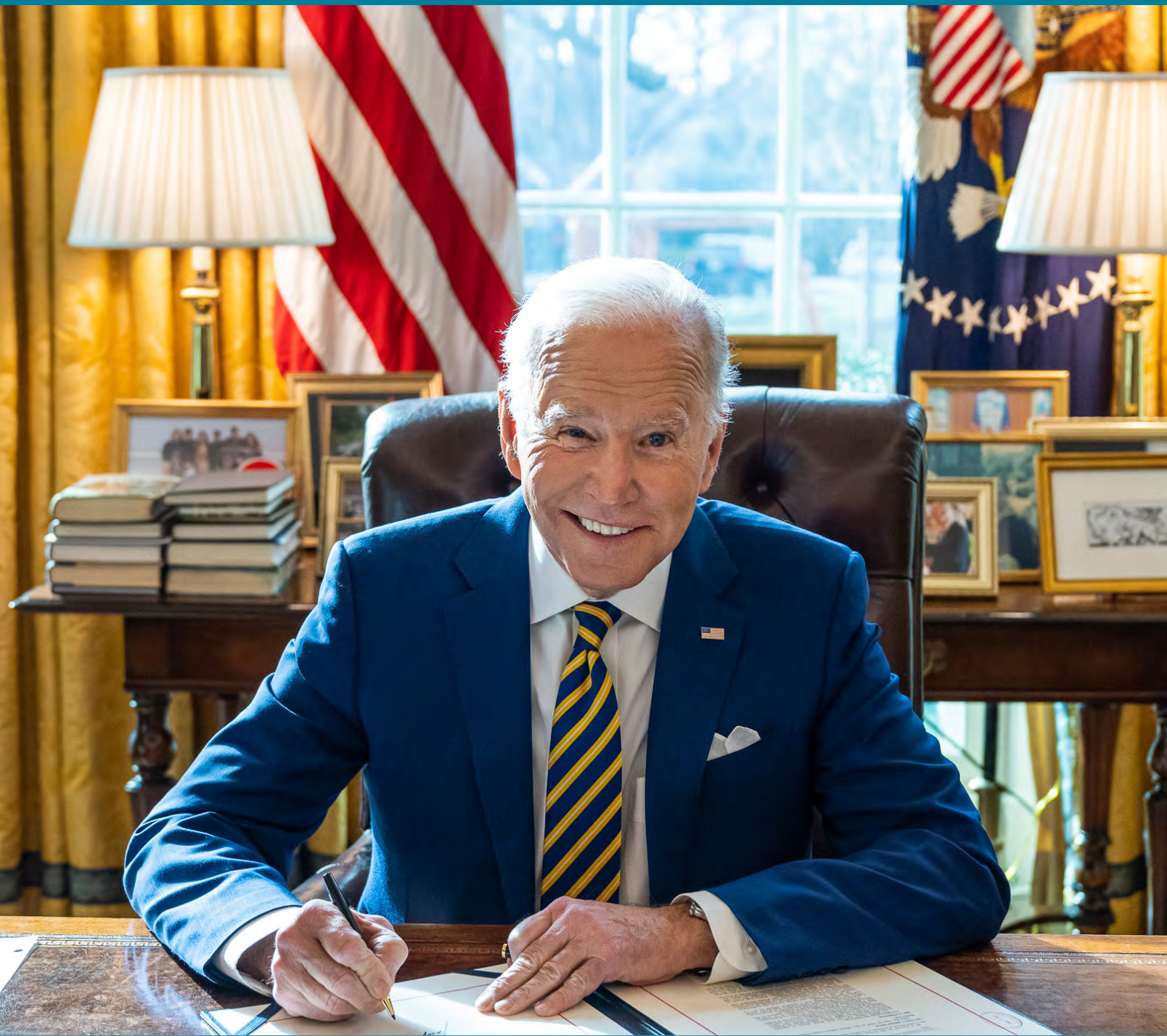
Current ATE Projects and Centers by Subject Area



ATE Fostered 7,560 Collaborations in 2020

69% with Business and Industry Groups
52% with Two-Year and Four-Year Colleges

Foreword



"To compete on the world stage, we must train and develop the absolute best technical workforce, which is exactly what the National Science Foundation's Advanced Technological Education (ATE) program champions."

President of the United States Joseph R. Biden



THE WHITE HOUSE
WASHINGTON

March 8, 2022

As the First Lady often says, any Nation that out-educates us will out-compete us. The COVID-19 pandemic emphasized the demand to strengthen our manufacturing and technology infrastructure, and that includes investing in our Nation's workers and students. To compete on the world stage, we must train and develop the absolute best technical workforce, which is exactly what the National Science Foundation's Advanced Technological Education (ATE) program champions.

Our Nation's economy and prosperity depend on a skilled technical workforce. By facilitating high-quality programs in community and technical colleges across the Nation, the ATE program is educating and training the next generation to ensure America wins the 21st century. It also provides students with the knowledge and skills required to support the health and resilience of our Nation's technical infrastructure. I commend the work of the National Science Foundation, the ATE program, and the critical efforts of their community and technical college partners.

There is nothing our Nation cannot do if we do it together. I hope that the projects and centers featured in this report inspire and inform educators, students, parents, and industry leaders across our country about the opportunities ahead and the future we can build together. It has never been a good bet to bet against America, and I know we will meet the moment.

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Introduction

Innovative educators energize the National Science Foundation's Advanced Technological Education (ATE) program's effort to improve technician education programs in the United States. These educators' creativity and their drive to help students succeed in advanced technology careers and to support other educators in the preparation of technicians are evident throughout this publication.

Since it was created by the National Science Foundation (NSF) in response to the Science and Advanced Technology Act of 1992, the ATE program has become the largest two-year college investment in the science agency's portfolio. Over the years, NSF has awarded almost 2,000 ATE grants through its rigorous merit review process. The appropriation for the ATE program was \$75 million in the 2022 fiscal year.

Along with its mission to improve the skills of technicians for the high-technology fields that drive the nation's economy, the ATE program also seeks to grow and broaden the diversity of the skilled technical workforce. Toward that end, it has supported efforts to educate populations historically underrepresented in science, technology, engineering, and math (STEM) fields and technicians in rural areas.

Distinct aspects of the ATE program include the expectations that ATE initiatives will

- involve community and technical college educators in leadership roles;
- partner with industry and other education sectors to prepare people for advanced technology careers, not just jobs;
- award students associate degrees and certificates, and facilitate their acquisition of other industry-endorsed credentials;

ATE Alum: Josephine Hollandbeck Works on Critical Infrastructure Projects

"My experience in the cybersecurity bachelor of applied science degree program at WCC was life-changing," says Josephine Hollandbeck. She earned a bachelor's degree at Whatcom Community College (WCC) in 2021 and an associate degree in cybersecurity in 2019.

Whatcom's faculty have benefitted from professional development and resources offered by the National Cybersecurity Training and Education Center (NCyTE).

Because Hollandbeck worked full time while attending classes, she said the program's attentive and knowledgeable faculty, flexible course schedule, and tutoring services were extremely helpful to her.

"I made connections to peers and future colleagues through clubs, events, and engagement by teachers. I experienced a variety of cutting-edge experiences in cyber, more than just a lecture. The program laid the foundation for my success in any area of cyber I chose to pursue, leaving me with a wide variety of options," she said.

During 2022 Hollandbeck is focusing on completing an inside wireman apprenticeship, which requires 8,000 hours of experience working with a journeyman. Her assignments include critical infrastructure projects for International Brotherhood of Electrical Workers contractors.

When she completes the apprenticeship, Hollandbeck plans to open a business that provides cybersecurity for industry control systems and electrical installations.



- develop regional and national approaches to meet employers' needs for skilled technical workers; and
- continue in some form after grants expire.

ATE principal investigators' enthusiastic collegiality means that they encourage other educators to adopt or adapt ATE curricula and materials and provide professional development that helps with implementation. In this way the ATE program helps educators across the nation build the skilled technical workforce.

Resiliency during the Pandemic

As with every other aspect of human existence since early 2020, the COVID-19 pandemic challenged ATE principal investigators and their teams. In most instances, principal investigators' agile thinking led to reconfigured activities that helped educators and students persevere.

The generally positive results show the resiliency of the ATE community. Here are some examples:

- The leaders of Bioscience Technician Expansion Project used what they learned converting their biotechnology courses for online delivery, which was the goal of their ATE project, to help their colleagues at North Central State College convert all of the college's science, technology, and math courses for remote delivery in March 2020.
- In 2021, MATE II incorporated both in-person and remote competitors in its international student competition for remotely operated vehicles.
- Several ATE centers reported that making their discipline-specific annual conferences virtual meetings rather than in-person gatherings facilitated scheduling of presentations by renowned experts and attracted larger, more diverse audiences to their programs.
- By assembling and shipping hands-on kits to students for course labs and to faculty for professional development workshops, numerous ATE centers and projects helped sustain a wide variety of STEM learning across the nation.
- Webinars, instructional videos, modules, and podcasts created by centers and projects to provide instructional content for colleges and high schools in the early days of the pandemic led to a plethora of enduring educational resources.

Project Promotes Cross-Disciplinary STEM Skills

The Preparing Technicians for the Future of Work project at the Center for Occupational Research and Development (CORD) in Waco, TX, has gathered information from industry representatives and subject-matter experts across disciplines to create a framework for incorporating regionally prioritized cross-disciplinary skills within technical programs.

The project has developed

- *A Framework for a Cross-Disciplinary STEM Core* report;
- instructional cards on cross-disciplinary knowledge and skill areas;
- professional development webinars and workshops; and
- podcasts with influential leaders from education and industry.

See <https://www.preparingtechnicians.org> for more information.

Introduction

- Most of the new courses developed by ATE projects and centers in 2020 were either hybrid courses that mixed online and face-to-face delivery, or online courses.*
- 68 ATE initiatives managed to offer workplace-based learning opportunities in 2020: 78% of these workplace-based opportunities were internships and 15% were apprenticeships.*

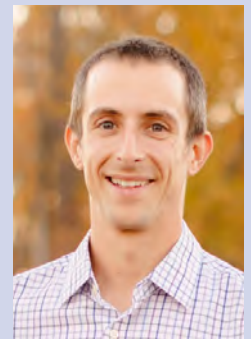
The vignettes about ATE program alums featured in the introduction and elsewhere provide a glimpse of how ATE initiatives sharpen students' learning and lift the trajectories of their careers. ATE innovations prepare skilled technicians who are ready to do complex tasks today and to master new technologies when they arrive in their workplaces in the future.

* Source: *ATE Annual Survey: 2021 Report by EvaluATE* (<https://atesurvey.evalu-ate.org>)

ATE Alum: Brandon Dixon's Cybersecurity Career Sparked by CyberWatch Leader's Presentation

Brandon Dixon, a product and intelligence strategy leader at Microsoft, traces his career choice to Casey O'Brien's 2004 cybersecurity career presentation to sophomores in a networking course at Sollers Point Technical High School in Dundalk, MD.

O'Brien, co-principal investigator of the National CyberWatch Center, talked about "finding vulnerabilities and being able to exploit those to make security better. That's kind of what drew me into security more broadly," Dixon recalled.



The "edginess" of cybersecurity appealed to Dixon, and he became a dual enrollment student at the Community College of Baltimore County (Essex Campus). While in high school he earned As in 200-level courses, tinkered with networking equipment at home, and started his first company fixing computers and helping people with network-based problems.

After completing his associate degree, Dixon plowed through the bachelor's degree program at Capitol College (now Capitol Technology University) while working full time.

Coding was so much fun to Dixon he initially gave away the software tools he built.

"Once you know how to write code, you know there are ways to automate, or change your circumstances, and that really drove a lot of creativity for me because then I didn't have to wait for someone else to invent it. I could invent," he said.

O'Brien, who is proud to have taught Dixon in an introductory information security course at the college after recruiting him to cybersecurity, explained that Dixon became one of the world's foremost experts on PDF exploits – that is when .PDFs are used to deliver malware.

PDF XRAY is just one of the products Dixon developed for a large high-tech employer. Then, in 2014 after leaving a position at Verisign, Dixon and a friend started PassiveTotal, a cybersecurity platform that aids analysts' investigations of malicious actors. In less than two years they sold the company to RiskIQ, where Dixon was vice president of strategy when Microsoft acquired it in 2021.

Dixon appreciates the excellent instruction he received from O'Brien and Nancy Null, the networking instructor at Sollers Point Technical High School. "She would always tell us 'With great power comes great responsibility.' And she would make us say it in the class to ensure that we respected what we were learning and how not to apply and not use it for malicious purposes," he said.

ATE Is Part of Kapil Chalil Madathil's Extraordinary Career Arc

Kapil Chalil Madathil has fond memories of talking briefly about his research with Gerhard Salinger and V. Celeste Carter at the 2009 ATE PI Conference.

A master's degree student at the time, he and the community college students who participated in the conference received congratulatory handshakes and certificates from the two National Science Foundation program directors who then were co-leaders of the ATE program.

"That was an exciting moment for me," he said, explaining that he treasures the photo that captured it. He considers the certificate his first student award.

In his early career Chalil Madathil was a tool and die maker in India where he earned associate and bachelor's degrees prior to his graduate studies at Clemson University in South Carolina.

The year and a half he spent as a skilled technical worker influenced the virtual reality simulations he designed as a graduate assistant for the Center for Aviation and Automotive Technological Education Using Virtual E-Schools (CA2VES) at Clemson. It also informs his current participation on the workforce development committees for the National Academy of Engineering and USA Manufacturing Institutes. "Because I've gone through the particular process, I understand what's happening out there and what will make an impact," he said.

Since completing his PhD in industrial engineering, Chalil Madathil has risen through the academic ranks at Clemson. He is now the Wilfred P. and Helen S. Tiencken Endowed Associate Professor of Civil and Industrial Engineering and the director of technology for the Clemson University Center for Workforce Development.

His research on human systems integrations focuses on how humans and machines work together. His utilization of virtual and augmented realities is discipline agnostic and has been used to address technician education, healthcare, and social problems. For example, one of his current NSF-funded studies uses simulations to identify factors that lead people to participate in dangerous social media challenges and to develop recommendations for interventions.

Although he and his Clemson team have been quite successful at obtaining support from other federal agencies and other entities, Chalil Madathil said the ATE program remains "close to his heart" because it paved the way for him to be a successful researcher.

He is now a co-principal investigator of CA2VES, the ATE center that employed him as a graduate assistant in 2009. He is also the principal investigator of the ATE research project Exploring the Strategies Used by Two-Year Colleges to Support Academic Continuity in STEM Education During the COVID-19 Crisis.

That project uses a resilience engineering framework to examine how educational institutions mitigated instructional challenges during the COVID-19 pandemic. "Because this is not going to be the last pandemic, we need to prepare ourselves for the future," he said.



The ATE Impacts book showcases the important role that two-year community and technical colleges play in building the skilled technical workforce and provide evidence of the United States' critical economic need for technician education. The text, photos, and data throughout this book highlight the innovative and exciting work being done by the ATE community and by the people central to those efforts.

The accompanying videos created in collaboration with Vox Television share the experiences of those people – students, administrators, educators, and industry partners – and the profound impact of ATE initiatives on their lives and careers.



"When I talk to community members, it's about me sharing that we're part of this community, that we're giving back to the community by creating the future workforce. Not only that we have that workforce, but they care about the communities in which they reside, and they're giving back ... Without the ATE program, it would be hard for me to imagine what my college would be like."

Annette Parker
President
South Central College
North Mankato, MN



"Using chemistry, microbiology, and technical knowledge gained during the duration of the water quality technology degree program, I was able to start a new career as a wastewater plant operator and provide clean water for my community while protecting the environment."

Nicholas P. Galloway
Wastewater Plant Operator Grade III
City of Maryville, TN
Pellissippi State Community College Graduate
Knoxville, TN





"There are many examples of how that collaboration with Columbus State and ATE has really benefited not only Honda, but other manufacturers in Central Ohio. One way is through that ATE funding and collaboration, Columbus State was able to create a program that included career preparation, [with] coordinated and very intentional counseling from a career perspective at the college. They were able to realign the curriculum so that when students came out to work at Honda and the other employers, they had a high degree of technical skills that other students traditionally wouldn't have."

Scot McLemore
Manager
Workforce Partnerships/Government & Industry Relations
American Honda Motor Company, Inc.
Marysville, OH



"The Connecticut Community Colleges' College of Technology and its NSF ATE funding has been a driver of advanced manufacturing education for more than 20 years. The ATE funding has provided faculty with industry-driven professional development opportunities and students with life-changing, well-paying careers that have impacted not only their lives, but the lives of future generations. Our National Center for Next Generation Manufacturing (NCNGM) capitalizes on the commitment and expertise of partners from community colleges, secondary education, universities, industry, government, and other stakeholders and will ensure that community colleges across the nation will prepare our graduates for advanced manufacturing careers needed for the US to be competitive globally in the manufacturing landscape."

Karen L. Wosczyzna-Birch
Executive Director & Principal Investigator
National Center for Next Generation Manufacturing
Connecticut College of Technology
Tunxis Community College
Farmington, CT



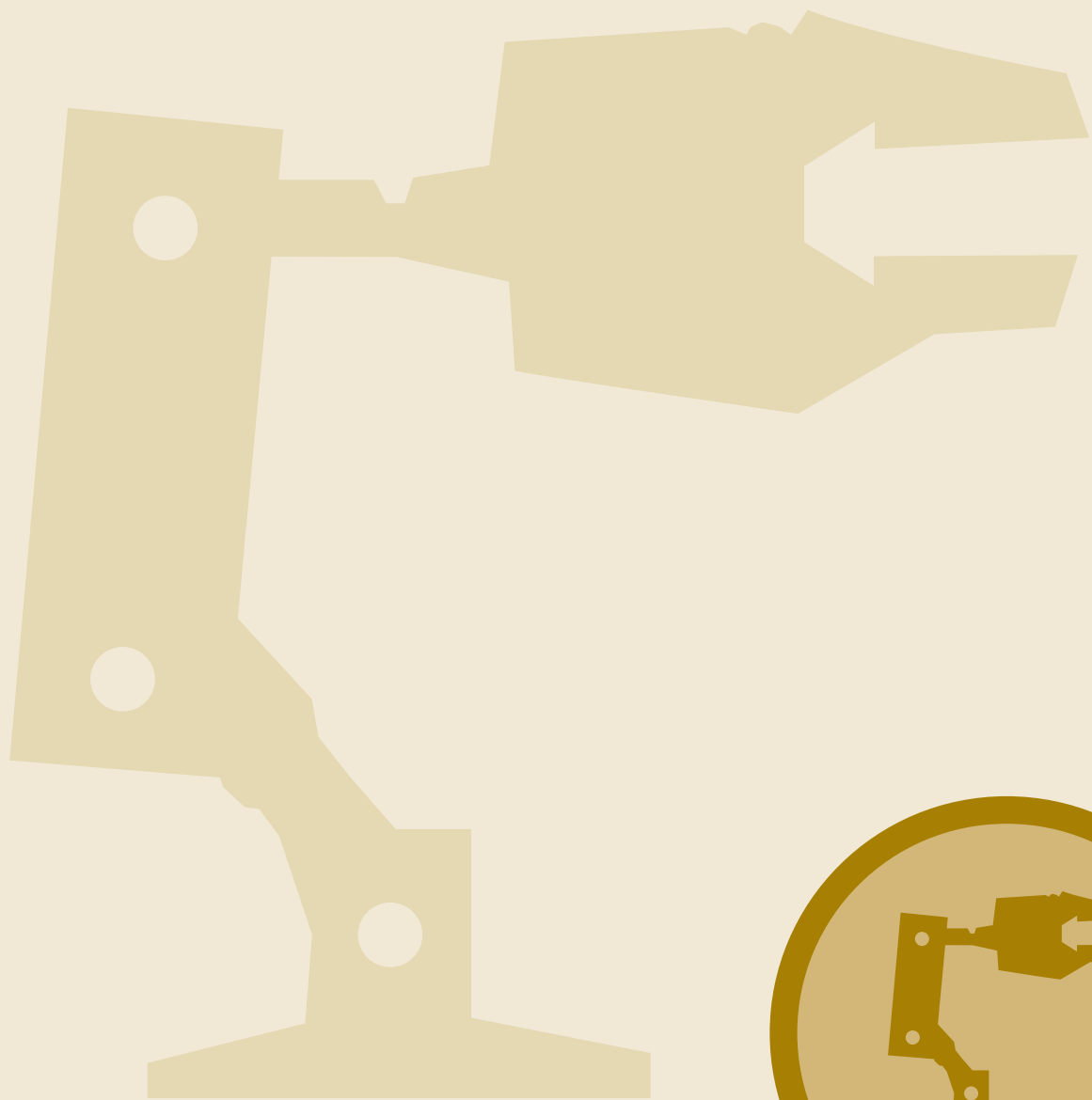


MakerBot Replicator 218
3D PRINTER



Advanced Manufacturing Technologies

<https://ate.is/mfg>





An aspiring technician reviews mechatronics curriculum developed by CA2VES and shared via the EducateWorkforce platform.

CA2VES

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

Center Facilitates E-Learning

In response to COVID-related challenges, CA2VES created separate webinar series for two-year college educators and two-year college

students on the migration of in-person instruction to e-learning. The center also offers a webinar series that provides guidance to educators on the use of VR and augmented reality (AR) for e-learning.



During 2022 CA2VES plans to pilot a four-track robotics digital learning package. Partner institutions at the high school, associate, baccalaureate, and graduate degree levels will be testing the courseware that includes VR simulations, video lectures, open text, and interactive assessments.

Key Activities

- Generates new knowledge through evidence-based controlled and longitudinal studies on the efficacy of e-learning approaches
- Creates flexible e-learning curriculum modules and virtual reality (VR) simulations for broad dissemination
- Develops, refines, and disseminates professional development resources to support two-year college instructors



CA2VES Digital Learning Tools

300+

3D & Computer-Aided Design Models

167

e-Learning Modules

141

Virtual Reality Modules

37

Courses

9

e-Books

CA2VES designs and develops digital curricula and VR educational simulations that aim to increase the diversity and quality of the STEM talent pipeline.



Partnerships Craft Customizable Digital Learning Tools

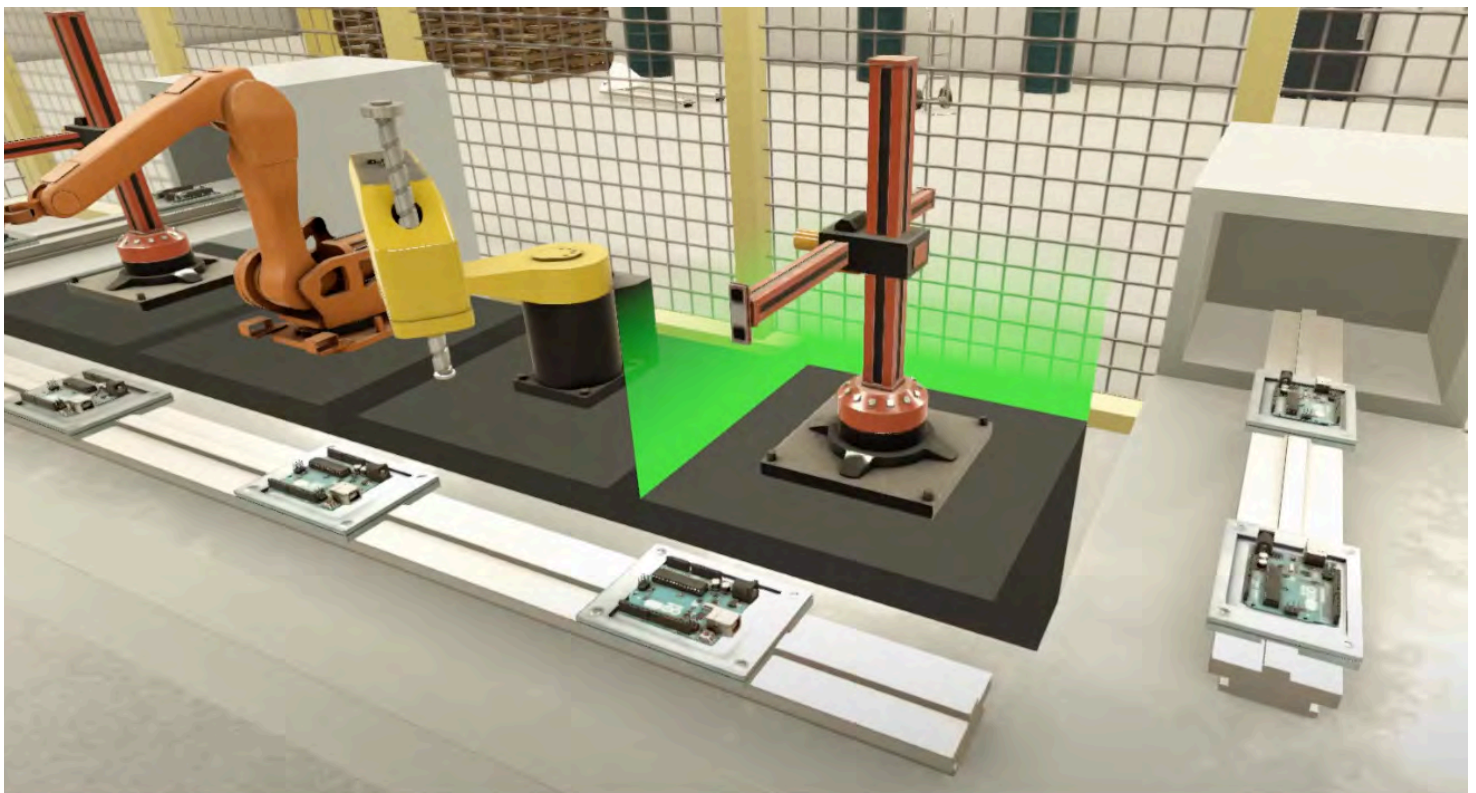
For more than a decade, CA2VES has partnered with industry and two-year college educators to use new technologies to enhance manufacturing and aviation technician education programs and employers' re-skilling of technicians. It is through these partnerships that the flexible e-learning modules provided on the CA2VES learning management system, EducateWorkforce.com, are easily customized to meet the ever-changing needs introduced by the newest technologies.

EducateWorkforce's digital learning tools were developed by CA2VES in collaboration with Department of Labor Trade Adjustment Assistance Community College and Career Training (DOL TAACCCT) grantees, two-year college and industry partners, and multiple ATE centers and projects. These tools are designed to help innovative educators blend powerful online and digital resources into their existing courses.

By 2021 EducateWorkforce.com had more than 14,800 users in 46 states. It has offered more than 1,000 online class sections on manufacturing maintenance, safety, processes, production, quality, and other STEM topics.

"The CA2VES staff is an amazing team of scholar practitioners. Their ability to develop research-based solutions to assist technical colleges with advanced manufacturing pedagogy using virtual reality and artificial intelligence platforms is second to none."

Hope Rivers
President
Piedmont Technical College
Newberry, SC



A screenshot from a CA2VES-developed VR module showcases a real-life analog of various types of robotic arms. This simulation is for students in robotics-related associate degree programs.



A technician deburs metal from a motor housing.

FLATE

Florida Advanced Technological Education Center

FLATE's Mentorship Spreads ET Degree Programs

With FLATE's mentorship since 2007, the number of Engineering Technology Associate of Science (ET AS) degree program locations grew from three to 24 of Florida's state and community colleges. Enrollments increased from 145 in 2008-09 to 2,012 in 2019-20. Female enrollment increased from 99 (9%) in 2013 to 251 (12%) in 2020.

Enrollment by historically underrepresented populations also grew from 454 (41%) in 2013 to 929 (46%) in 2020.

Enrollment by military students and veterans grew from 53 (5%) in 2013 to 196 (10%) in 2019-20.

Since 2007, more than 23,800 aspiring technicians have earned the MSSC Certified Production Technician (CPT) certification. It is a stackable credential within the ET AS degree program.



Key Activities

- Embeds Industry 4.0 technician skills in statewide curriculum
- Creates multi-entry and exit pathways for technicians to engineers
- Supplies infrastructure for career awareness, recruitment, retention
- Delivers technician educator professional development
- Leads a community of practice for excellent technician education hosted by FloridaMakes Network
- Educates manufacturers about career pathways



"FLATE is looking at the state of Florida and overall needs for the entire state, and then matching those needs with the schools and the advanced education facilities. So, that [approach] ties us together and gives us a broad view of what's going on around the state and [what] the national impact [is]. FLATE exposes us to resources we wouldn't normally see."

Russell Henderlite
Manufacturing Academy Teacher
Frank H. Peterson High School
Jacksonville, FL

FLATE Activities 2004-2021

413

Online Resources
Created & Disseminated Via
madeinflorida.org, fl-ate.org,
flate.pbworks.com

1,060

Manufacturing Tour Events Offered
in 50 Florida Counties

29,672

Students Introduced to
Advanced Manufacturing Workplaces

68,370

Hours of Professional Development
Delivered to

59,283

Educators & Employees
of Manufacturers

FLATE has worked with more than 400 industry partners to create manufacturing education resources, tours, and professional development programs.

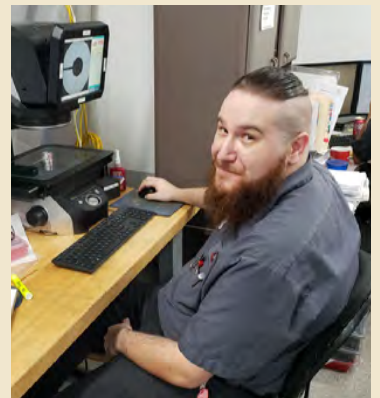
ATE Alum: Austin Atwood Makes His Way in Manufacturing

Austin Atwood had plans to enter the medical field just as both his parents had. That was until he participated in FLATE's MFG Day tour program when he was a junior in high school. Atwood credits 100% of the change in his career plans to the MFG Day tour in 2012.

"I took the tour on Manufacturing Day. I got the job a year later, and then I ended up completely changing my career path and ended up here in engineering," Atwood said.

One of the companies he visited, Southern Manufacturing Technologies (SMT) hired him part time the summer after the tour. More recently Atwood worked full time as a quality assurance technician at SMT while taking classes part time at Pasco Hernando Community College. After completing his engineering technology degree, Atwood plans to work his way up in quality assurance at SMT.

Atwood whole-heartedly recommends MFG Day tours to other students. His advice: "Keep an open mind, look at what's going on around you, and figure out what you want to do."



Austin Atwood, who changed his career plans after attending FLATE's MFG Day, works as a quality assurance technician and takes ET AS degree courses.



During FLATE MFG Day Tours students visit a wide variety of manufacturers, including printers that produce newspapers and other paper products.



A teacher learns how to take apart and reassemble a small gas engine during the CTE Train-the-Trainer Workshop.

MSAMCOE

Minnesota State Advanced Manufacturing Center of Excellence

Webinars Publicize Resources to Educate Students & Incumbent Technicians

In a response to the COVID-19 lockdown, MSAMCOE mobilized to help educators at schools and colleges access resources for online instruction. MSAMCOE created nine webinars that shared resources for educating current and future students, as well as incumbent technicians. This effort aligned with the center's three strategic priorities: engaging industry, enhancing education, and inspiring students to pursue careers in manufacturing.



MINNESOTA STATE
Advanced Manufacturing
Center of Excellence

The webinar series attracted participants from Minnesota, nine other states, and India. Topics covered included MSAMCOE's 360 eTECH Online and Hands-On Manufacturing Education materials; manufacturing careers; workforce solutions; robotics team coaching; and Minnesota's dual-training pipeline.

Participant survey data indicate that the webinars connected people to other regional initiatives.

Key Activities

- Creates manufacturing career webinars
- Offers professional development
- Encourages students' participation in the Digital Badge Pathway
- Emphasizes manufacturing career opportunities to women
- Promotes the Manufacturing Career Tool and multiplicity of career information to K-12 and college students and to adults
- Facilitates manufacturing industry tours



A female welder learns a shielded metal arc welding technique from another woman with industrial welding experience at the Women in Welding Competition.





Small Cohort Professional Development Yields Positive Results

MSAMCOE co-hosted a three-day CTE Train-the-Trainer Workshop in August 2020 in collaboration with Minnesota State Centers of Excellence for Advanced Manufacturing, Agriculture, Energy, and Transportation.

Attendees were divided into small cohorts to meet COVID guidelines and to provide instruction tailored to their various skill levels. The 24 career and technical educators (CTEs) traveled an average of 100 miles from communities where they teach secondary school students about welding, small gas engines, and energy.

In addition to enhancing teachers' skills, the workshop aimed to build relationships between the high school teachers and the college faculty who served as workshop instructors. The goal was to give the CTE teachers personal knowledge of advanced manufacturing programs to share with their students.

Post-program survey data indicate the workshop benefited the 24 CTE teachers as well as the three college faculty who served as instructors:

- 95% indicated they were extremely likely to participate in future events.
- 100% reported they were likely to tell a colleague about the event.

"Most of the classes were enjoyable and not extremely difficult. The instructors were all very kind and understanding as well. These classes did an excellent job of making the process more interesting and fun, especially the hands-on ones. The program equips you with knowledge that you can use for your entire life."

Jack Patten
2021 Production Technologies Graduate
Northwest Technical College
Bemidji, MN

Minnesota Manufactured Digital Badge Pathway



Learn about
High-Tech
Manufacturing



Go to
Manufacturing-
Related
Camps & Labs



Participate in
Robotics
Competition



Tour College &
Manufacturers



Explore
Manufacturing
Careers & Apply
Knowledge



Do Real
Manufacturing
Experiences

Credentials that document students' manufacturing-related activities are embedded in the digital badges that recognize students' participation in various activities. Students who complete the Digital Badge Pathway can apply for one of four Minnesota Manufactured education scholarships, valued at \$4,000 each, to use at a partnering college of their choice.



NCNGM programs include a variety of machining programs to allow students to experience the wide array of equipment that manufacturers use.

NCNGM

National Center for Next Generation Manufacturing

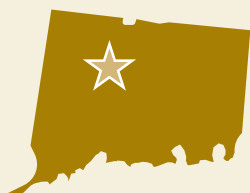
NCNGM Builds National Response to Industry 4.0

NCNGM partners with collaborators from education, industry, government, and private and public organizations throughout the US. These various stakeholders are working together to address the nation's need for a pipeline of students equipped with the skills to pursue careers in advanced manufacturing during the Fourth Industrial Revolution, known as Industry 4.0.

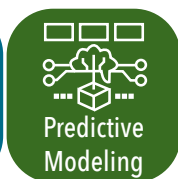
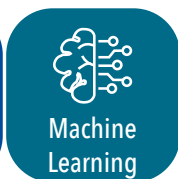


Key Activities

- Facilitates communication among manufacturing stakeholders
- Develops and maintains a repository of advanced manufacturing educational materials
- Provides professional development opportunities for educators
- Leads efforts to recruit and retain a diverse manufacturing technician workforce



NCNGM Incorporates Industry 4.0 into Advanced Manufacturing Curricula & Programs



NCNGM is working with advanced manufacturing programs across the US to make instructors aware of Industry 4.0 and how to incorporate it into existing curricula.



NCNGM Addresses Need for Highly Skilled, Diverse Workforce

NCNGM utilizes guidance from national equity associations and leaders of other Advanced Technological Education (ATE) centers and projects to develop the diverse workforce that advanced manufacturing companies in the US need to compete globally. Toolkits of resources that demonstrate best practices in diversity, access, and equity are disseminated to high schools and community colleges for the recruitment and persistence of underrepresented populations in next generation manufacturing.

The center's innovations include model educational programs, professional development for high school and higher education faculty, and an online repository of resources for building seamless, stackable credentials and career pathways in advanced manufacturing. The model programs prepare students for immediate employment in high-tech manufacturing sectors. They also offer various credentials that respond to employers' interest in verification of technicians' skills such as industry certifications, microcredentials, digital badges, as well as college certificates and degrees.

In addition to developing Industry 4.0 educational programs, NCNGM leaders and teams of technology experts are devising curricula that cover manufacturing sub-sectors. These include design, fabrication, processing, supply chain, logistics, and quality control.



NCNGM programs integrate electronics skills that are critical to manufacturing products and repairing manufacturing equipment.

“In my discussions with manufacturing business leaders, the number one challenge is finding skilled workers to fill open positions. This is not just a Connecticut issue; it is a national issue. Right behind this is upskilling the incumbent workforce and preparing those employees for the digital transformation of manufacturing. The programs developed and implemented by the National Center for Next Generation Manufacturing address both of these critical needs by recruiting and educating the Industry 4.0 workforce.”

Colin H. Cooper
Chief Manufacturing Officer
State of Connecticut
Hartford, CT



Technicians often use straight-beam ultrasounds to test raw materials for flaws prior to machining.

Weld-Ed

National Center for Welding Education and Training

Center Podcasts Augment Remote Instruction Resources

Many welding educators and students alike scrambled to adjust to a sudden shift in welding education due to COVID-19. To help facilitate the transition to remote delivery of instruction, Weld-Ed offered its core professional development module slides as a free download to educational affiliates. Previously the center made these slides available to participants of its professional development workshops.



Additionally, Weld-Ed created biweekly welding-education-related podcasts, which were available on demand via YouTube. The podcasts feature Weld-Ed partners discussing distance education resources, offering tips to increase student engagement, and sharing insights from industry partners. The podcasts are now available through Weld-Ed's Facebook group.

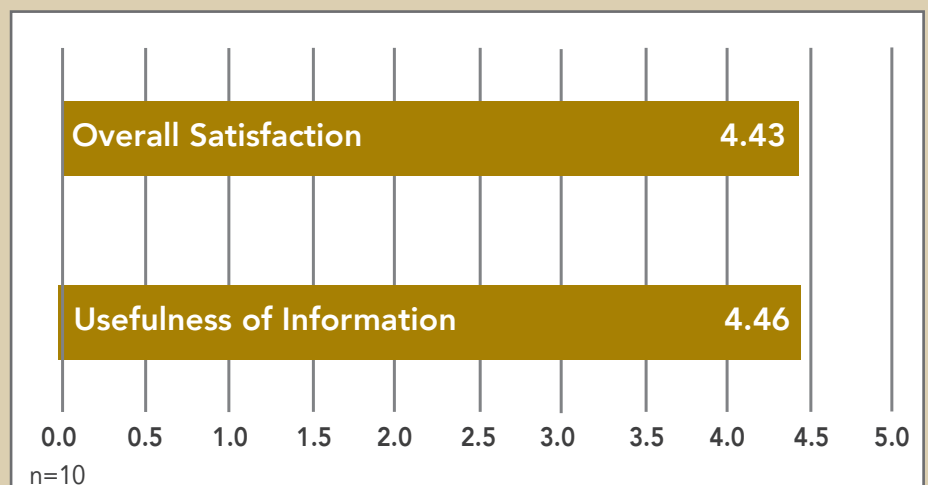
Weld-Ed Co-Principal Investigator W. Richard Polanin's report about COVID's impact on welding education – based on data from 291 welding educators – recommends development of hybrid courses and other adaptations.

Key Activities

- Increases career awareness for underserved students in welding
- Enhances the skill and knowledge base of faculty in welding through professional development
- Improves welding technology education through innovative practices and strategic partnerships
- Broadens educational offerings in lightweight welding and nondestructive testing



Feedback on Professional Development Module about Codes, Standards, Specifications & Safety



The educators who participated in the 2021 in-person professional development module on critical workplace information gave it high ratings.

Expanded Partnerships Focus on Lightweighting Welding Technologies

Weld-Ed has expanded its longtime collaboration with the American Welding Society (AWS) to include LIFT, a nonprofit, public-private partnership that is part of the national network of manufacturing innovation institutes. LIFT is operated by the American Lightweight Materials Manufacturing Innovation Institute (ALMMII).

In this new triumvirate, LIFT represents industry and research; AWS brings standards-based, industry-recognized credentialing; and Weld-Ed adds expertise in the development of education and training programs. Together they are addressing the workforce demand for skilled welding technicians, especially technicians who know lightweighting welding processes. This is a significant workforce challenge that impacts advanced manufacturing and tertiary industries because lightweighting is the joining of non-metal materials and alloys to reduce emissions during manufacturing.

Their goal is curriculum that addresses welding technology advancements as well as industry-recognized credentials related to lightweighting that are standards-based and nationally portable. Together they are

- building on the high-quality AWS SENSE Welding curriculum to develop a competency-based, modular lightweighting welding technician curriculum that will prepare welders for lightweighting-related technology advancements;
- utilizing the AWS Certified Welder program to identify the appropriate standards-based, nationally portable, industry-recognized credentials for lightweighting welding processes; and
- piloting the lightweighting welding technician curriculum in the LIFT Learning Lab to serve as a basis of an industry-recognized apprenticeship program (IRAP).



An instructor lights an oxyacetylene cutting torch at the 2021 AWS Instructor Institute.

“Hopefully you guys continue doing these [professional development] workshops every year because you can count on me to participate each year! Expect to see my name next summer!”

Jason Hill, Certified Welding Instructor & Director of Welding Technology
Northeastern Junior College, Sterling, CO
Welding Discipline Chair, Colorado Community College System



*NextFlex and
Evergreen Valley College
San Jose, CA*

<https://ate.is/AMT-UP>

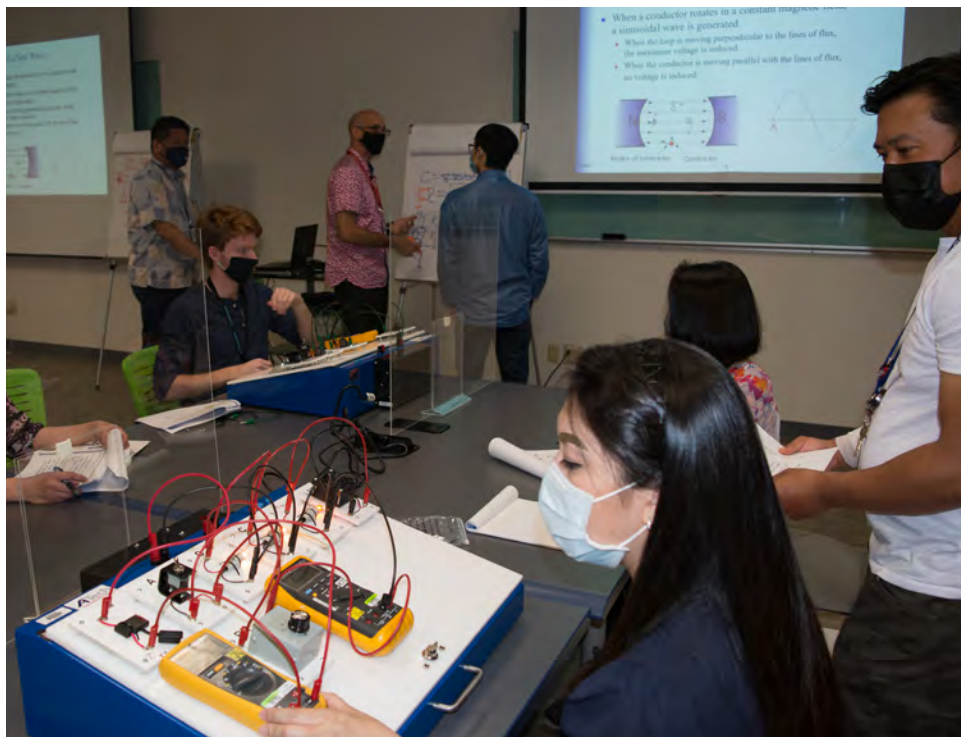
Key Activities

- Develops and delivers an innovative advanced manufacturing technology program to meet regional demand for technicians and technologists
- Leverages a Business Industry Leadership Team (BILT) to include industry representatives in development and delivery of curriculum
- Provides work-based learning opportunities for students

Innovative Collaboration Creates Hiring Pipeline for Advanced Manufacturing Technicians

NextFlex, in partnership with Evergreen Valley College (EVC), offers an advanced manufacturing technology program for technicians. This program involves industry in the creation, implementation, and delivery of the curriculum. NextFlex is a consortium of companies, academic institutions, nonprofits, and government partners that work together to advance the manufacture of flexible hybrid electronics, a technology that enables the electronics of numerous products.

During the COVID-19 pandemic, the project successfully delivered a hiring pipeline for CAES, a manufacturing company pioneering advanced electronic solutions and a leading member of the project's BILT. To ensure the project could launch during the pandemic, CAES hosted students on its site where COVID-19 safety protocols were in place. At its facilities, CAES delivered two, eight-week electronic skills courses in the spring and fall. Of the 24 students who completed the course, CAES hired 11 as production test technicians, seven as apprentices, and four as full-time employees. Almost all the students are planning to continue their technical education at EVC while pursuing their careers at CAES.



AMT-UP students stayed on track during the pandemic thanks to CAES hosting electronics skills courses at its facility.



New Curriculum Leads to More Students with Credentials Employers Seek

The project's creation of an automation maintenance associate degree and certificate aligned to industry standards means that students have the skills to earn industry credentials, which employers recognize and reward with greater responsibility.

One hundred twenty-six students took the 10 new courses during the first two years they were offered; 39 students subsequently declared themselves automation maintenance majors. Overall course success rates (receiving a grade of C or better) were 86%, indicating both academic rigor and barrier-free completion for students. The number of students who took industry certification exams increased from 35 to 106 from year one to year two of the project.

Students Sharpen Skills with Virtual Tools

Although not originally part of the project, virtual tools were added when the COVID-19 pandemic cancelled in-person classes. Students were able to continue learning using simulators for electrical circuits, control diagrams, and motor controls. Upon completion of the simulations, students demonstrated their skills during virtual meetings with instructors. When campus re-opened, students showed their skills on actual lab equipment. The clear benefit to students' learning means that simulations will continue to be part of the program's pedagogy.



Students practice maintenance skills on industrial robots.



*Montcalm Community College
Sidney, MI*

<https://ate.is/robot>

Key Activities

- Utilizes modernized robotics curriculum to deliver skills that align with industry standards and meet industry partners' needs
- Provides students with access to Smart Automation Certification Alliance (SACA) certifications
- Raises the visibility of robotics careers with dynamic outreach activities



South Central College
North Mankato, MN

<https://ate.is/imec2>

Key Activities

- Increases capabilities of rural high school teachers with Instructor-in-the-Loop format
- Distributes independent Remote Experiment Automation Lab (iREAL) trainers and videos for iMEC 2.0 curriculum
- Offers mechatronics courses for college credit at Minnesota and Nebraska high schools
- Fosters relationships between educators and industry partners

New Trainers & Videos Support Mechatronics Learning in Rural Areas

iMEC 2.0 builds on the lessons learned from the independent Mechatronics Education Curriculum (iMEC 1.0), an ATE project at South Central College that created iREAL mechatronics trainers for rural high schools. This new grant revises the iMEC 1.0 curriculum with new content, detailed instructional videos, and enhances the iREAL trainers. The result is more robust pathways for students to follow to two-year technical college STEM programs.

To support high school STEM teachers who have limited or no background in mechatronics, iMEC 2.0 created its Instructor-in-the-Loop format. It brings math, science, and technical education instructors from five Minnesota high schools to South Central College and from five Nebraska high schools to Columbus Community College for intense professional development. Those workshops are led by the technical college faculty who are the instructors of record for the college credit courses offered at the rural high schools. During the academic year the college instructors work closely with the high school teachers who facilitate learning via well-informed, face-to-face instruction to high-school students.



High school teachers' professional development includes assembling iREAL trainers, which support hands-on labs for the college credit courses in high schools.

Mobile AMP: The Development of a Mobile Platform for Additive Manufacturing

Featured ATE Project



Mobile AMP Focuses on Sophisticated Additive Manufacturing Skills

Mobile AMP moves additive manufacturing educators and students to more complex 3D printing operations than the usual output of key chains and trinkets. Instructional resources developed by this project teach educators and students how to harness the advanced design and production capabilities of additive manufacturing. They also learn about generative design, lattice structures, exotic composite plastic materials, highly durable resins, and even low-cost metal 3D printing to make next generation products.

15-Week Professional Development Course Mixes Virtual & In-Person Instruction

The pandemic hit just as Mobile AMP was poised to take additive manufacturing instruction to schools and colleges across Kentucky and Tennessee using a custom-equipped trailer full of 3D printing equipment. The project team quickly pivoted to create a mostly virtual, 15-week train-the-trainer curriculum that concludes with a single in-person workshop. During the 2020-21 academic year 23 educators in Kentucky and 19 in Tennessee participated. They reported that they plan to implement what they learned when teaching a total of 2,500 students in 2021-22.



Educators examine the first test prints from the 3D printers they built during Mobile AMP's workshop that concludes the otherwise virtual professional development.



Somerset Community College
Somerset, KY

<https://someset.kctcs.edu/mobileamp>

Key Activities

- Provides in-depth, train-the-trainer instruction on 3D printing and additive manufacturing
- Explains the potential impact of emerging advanced manufacturing technologies to secondary and postsecondary educators in Kentucky and Tennessee
- Educates business leaders about the potential for additive manufacturing to improve regional economic activities



*Bridgerland Technical College
Logan, UT*

<https://ate.is/SUUAMTP>

Key Activities

- Develops hands-on, competency-based courses delivered via remote technologies to rural high schools
- Increases recruitment and retention of high school students
- Delivers professional development to secondary and postsecondary educators
- Helps other institutions reproduce the project's innovative program

Project Builds Quality, Capacity & Quantity of Regional Technical Workforce

Since 2018 SUUAMTP has sought to increase the quality, capacity, and especially the quantity of the next generation of skilled advanced manufacturing and electronics engineering technicians in the Intermountain West. The project does this by supplying high school, technical college, and university faculty with innovative manufacturing curriculum, designs for low-cost training equipment, top-notch summer professional development workshops, and ongoing one-on-one instructional guidance. This multi-faceted support enables other educational entities to implement this fresh approach to manufacturing education.

Unexpected Positive Development of COVID-19: Video Tours Open Doors to Broader Partnerships

When COVID-19 cancelled all recruitment and retention activities, SUUAMTP leaders developed new outreach strategies that leveraged email and text. They also shifted project resources to produce videos of industry tours to replace the site visits to manufacturers that had been planned for high school teachers and guidance counselors. These video tours aim to dispel misconceptions about manufacturing, describe manufacturing technician job duties, highlight student success stories, and introduce local companies to the community. These videos have been shared with guidance counselors and industry advisory members, and are opening doors that have previously been shut – an unexpected positive development during a difficult time.



A SUUAMTP program graduate demonstrates automated manufacturing job tasks in a video of an industry tour at Casper's Ice Cream.

ATE Alum: Shianne Cannizzarro Has Competitive Edge Thanks to RCNGM



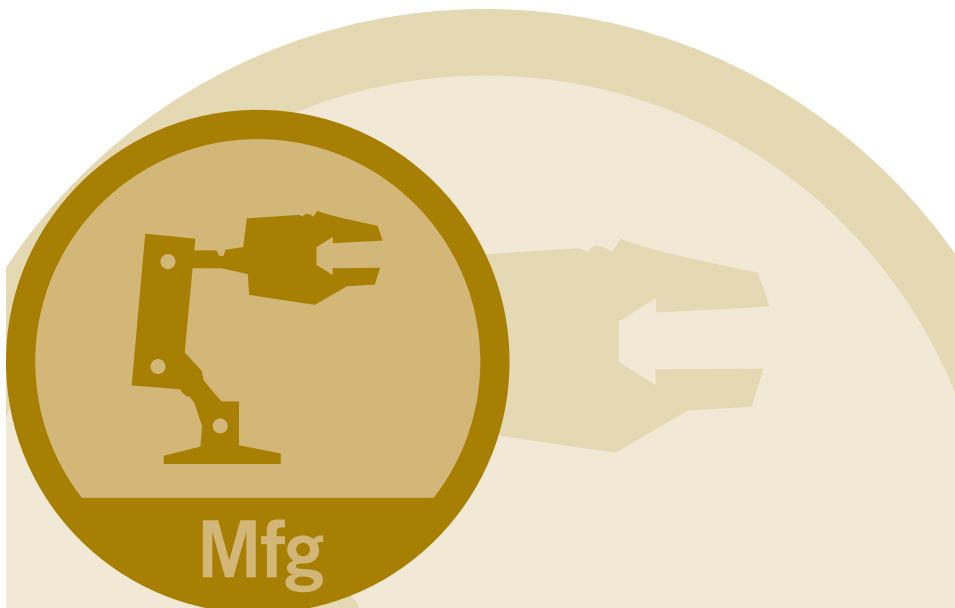
When Shianne Cannizzarro returned to civilian life after six years of service in the US Air Force as a weather forecaster, she decided to follow the successful careers of several relatives and go into manufacturing.

In August 2020 she graduated from Asnuntuck Community College (ACC) with a certificate in advanced manufacturing and machining. ACC's advanced machine technology program is based on curricula originally developed by the Regional Center for Next Generation Manufacturing (RCNGM), an ATE center. The new National Center for Next Generation Manufacturing continues to disseminate and build on curricula developed by RCNGM.

"The program taught me to be flexible with whatever comes my way and to pay attention to detail," said Cannizzarro. Her academic performance earned her membership in two honor societies.

Now employed as an airfoil cell operator at Pratt & Whitney, she runs a multitude of equipment including shot peening, water flow, and airflow machines.

"The program gave me skills for entering a competitive field where knowledge is power, and I was ahead of others thanks to the knowledge I had," Cannizzarro said.







Agricultural and Environmental Technologies

<https://ate.is/ag-env>





A technician at Nahant Marsh Education Center conducts a prescribed burn to keep the prairie healthy and improve the wildlife habitat.

ATEEC

Advanced Technology Environmental Education Center

ATEEC Grows User Base with Easy-to-Access Content

In rising to meet the challenge of the pandemic, the center's AVR team was able to envision better ways to disseminate its instructional materials. After noticing faculty engagement was higher when the threshold for using the center's training applications was low, the team switched to focusing more on web-based virtual simulations and mobile applications.



The team has since focused on developing its software to run more effectively on less powerful, "lowest common denominator" hardware. This has taken ATEEC's work in promising directions that might have otherwise been overlooked. In addition to developing an online platform to distribute AVR training software, the steps that ATEEC is taking to "future-proof" products are widening its user base.

Key Activities

- Identifies and shares emerging environmental technology (ET) workforce trends, instructional materials, and faculty development opportunities
- Conducts annual symposiums and workshops
- Addresses ET workplace knowledge, skills, and competencies
- Produces interactive career websites and augmented and virtual reality (AVR) education modules
- Guides faculty to use research and scientific principles in ET programs



Students assist with studies of Blanding's turtles and conduct undergraduate research projects at Nahant Marsh Education Center.



EARTh Center Builds on Accomplishments of ATEEC & Its Partners

ATEEC, along with its consortium partners – Partnership for Environmental Technology Education (PETE), Nahant Marsh Education Center, and the newly created National Leadership Network, is transitioning to the Environmental and nAtural Resources Technology (EARTh) Center.

This new ATE center will support and instruct educators to help them meet the current and projected skilled technical workforce needs in the ever-evolving field of environmental technology. EARTh Center will provide information to instructors while simultaneously generating and sharing best practices for engaging, recruiting, retaining, and graduating students prepared to tackle the challenges ahead.

It will provide instructional support to the environmental technology workforce through cutting-edge technological platforms, including augmented reality, virtual reality, and mixed reality. This service will allow it to harness the potential these technologies possess to transform workforce education modules.

EARTh Center will also convene annual symposiums, a Defining ET Forum, Developing a Curriculum (DACUM) workshops, and virtual Fellows Institutes. It plans to produce DACUM charts with occupational competencies, the *Defining ET Report*, and a best practices guide for recruiting and retaining students in ET programs.

“Climate change is the environmental challenge of our generation. ATEEC – and now EARTh – play a critical role in not only preparing a competent technician workforce but also in helping educate about the essential equilibrium of economics, environment, and social responsibility.”

Cheryl Stith
Environmental Health &
Safety Specialist
California Department of
Public Health
West Sacramento, CA

New Environmental Jobs Projected from 2016 to 2026

Occupation	Projected Increase 2016 to 2026	Median Annual Wage in 2017	Typical Entry-Level Education
Environmental Engineering Technician	+2,200	\$86,800	Associate Degree
Environmental Science and Protection Technicians, including Health	+4,200	\$45,490	Associate Degree
Hazardous Materials Removal Workers	+7,900	\$41,400	High School Diploma or Equivalent
Solar Photovoltaic Installers	+11,800	\$39,490	High School Diploma or Equivalent

Source: U.S. Bureau of Labor Statistics, Office of Occupational Statistics and Employment Projections

The major industries that employ environmental technicians include engineering services, local and state government agencies, consulting services, public health agencies, manufacturers, and remediation services. All anticipate needing additional skilled technicians through 2026.



Faculty who attend the CREATE Energy Institute learn how to install solar photovoltaic panels.

CREATE

Center for Renewable Energy Advanced Technological Education

CREATE Virtual Workshops a Huge Success

CREATE leaders' rethinking of how to offer professional development in the midst of COVID-19 lockdowns prompted a new collaboration with KidWind, a long-time partner. Together they offered 13 professional development workshops virtually in 2021 on topics ranging from wind energy to the electric power grid. The workshops served 120 faculty members nationwide, including 94 female STEM instructors. The virtual format reached a total audience roughly double the number who attended CREATE's previous face-to-face workshops.

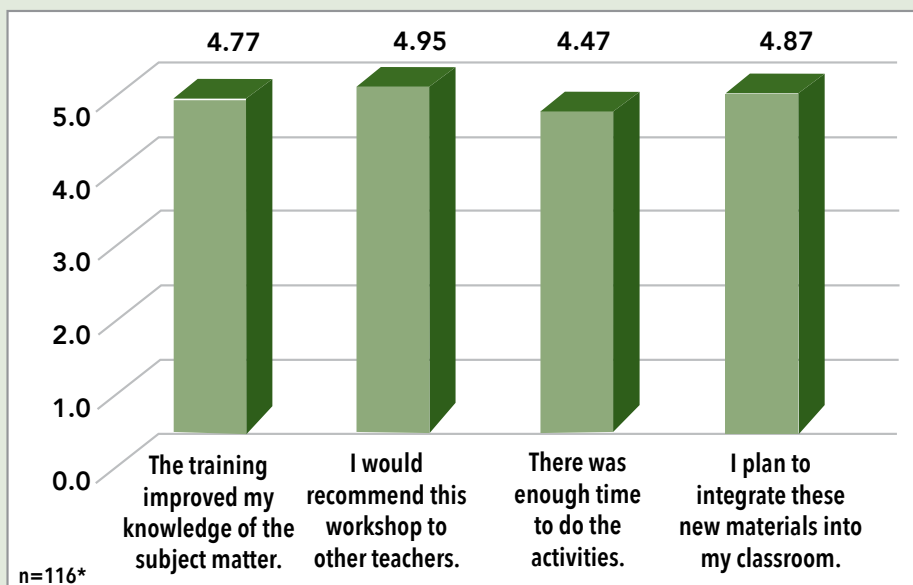


Key Activities

- Establishes partnerships between academic institutions and the renewable energy industry
- Promotes renewable energy technician careers
- Develops, validates, updates, and distributes renewable energy materials and pedagogical practices
- Provides mentoring and professional development for faculty and prospective NSF principal investigators in renewable energy technology

The attendees were sent lab material kits that made it possible for them to complete hands-on modules from the safety of their homes. In post-workshop surveys, participants reported they plan to use what they learned in their classrooms. CREATE plans to continue this successful partnership and blend of virtual instruction with hands-on modules.

Participants' Ratings of 2021 Workshops



* Solar=33, Wind=36, Power Grid=47 survey responses

The 116 educators who completed surveys after attending CREATE's workshops during 2021 gave the virtual programs very high ratings above 4 on a 5-point scale.



CREATE Students & Faculty Contribute to Research & Development of Self-Cleaning Solar Panels

A student-initiated experiment led students and faculty to collaborate on the research and design of self-cleaning solar panels. The project – spearheaded by Madison College Instructors Tim Hoege and Ken Walz – supports the development of the self-cleaning technology created at the University of Wisconsin. The work by the Madison College instructors and students is helping to move this innovation into the commercial marketplace.

The Madison College faculty and students developed a new coating protocol. It involves treating the solar panels with thin film coatings of nanoporous silica-titania metal oxide. Their research investigates whether the nanoparticles improve the anti-soiling and self-cleaning properties.

CREATE partnered with Madison College's auto collision repair program to use its paint booths and spray equipment to apply thin film coatings to 135 solar panels. During 2021 the coated panels were installed in a new 130-kilowatt solar field at Madison College's Watertown campus.

The electrical output of the coated panels will be measured against two uncoated control sites with identical equipment. Madison College students will collect and analyze the data through 2022 to check the effectiveness in different seasons. They will also assess the weathering and durability of the self-cleaning coatings.

"This has all been really cool! It's fascinating to see first-hand how the solar production gradually shifts as the days extend from winter into the spring, and to analyze the effects of snowfall. Quantifying the difference between the two systems was enlightening, and hopefully these results will be useful to others."

Austin Butler
Solar Energy Undergraduate Researcher
Madison College
Madison, WI



Madison College students spray deposit a nanoparticulate thin film coating to impart anti-soiling and self-cleaning properties to the surface of solar photovoltaic panels as part of an ongoing research and development project.



RCNET faculty members learn while touring the Experimental Breeder Reactor I in Idaho.

RCNET

Regional Center for Nuclear Education & Training

RCNET Dynamic Is Multi-Disciplinary in Nature

The nuclear industry, like many older industries, is undergoing a major technology overhaul. Nuclear program graduates in the 21st century need to know both state-of-the-art nuclear technology information and a wide swath of advanced technology skills from other fields such as cybersecurity, data analytics, remote sensing, and robotics. RCNET has helped embed a large array of these emerging technologies into college nuclear programs across the nation, which has resulted in much more work-ready graduates. Through its network of industry partners RCNET has placed more than 3,000 program graduates in STEM technician jobs at about 100 industry partners' locations.



Key Activities

- Facilitates industry and academic partnerships to increase student completion and career placements
- Offers comprehensive curricula for power generation, life and plant sciences, and environmental management
- Provides customized support to community college programs, including advocacy and best practices for program sustainability



RCNET's Girls in STEM project involves high school girls interviewing young female technicians like Sydney Eisinger (left), an RCNET graduate who is a control room technician at Florida Power and Light.





RCNET Helps College Programs Address Sustainability Challenges

While the national STEM technical workforce has continued to grow in strength, the challenges many community colleges face trying to keep nuclear technician programs going have also intensified. For about a decade, RCNET has focused on these challenges in the nuclear sector by helping colleges address budgets, enrollment, disruptive administrative turnover, and other challenges with a host of solutions.

"RCNET has always been responsive to industry's needs. As a result, its graduates prove to be very work-ready. They have the latest technical, critical thinking, and soft skills needed to excel in today's workplace."

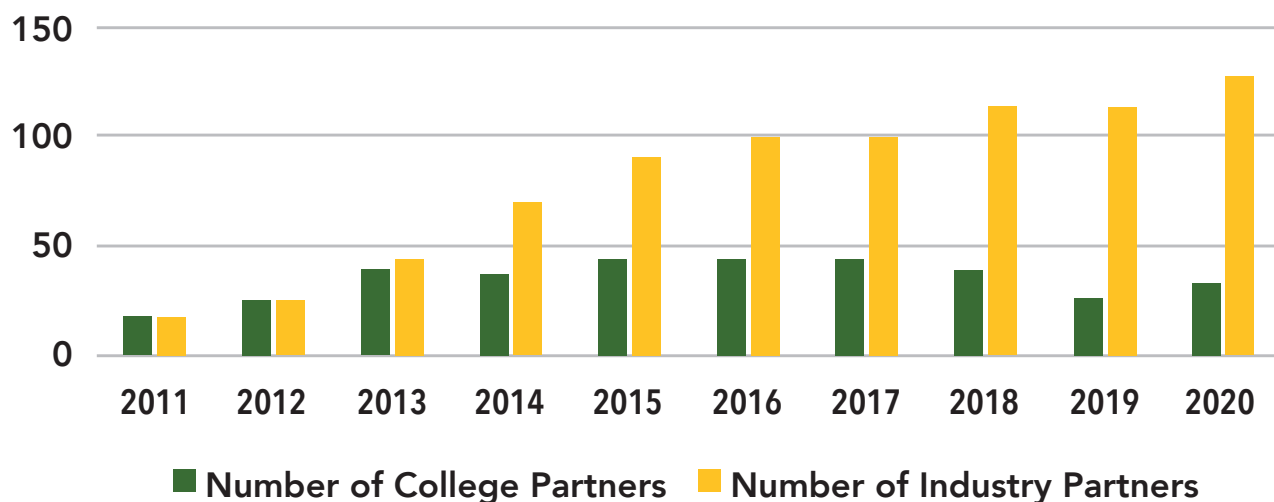
Natasha Mitchell
Supervisor of Project Services
BHI Energy
Lake Worth, FL

These efforts have included helping colleges broaden their nuclear programs into more fields to avoid saturating one employer or industry sector. RCNET also builds national industry relationships; keeps critical, but low-enrollment courses available via online programs; mentors community college faculty through grant application processes; and designs curricula to attract diverse student populations.

Video Series Aims to Increase Female STEM Enrollments

Through its *Girls in STEM* video series RCNET hopes to build awareness of the productive STEM careers that women are pursuing. RCNET facilitates high school students' interviews of young female technicians at their workplaces. The video recordings of these interviews are available on RCNET's YouTube channel for educators to utilize and the general public to view.

College & Industry Participation in RCNET Network



RCNET's college and industry partnerships support student learning and facilitate job placements.



A mentor shows a VESTA student how to check on the health of grape vines.

VESTA

Viticulture and Enology Science and Technology Alliance

VESTA Enhances Its Curriculum to Sustain Student Learning Experiences during Pandemic

While many two-year colleges across the country had to undergo major changes in their courses due to COVID-19, VESTA already had a fully functional online curriculum. Public health precautions, however, did require revisions to two workshops integral to the enology program. The Wine Chemistry Workshop was conducted via Zoom rather than in person. A more extensive redesign, however, was necessary in the Sensory Evaluation course. VESTA personnel developed a kit of materials and shipped it to students for them to use during the online sessions. These steps preserved the important hands-on nature of the workshop.



Key Activities

- Delivers industry-validated online courses, field experiences, and workshops in viticulture, enology, and entrepreneurship
- Leverages support from partners and other organizations that enables students to address real-world challenges to the grape and wine industry
- Promotes US Department of Labor Registered Apprenticeship Programs that use VESTA courses



A VESTA student who is in a Registered Apprenticeship Program works alongside a mentor to prepare a bottling line at a field practicum site.





Responding to Industry Needs, VESTA Expands Registered Apprenticeship Opportunities

Grape and wine producers are embedded in all aspects of the VESTA program. From its inception in 2003, VESTA has relied on these practitioners to ensure online courses, field experiences, and workshops focused on the development of a knowledgeable and skilled technical workforce.

Two-year college partners in VESTA continue to collaborate with their industry associations to acquire additional funds from federal and state agencies. Several of these grants are enabling students and faculty to conduct viticultural research that explores the potential for expanding the diversity of grape varieties suitable for commercialization in their home states.

Responding to the industry's need not only to acquire, but also advance and retain quality employees, VESTA expanded the scope of its work to include designing and promoting Registered Apprenticeships for the grape and wine industry. By adding industry associations, as well as state and local workforce development organizations to these collaborative efforts, VESTA has acquired additional grant funds, increased the number of occupations approved for US Department of Labor Registered Apprenticeships, increased the visibility of workforce development opportunities that are effectively addressing workforce needs, and established Registered Apprenticeship Programs in Missouri and Tennessee.

"As a former VESTA student, myself, I can attest to the benefits of quality instruction alongside real-world experience. The working knowledge and eagerness to learn the industry that they come equipped with because of VESTA is invaluable to me as an employer. The Registered Apprenticeship Program through VESTA is the logical next step in creating a system to attract top-level talent to entry-level positions, and to retain that talent within our company and industry."

Patrick Spensley
Owner and Winemaker
Cherry Creek Cellars
Brooklyn, MI

VESTA 2003 - 2021

30

Partner Institutions

33

Online Courses Developed

600+

Field Practicum Sites

130+

Technical Workshops

14,104

Total Program Enrollment

47

Students' Average Age

70%

Percent with Degrees

48 & DC

Students' Home States

13

Non-US Students' Home Countries

80+

Grape & Wine Industry Conferences

VESTA partner institutions bring industry-validated, online viticulture and enology courses and mentored, hands-on field experiences to students across the US and the world.



Featured ATE Project

Creating Precision Agriculture and Crop Protection Pathways via Industry Partnerships



*Allan Hancock College
Santa Maria, CA*

<https://ate.is/AHCag>

Key Activities

- Creates pathways in diverse agricultural studies, including crop protection and precision agriculture
- Connects students with industry partners via mentor relationships and internships
- Engages high school students with college agriculture programs
- Establishes relationships with university agriculture programs to ensure successful transfer

Learning Emerging Ag Technologies Improves Students' Prospects

With Santa Barbara County, CA, agricultural production grossing more than \$1.5 billion annually, the project launched three degree and certificate programs in 2018 to prepare students for skilled technical careers that use emerging agriculture technologies. Sixty-two percent of the college's students are first-generation college students; many are the children of farm laborers. In 2020-21, 505 students had declared majors in agricultural business, agricultural plant science, or agricultural science.



Agriculture degree and certificate programs created with ATE grant support include "learn-by-doing" experiences in the garden and vineyard at Allan Hancock College.



ATE Alum: Diego Campos Atilano Finds Scientific Career Path with Agriculture

After watching his parents work long hours doing manual field labor, Diego Campos Atilano initially majored in psychology.

But that wasn't a good fit for him, and when he talked with Erin Krier, principal investigator of this project, he shared that he had "long been mesmerized" by citrus tree yields, diseases, and pests. After enrolling in the agriculture degree program, he discovered his career passion is plant science.

In May 2020, Campos Atilano became the first graduate of Hancock's associate degree in agricultural plant science. He then transferred to the prestigious plant science program at California Polytechnic State University.

Featured ATE Project Modernizing Agriculture Technician Education in Appalachian Northeast Georgia (MATE-ANG)



Strong Student Recruitment & Partner Support Set Program Apart

MATE-ANG recruits students from rural Appalachian Northeast Georgia and connects the technical agricultural education program with agricultural employers in the region. Growth in agriculture equipment manufacturing, agriculture technology, as well as livestock and poultry production is fueling demand in the skilled technical workforce.

The MATE-ANG project is led by an industry advisory committee that has provided internships, multiple site visits for agribusiness classes, funding for certification testing, and teaching supplies and research materials for student projects.

Collaboration Gives Students Access to Real-World Learning with Specialty Equipment

MATE-ANG is collaborating with the Chestatee Chattahoochee Resource Conservation Development Council, Inc. to develop real-world experiential learning labs for students. The agency provides much-needed specialty equipment such as no-till drills, roller crimpers, and combines. It also makes materials and supplies available for students to conduct research in forage production and soil health reclamation with processes such as the use of cover crops to build soil fertility.



MATE-ANG hands-on lessons teach students to analyze soil health based on plant growth and chlorophyll production.



*North Georgia Technical College
Clarkesville, GA*

[https://northgatech.edu/
nsfagriproject](https://northgatech.edu/nsfagriproject)

Key Activities

- Recruits Appalachian students through presentations to high school agricultural education classes
- Partners with the Chestatee Chattahoochee Resource Conservation Development Council, Inc. to share technical resources including equipment and instruction
- Promotes technical skill-building through applied experiential learning



*Lane Community College
Eugene, OR*

[https://www.nweei.org/
2-year-degrees/
water-conservation-tech.html](https://www.nweei.org/2-year-degrees/water-conservation-tech.html)

Key Activities

- Delivers online water conservation technician curriculum that is accessed by students throughout the US
- Utilizes local professionals as partners who provide students with hands-on fieldwork experiences
- Educates students and communities about water conservation

WATER-I Combines Online Instruction with Hands-on Learning near Students' Communities

WATER-I developed the water conservation technician program as a two-year associate of applied science degree that combines online lessons and practical experiences carried out with oversight by local industry professionals. Students never need to travel to Lane Community College to complete this program. Instead they do the hands-on component of lessons in their local communities. This saves students time and money and prepares them to address the myriad current and future issues related to water use, conservation, and natural resources stewardship close to where they reside and where they hope to establish water-related careers.

WATER-I graduates are able to

- design, implement, evaluate, and market water conservation programs;
- evaluate water usage patterns for rural, urban, residential, and commercial sites and recommend efficiencies;
- understand water distribution, flow, and elimination systems, basic hydraulics, and quality issues;
- understand the many stressors to water accessibility and how they interact to affect supply and demand;
- monitor, collect, interpret, and analyze data to evaluate the effectiveness of programs and modify them over time; and
- calculate water and cost savings and produce comprehensive cost-benefit analysis reports.



A WATER-I student attaches rainwater catchment system pipes with guidance from a local professional.

ATE Alum: Emily Greene's Career Mix of Energy Efficiency & Regulatory Compliance Began with Instructors' Professional Development



During the past decade Emily Greene has applied her knowledge of energy resources and efficiencies to make a positive difference in her home state of Delaware. She has worked for a private energy services contractor verifying energy use in commercial buildings, for the state of Delaware writing renewable energy regulations, and for a public power joint-action agency representing municipal utilities' management of energy efficiency programs.

She is now the compliance administrator at Delaware Municipal Electric Corporation's Beasley Power Station.

Her credentials are two associate degrees in renewable energy solar and energy management from Delaware Technical Community College (Delaware Tech) and certification as a measurement & verification professional from the Association of Energy Engineers.

"The degree itself is what gives you the fundamental knowledge and basis to be able to talk with all these other disciplines in energy. That was why I was able to work for a private for-profit company, the state government, a public power joint-action agency representing local governments, and an electric generator. That is why I'm able to work in all these various disciplines in the field of energy," she said.

In 2014 Greene was the first graduate of the renewable energy-solar degree program that Delaware Tech faculty created with professional development and other support from the Center for Renewable Energy Advanced Technological Education (CREATE), an ATE center at Madison Area Technical College. The energy management program was adapted from curricula that faculty at Lane Community College in Eugene, OR, developed with ATE support and shared with Delaware Tech instructors and other educators at summer workshops.

"Being able to apply that technical degree has allowed me to get pretty far, pretty quick in my career," Greene said.

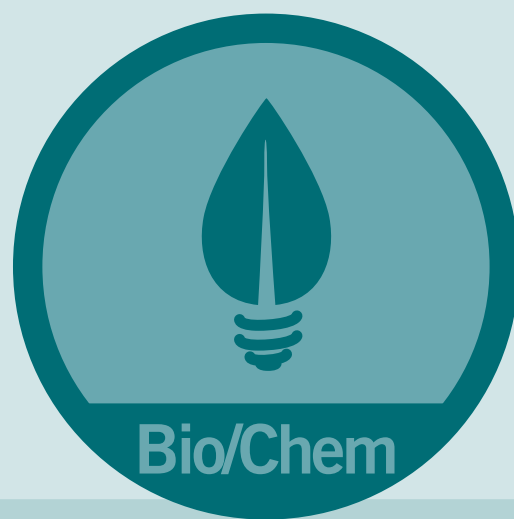
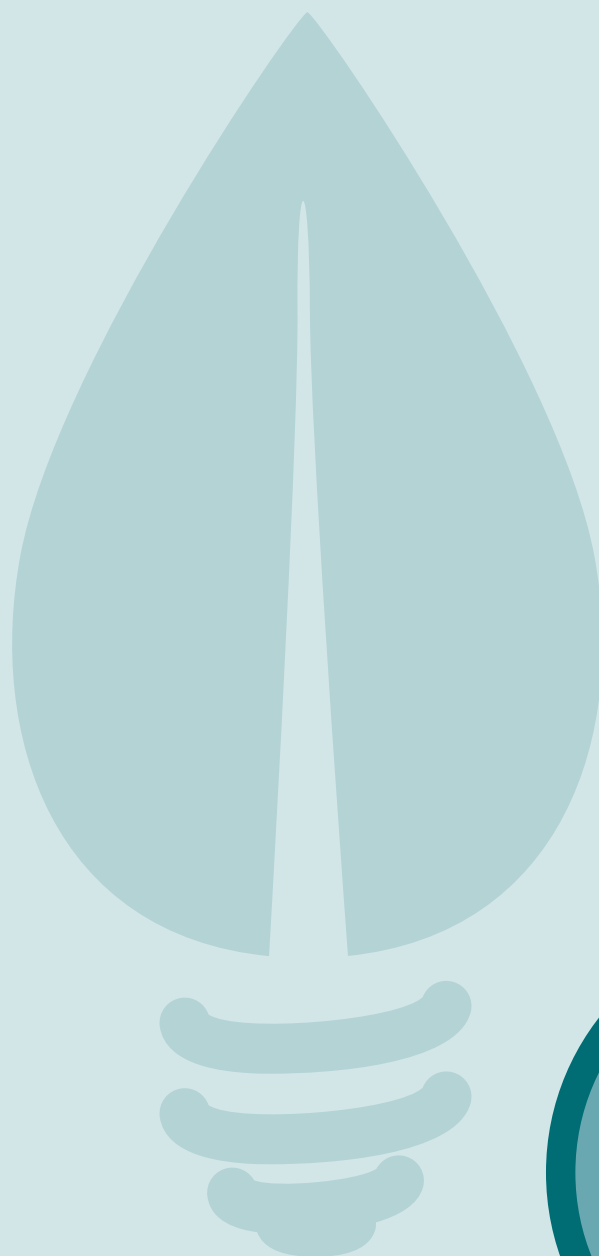






Bio and Chemical Technologies

<https://ate.is/bio-chem>





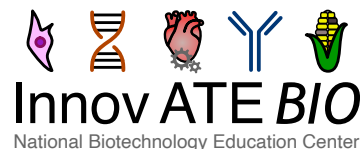
An undergraduate research student sampling for an industry partner project.

InnovATEBIO

National Biotechnology Education Center

Response to COVID Leads to Enduring Resources

In response to the COVID-19 limitations on in-person instruction, InnovATEBIO and its partners collaborated to help educators teach online.



The new webinars, online workshops, and training series they created included a summer series for high school teachers and a 16-week webinar series. All the programs highlighted best practices from ATE projects. They also gave participants, who were usually community college and high school biotechnology instructors, opportunities to find novel collaborations and potential synergies among their projects.

The webinars not only helped participants during the pandemic, but they remain valuable resources that are accessible via the center's website.

Key Activities

- Implements infrastructure to support and engage existing and new biotechnology programs nationwide through mentorship, community meetings, and hub development
- Recruits new undergraduate research institutional partners while developing novel, industry-relevant undergraduate research projects
- Partners with the Coalition of State Biosciences Institutes and TEconomy to produce the *2021 Life Sciences Workforce Trends Report* based on real-time industry demand information



InnovATEBIO's National Network

**130 College Programs
in 38 States**

Offer

**37 Different Types of
Biotech Degrees & Certificates**

(Medical Devices, Regulatory Affairs, Stem Cell Technology, Laboratory Sciences, Agriculture, Algae Cultivation & Biofuels, Quality Control & Quality Assurance, Manufacturing Operator, Forensics, and more)

Foster

Career Paths via

**55 Articulation Agreements with Four-Year Colleges
17 High School Partnerships
14 Dual-Credit High School Partnerships**

Partner With

83 Industry Advisory Boards

InnovATEBIO facilitates the development of new projects and improvement of existing biotech programs to ensure students have the best education to succeed in industry.

New Biosciences Leadership Institute Develops Educators' Skills

InnovATEBIO created the Bioscience Leadership Institute to give community college and K-12 educators the opportunity to interact with seasoned bioscience industry, workforce, and academic stakeholders who serve as subject-matter experts on leadership. The program stresses strategic thinking, problem solving, and the dynamics of leading people.

The institute began in June 2021 with 25 community college and high school educators from across the US. During the 12-month program participants view lectures by subject-matter experts, read leadership texts and biotech reports, do case studies on real industry issues, and receive personal leadership guidance.

The participants are encouraged to apply what they learn in a leadership project of their choosing and report on it during a face-to-face meeting in June 2022.

InnovATEBIO Partners with 3 Manufacturing Institutes & Other ATE Centers

InnovATEBIO is coordinating its activities with three federally sponsored manufacturing innovation institutes: the National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL); Bioindustrial Manufacturing and Design Ecosystem (BioMADE), and the Advanced Regenerative Manufacturing Institute (ARMI).

InnovATEBIO also collaborates with the ATE Micro Nano Technology Education Center to expand research opportunities for community college students.



A laboratory technician teaches a student proper pipetting techniques.

“The InnovATEBIO team and the industry partners on the National Industry and Workforce Advisory Council work hand in glove to make sure that emerging industry trends are in biotechnology education programs.”

Sulatha Dwarakanath
Founder & CEO
Kaya17, Inc.
Livermore, CA
Co-Chair of InnovATEBIO National
Industry and Workforce
Advisory Council



An NBC2 College Company Connection intern prepares to count cells on an automated cell counter.

NBC2

Northeast Biomanufacturing Center and Collaborative

Experiment Data Substitute for Hands-On Labs during Pandemic

The switch to remote learning due to the COVID-19 pandemic left many instructors in need of material that could substitute for hands-on laboratory learning. NBC2 responded by quickly publishing experiment

data documents for three areas of monoclonal antibody biomanufacturing: upstream processing, downstream processing, and analytics. The data were generated by students' experiments in biomanufacturing courses that followed NBC2 processes and procedures.



Key Activities

- Creates multi-level biomanufacturing curricula for easy adoption
- Promotes up-to-date and industry-relevant programs
- Conducts hands-on workshops and faculty mentoring to enhance existing or create new biomanufacturing programs
- Promotes student success by facilitating the transition from classroom to workforce through an industry-sponsored internship program

The documents were well received by biotechnology faculty. Many instructors reported using the data as sources for discussions about experiments and procedures, assignments and assessments, and lecture presentations.



At miniBIOMAN workshops educators perform hands-on lab activities, analyze data, and attend presentations by industry professionals. Participants leave with a comprehensive, ready-to-insert curriculum module to utilize in their own classrooms.





NBC2's College Company Connection Benefits Students & Employers

NBC2 has collaborated with scores of biotechnology and biomanufacturing companies to develop technician skill standards, cutting-edge curricula, and lessons to prepare community college students for entry into the workforce.

In 2020 NBC2 launched the College Company Connection student internship initiative. Internships provide a unique bridge from the laboratory classroom to the workplace by offering an experience that greatly increases students' confidence, skills, and professionalism. This workplace-focused initiative pairs students with designated industry mentors and defined industry projects.

By mid-2021 eight student interns had conducted real-world research projects with four biotechnology companies. The projects included producing and characterizing a novel monoclonal antibody; beta testing a commercial CRISPR kit; adopting an electronic cell culture data tracking system; developing a recombinant mammalian cell line for cell therapy development; and optimizing the growth of fungal cells for the production of metabolites.

The College Company Connection is a winning situation for all. Companies work with potential employees, and students benefit from reinforced technical skills, data analysis, and professional communication. The growth in students' skills increases their competitiveness in the employment market.

NBC2 Products & Reach 2015 to 2021

66

Standard Operating Procedures Published

9

MiniBIOMAN Workshops
Serving 93 Educators

8

Curriculum Modules

169

Biomanufacturing Education Resources
in NBC2 Website Instructors' Portal

200

Members of
NBC2 Instructors' Portal
Representing 165 Institutions

NBC2 supports biomanufacturing faculty through hands-on professional development, lab-based curricula, and other resources that facilitate course updates and new course and program development.

"Having been associated with the NBC2 curriculum for a number of years, I and my college have benefited significantly from the workshops and the detailed information on the website. These resources have actually strengthened our affiliation with a major biopharmaceutical company in our region and contributed to the hiring of many graduates from our program. Continued support from NBC2 has significantly benefitted our biotechnology program."

Peter A. Schaefer
Chair of Biology, Chemistry, & Physics
Hudson Valley Community College, Troy, NY



North Central State College
Mansfield, OH

<https://ate.is/bioscience-technician-expansion>

Key Activities

- Creates hybrid course materials to facilitate degree completion by working students
- Promotes outreach about biotechnology to prospective students
- Develops pathways for workforce sustainability via high schools and career centers

Lessons Learned in Development of Remote Bioscience Courses Provide Far-Reaching Support in College-Wide Course Conversion during Pandemic

The Bioscience Technician Expansion Project initially focused on delivering course materials remotely to enhance a critical workforce shortage of skilled lab technicians in North Central Ohio. The project developed six courses with virtual lectures and in-person labs to allow students to complete their degrees while working. Project leaders completed most of their course conversion work ahead of schedule, giving them valuable insights into distance learning pedagogy and technical processes prior to the COVID-19 pandemic.

When all in-person instruction was eliminated as a public health precaution in March 2020, project personnel shifted gears and applied what they learned through their ATE project to help colleagues convert 55 in-person courses for remote delivery.

At the forefront of this endeavor, Principal Investigator Justin Tickhill directed the digital development of large-enrollment courses such as biology and anatomy. Co-Principal Investigator Jason Tucker reviewed and supported the development of courses across the college as a member of the Quality Matters Group. Consequently, about 2,000 students college-wide and 280 in the biology department benefitted from the ATE project in 2020-2021.



The Bioscience Technician Expansion Project utilizes recorded lectures, interactive virtual class meetings, and hands-on lab experiences.



Website Raises Awareness of Biotech Careers

Biotech-Careers.org is a comprehensive career information site used by college and high school educators throughout the US. Survey data indicate the site is an important resource for raising awareness of biotechnology jobs and the diversity of biotechnology specialties, and that it is increasing student interest in pursuing biotech careers.

In March 2020, the website began highlighting the biotechnology industry's response to the COVID-19 pandemic. The COVID-19 database page counts over 600 employers working on related diagnostics, vaccines, and therapies.

Between May 31, 2020, and June 1, 2021, Biotech-Careers.org had 519,750 visitors – including 70,000 students – who viewed more than 1.1 million pages.

Biotech-Careers.org features:

- Extensive Database with 8,600+ employers organized by 500+ biotech terms and geographic locations
- Interactive Maps that show 780+ employers of community college students, and 4,000+ career pages
- Profiles of Community College Alumni working in biotechnology
- Job Descriptions that explain work activities and education requirements, and provide links to InnovATE^{BIO} community college programs
- Blogs & Videos about the biotech industry



Digital World Biology, LLC.
Seattle, WA

<https://biotech-careers.org>

Key Activities

- Helps educators increase students' interest in pursuing scientific careers
- Describes entry-level jobs and how they fit into different biotechnology areas
- Provides "day-in-the-life" alumni stories
- Hosts a very large employer database with maps and links to employer career pages

Biotech-Careers.org Usage Data

May 31, 2020 to June 1, 2021

1.1 Million +
Page Views

519,750
Total Visits

70,000+
Student Visits

Since 2012*

4 Million +
Page Views

1.8 Million +
Total Visits

400,000+
Student Visits

The number of people visiting Biotech-Careers.org and viewing multiple pages on it leaped during the COVID-19 pandemic.

* Biotech-Careers.org began as a project within Bio-Link, a previously funded ATE center.



*Del Mar College
Corpus Christi, TX*

<https://ate.is/BTWST>

Key Activities

- Establishes, implements, and sustains a new advanced biomanufacturing certificate program
- Follows industry guidance for technology-enabled pedagogy
- Shares new biomanufacturing curriculum through InnovATEBIO
- Improves biomanufacturing instrumentation in Del Mar College laboratories

Biomanufacturing Certificate Responds to Industry Needs

To help grow the biomanufacturing workforce in South Texas, the project offers a new advanced biomanufacturing certificate program that incorporates innovative pedagogical approaches. Project leaders, who are working in collaboration with educators at Texas A&M University, have developed and adapted educational materials from multiple sources including other ATE initiatives.

The new program incorporates hands-on, instructor-led modules on topics such as bioprocess operations, upstream and downstream manufacturing of biologics and vaccines, quality control, and regulatory compliance. Courses that will be offered online include Introduction to Pharmaceutical Manufacturing, Understanding the Science of the Biopharmaceutical Industry, Current Good Manufacturing Practice (cGMP) Procedures and Documentation, Pharmaceutical Facility Operations, and Safety in the Biopharmaceutical Industry.

Project leaders work with industry partners to provide students with real-world experiences using biotechnical and biomanufacturing equipment. The project is also implementing new strategies for recruitment and retention as well as offering professional development to educators.



A Del Mar College student injects culture media into a bioreactor at Tosoh Bioscience during a summer 2021 internship.

ATE Alum: Seethal Meda Excels with Skills Acquired in NBC2 Biomanufacturing Program



When Seethal Meda enrolled in the biomanufacturing program at Montgomery County Community College (MCCC) in 2017 her goal was modest: pass one semester of courses.

Meda had married right after completing a bachelor's degree in biology and chemistry from Andhra University in India in 2000. Since then she had focused entirely on family life in Pennsylvania, where she, her husband, and son had moved and become US citizens. In 2017, when her son entered high school she decided it was

time to brush up her science knowledge.

"I never thought I could get a job," she said. Completing assignments and navigating the campus environment were challenges; making a class presentation nearly defeated her.

Meda attributes the patient coaching of Margaret Bryans, principal investigator of Northeast Biomanufacturing Center and Collaborative (NBC2), which is at MCCC, with helping her succeed academically and overcome her nervousness about public speaking.

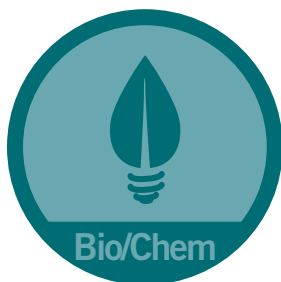
When Meda completed the 11-month biomanufacturing certificate program, however, she did not have six months of work experience that biotech employers expect and she lacked the confidence to enter the workforce.

At Bryans' suggestion Meda did a paid internship through the College Company Connection at MCCC and investigated a "knock-out gene" for a start-up company. "Working for a company, I was part of that world and I thought, 'OK. I could do this for another company,'" Meda said.

Presenting a scientific poster at the student showcase of the 2018 ATE Principal Investigators' Conference put her at ease for job interviews.

Rockland Immunochemicals, Inc., hired Meda and has promoted her. She is now a research and development scientist II, which is a technical role at the life science reagents manufacturer.

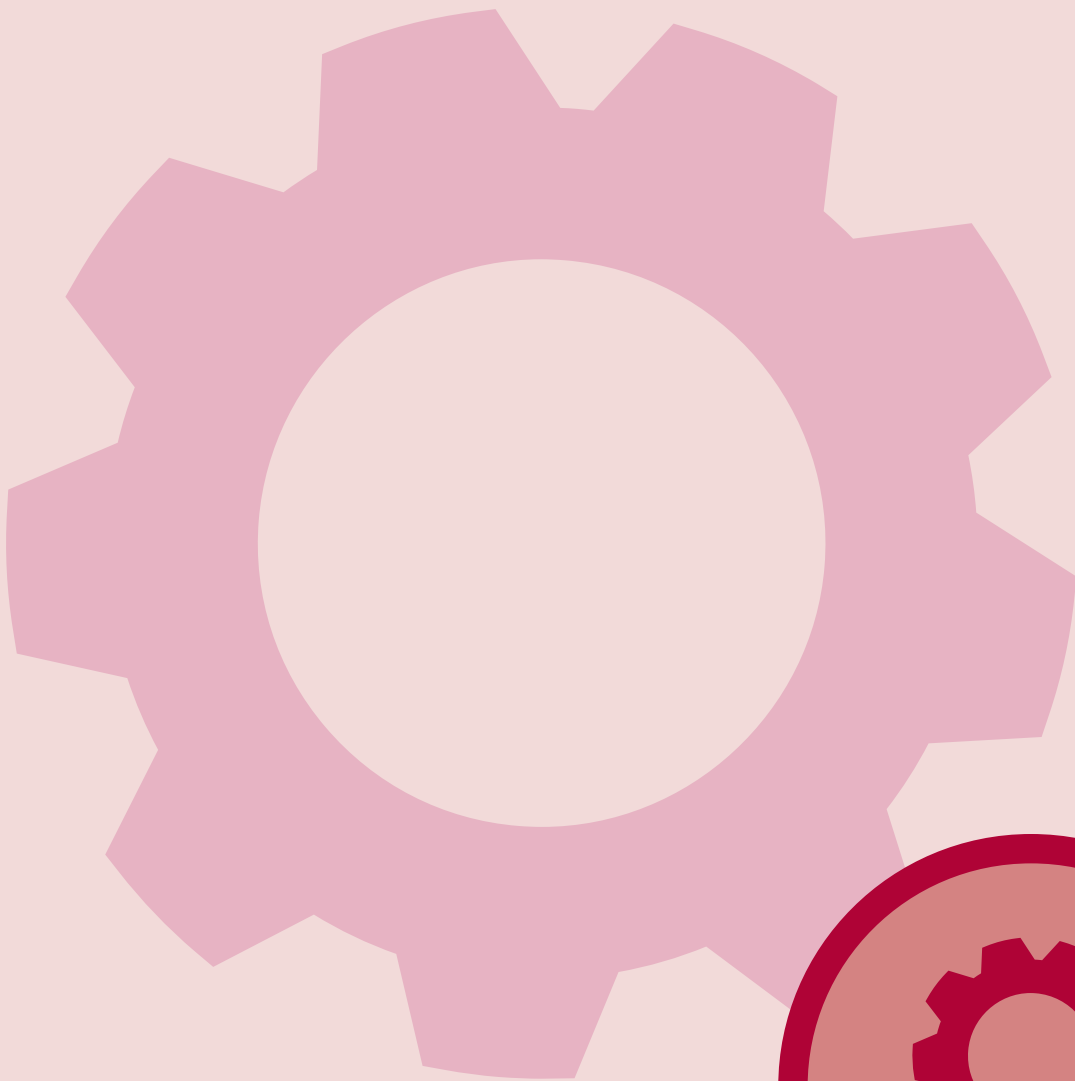
Meda is grateful to Bryans and the NBC2 program: "It was a miracle for me because I never thought I could start a career."





Engineering Technologies

<https://ate.is/eng>





An instructor guides a student through the boiler inspection protocol in BEST's model curriculum.

BEST

Building Efficiency for a Sustainable Tomorrow Center

Virtual Delivery of 2021 Institute Facilitated Increased Scope & Breadth of Attendance

Transforming its Annual Institute to a virtual event in 2021 produced a notable increase in attendance from the 40 who attended the in-person institute in 2020. The 208 participants represented a broader swath of stakeholders. The audience included educators, design professionals, building technicians, researchers, manufacturers, and representatives of non-governmental organizations. Instructors were from 23 states and four countries.



Other gains included numerous presentations by world-renowned experts who otherwise could not have fit conference travel into their schedules. Due to the success of this event, the 2022 Institute will be extended over three days to allow more time for live discussions.

Visit www.bestctr.org for links to Institute presentations on building operations during COVID, the electric grid and demand flexibility, and other timely topics.

Key Activities

- Promotes advanced technical and cognitive skills development for building technicians through two-year college programs
- Leads education-industry collaboration to support advanced educational programs in heating, ventilation, and air conditioning (HVAC), building automation systems (BAS), and energy management
- Provides lab-based professional development for college faculty
- Specifies nationally validated knowledge and skill requirements for high performance building technicians



An HVAC instructor and students review hydronic balancing and mixing for radiant floor heating.



Workshop Tests Blended Delivery of Professional Development

BEST experimented with online faculty development for its four-day 2021 BAS Workshop. It is normally a multi-day, in-person, lab-intensive program. To increase educators' knowledge of new lab applications and instructional techniques, the workshop blended virtual and hands-on experiential learning.

After attending two preparatory webinars, 30 workshop participants created programmable variable air volume trainers in their campus labs ahead of the event. During the workshop, faculty received online lectures and completed project-based learning exercises in online teams organized by region. The most experienced instructor in each region served as the team leader.

Instructors reported that the blended format was a distinct improvement over other web-based events. Attendees especially liked working in person in small groups at college labs and simultaneously interacting via videoconference with the presenter or other attendees.

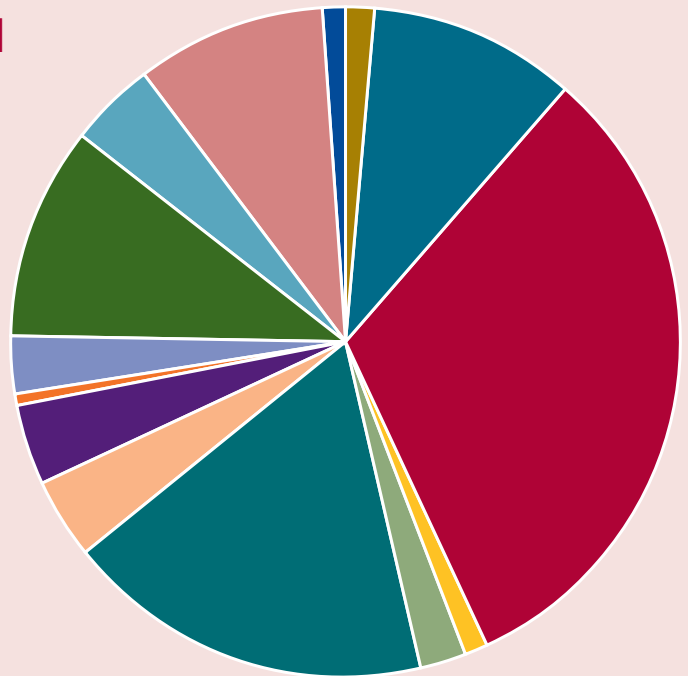
Faculty feedback has inspired BEST to create two BAS workshops for June 2022: one for colleges just getting started with building automation and another for advanced instructors. A blended format might use live and pre-recorded lectures ahead of the hands-on component to maximize time spent on in-person lab activities.

"The positivity of the BEST members I work with is contagious. As a woman who came from energy consulting, I really appreciate the great, can-do attitudes and openness to my questions that I receive from BEST leadership and instructor members."

Jenny Brinker
Energy Management Instructor
Northeast Wisconsin Technical College
Green Bay, WI

BEST Annual Institute Attendance in 2021

Industry or Education Sectors of Participants	#
Alternative Educational Program Instructor	3
Building Operations/Facilities Professional	21
College Faculty/Administrator	66
College Student	2
Community Activist	5
Design/Construction/Energy Management Professional	37
Educational Consultant	8
Government/Public Agency Representative	8
Graduate Student	1
High School Teacher	6
Manufacturer/Business Representative	21
Non-Government Organization Representative	9
Researcher	19
Union-Affiliated Instructor/Representative	2
TOTAL	208



By delivering its Annual Institute in 2021 virtually, BEST increased participation by people from a greater variety of industry and education sectors than had attended previous institutes.



Girl Scouts Engineers Week participants apply engineering concepts to build model roller coasters.

CAAT

Center for Advanced Automotive Technology

CAAT Labs Spark STEM Career Awareness

CAAT's free, in-classroom STEM labs demonstrate to middle school students the exciting careers that use emerging technologies. The hope is that this introduction will spark students' interest in taking STEM classes in high school and pursuing advanced technology careers. A related goal is that it will increase awareness among parents and teachers about the need for skilled technicians and engineers in Southeast Michigan, particularly in the automotive sector.

Center for Advanced
Automotive Technology
C • A • A • T

Key Activities

- Collaborates with industry and education partners to develop advanced automotive technology degree programs, courses, and modules
- Delivers webinars and other professional development programs to educators and industry professionals
- Provides science, technology, engineering, art, and math (STEAM) outreach activities to middle and high school students

By having students create hands-on projects with little guidance from their teachers, these labs increase students' problem-solving, spatial reasoning, and applied math skills. During the labs students design, build, and test simple machines such as catapults, balloon-powered cars, rubber-band racers, hovercrafts, and lunar-style buggies.



CAAT's curriculum covers procedures for safely servicing hybrid electric vehicles and working with other new automotive technologies.





CAAT Launches New Degree Program

CAAT leveraged its industry and educational partnerships to add courses on cybersecurity and microcontroller programming to its Vehicle Engineering Technician (VET) program. This two-year degree was formerly the Vehicle Development Technician (VDT) associate degree program, which had its first three graduates in 2021. Nine more VDT students are on track to complete the program in spring 2022. The VET program had 12 students in fall 2021.

Roush Industries, a CAAT partner, hosts VET program information sessions and offers internships at facilities where auto prototypes are built and tested.

The two-year Fiat Chrysler Automobiles (FCA) Automotive Manufacturing Program (AMP) has had 13 graduates. Upon graduation, all 13 FCA AMP graduates were offered jobs at FCA manufacturing plants. Twenty-five students are on track to graduate from the program in 2022.

"Thanks to CAAT and its continuing collaboration with industry there are instructional materials that are relevant to the automotive industry. There is a critical shortage of higher-skilled technicians in the Detroit area, and programs like CAAT's Vehicle Engineering Technician program will ultimately provide a significant contribution to resolve this technician shortage issue."

Amanda Alanouf
Director of Workforce - Prototype Services
Roush Industries
Allen Park, MI

CAAT Camps Offer Youngsters Experience with Emerging Technologies

During the COVID-19 pandemic, CAAT collaborated with two middle schools, one school district, two industry partners, five STEAM-based organizations, and the National Center for Autonomous Technologies (NCAT) to offer seven STEAM Camps – five robot camps and two drone camps – to nearly 300 middle school students. During the camps the students learned how to build and fly a drone and how to build and program a robot.

The two drone challenges engaged 70 middle school students and 35 Girl Scouts who flew drones through obstacle courses.

Two of the five robot camps intentionally recruited participants from populations historically underrepresented in STEM fields.

Reach of CAAT STEM Labs & Teachers' Critiques

Program Reach Since 2015

Schools	33
Classrooms	550
Students	16,032

Teachers' Responses

>80% indicated the STEM labs were extremely valuable
>90% are interested in doing another STEM lab
100% would recommend the STEM lab to a colleague
n=151

All 151 teachers who completed surveys after CAAT staffers delivered STEM labs in their classrooms indicated they were very satisfied with the free educational experiences for their students.



A LASER-TEC student works with a laser beam profiling system.

LASER-TEC

Center for Laser and Fiber Optics Education

LASER-TEC Helps Sustain College Photonics Courses during Pandemic

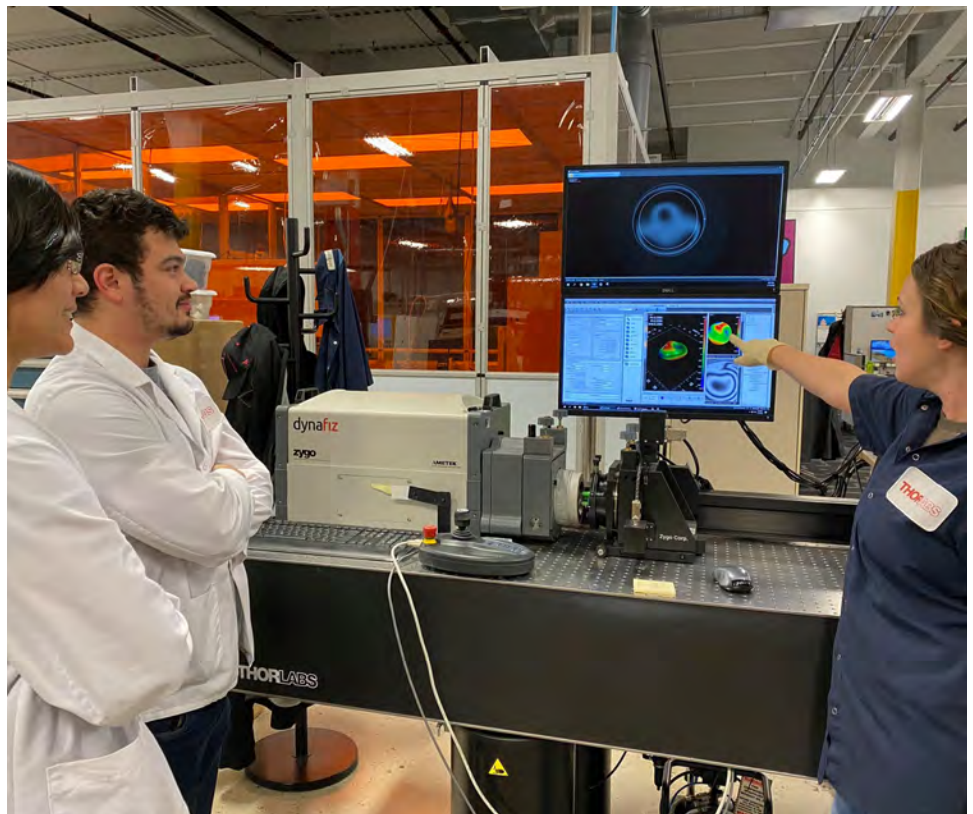
During the COVID-19 lockdown when all 44 institutions in the LASER-TEC College Network were forced to close their labs and teach remotely, LASER-TEC personnel quickly put together hundreds of home study Light and Optics Experiment Kits (LOEKs). Previously the kits were distributed at professional development workshops and sold from LASER-TEC's website. Each kit consists of 23 experiments for two entry-level optics and photonics courses and an illustrated lab manual.



Key Activities

- Expands technical workforce prepared to work with lasers, optics, photonics, and fiber optics
- Provides a broad range of resources to academic and industry training programs
- Facilitates professional development
- Guides infusion of photonics technologies in secondary, postsecondary, and professional certification education programs

To help faculty teach during the pandemic, the center created YouTube videos for each experiment and offered to send the kits directly to students free of charge. Colleges from 22 US states, Puerto Rico, Curaçao, and Canada requested LOEKs, which were sent directly to 250 students' homes.



LASER-TEC students analyze the surface form errors, flatness, radius of curvature and other optical surface qualities using a ZYGO DynaFiz Interferometer System.





LASER-TEC Develops Resources for Emerging Photonics Applications

LASER-TEC houses a collection of resources to help colleges and training programs with the integration of laser, optics, photonics, and fiber optics. The center focuses on developing materials on emerging photonics applications.

In partnership with PowerAmerica, a Manufacturing USA institute, LASER-TEC is creating educational modules on wide-bandgap (WBG) semiconductor technology. WBG is revolutionizing many industry sectors. It is gaining wide use in laser energizing systems that technicians install, maintain, and repair. Experts from industry and academia review the modules prior to their release. This review process has the added benefit of ensuring that previously developed LASER-TEC materials are relevant and up to date.

LASER-TEC is also partnering with EdQuantum, an ATE project, to develop a hybrid curriculum to update the skills of photonics technicians in advanced optics and quantum research-enabled technologies. The new materials will be suitable for postsecondary use and available on an accessible learning platform.

Board of Laser Safety Recognizes LASER-TEC Courses

The Board of Laser Safety (BLS) has approved a series of five LASER-TEC courses for photonics technologists. Enabling laser safety professionals to obtain certification maintenance points by completing these LASER-TEC courses expands technicians' professional education opportunities and raises LASER-TEC's visibility. BLS certifications are highly sought-after credentials by medical and non-medical laser safety officers.

"It has been a unique and fun experience, and I like doing the labs. Being under quarantine, I have been able to experiment with the laser and the other components. It has been a cool opportunity."

Luis Morales, Student
Puerto Rico Photonics Institute
Universidad Ana G. Méndez
Barceloneta, Puerto Rico

LASER-TEC College Network

31

Two-Year Colleges
Offer Photonics Programs in the US

13

Award Associate Degrees
in Photonics

8

Award Certificates in Photonics

10

Infuse LASER-TEC Content in Courses

13

Plan to Add Photonics Programs

The LASER-TEC College Network strengthens and enhances existing photonics technician education offerings and helps colleges start new photonics programs.



Students who participate in annual MATE ROV Competitions must apply technical and employability skills to engineering and piloting an ROV to accomplish tasks.

Key Activities

- Engages students and faculty via the MATE Remotely Operated Vehicle (ROV) Competition
- Measures student learning gains via Evaluate-Compete, an ATE project
- Provides faculty professional development, instructional resources, and starter ROV kits



MATE II

Marine Inspiration for Innovation

Creative Response Keeps ROV Competition Going

COVID-19 challenged but also inspired MATE II leaders to think differently and to be creative and innovative. To that end, they reconfigured the 2021 MATE ROV Competition season to include an in-person World Championship and a telepresence category. Students who competed in the telepresence category submitted videos of their ROVs performing the required tasks and made their presentations virtually.



The 2021 season also included a virtual reality (VR) environment, created in collaboration with the National Center for Autonomous Technologies (NCAT). The live video stream from the World Championship was broadcast both via Twitch and within the 2021 MATE ROV Competition VR World. Competition interactions within VR facilitated the socializing and peer-to-peer networking that students reported valuing in prior post-competition surveys. During the pandemic, students and mentors described craving the purpose-filled, shared experiences that the competition provides.

MATE ROV Competition Longitudinal Data



of Alumni Credit the Program with Influencing Their Education/Career Decisions (n=634)



of Alumni Who Graduated from College Earned STEM Degrees (n=390)



of Alumni Still Enrolled in College Were STEM Majors (n=305)



of Employed Alumni Had STEM-Related Jobs (n=467)

Responses from the 2020 MATE ROV Competition Alumni Survey demonstrate the impact that the competition has had on participants' education and career choices.

Alumni & Industry Partners Contribute Insights for Dynamic ROV Competitions

Many of the initiatives that the Marine Advanced Technology Education (MATE) Center developed over its 23-year history as an ATE center are being continued by MATE II, a nonprofit organization. Chief among these initiatives is the annual MATE ROV Competition. Each year, MATE II creates a new competition scenario and set of mission tasks that are based on real-world events and the latest advancements and applications of underwater technologies.

The scenario and tasks are developed in collaboration with and informed by industry partners as well as program alumni. These former MATE ROV competitors have graduated and are now working in maritime, aerospace, and automotive industries. It is especially helpful for these alumni to share their first-hand competition experiences and information about the technologies, equipment, software, and other applications that they use in their workplace.

That these former MATE competitors work in a variety of fields highlights the transferability of skills cultivated by the MATE ROV Competition. It also demonstrates that the MATE ROV Competition prepares students not only for the marine industry, but also for other advanced technology industries. MATE alumni are critical to helping the competition to stay relevant and focus on the skills that are needed for success in today's – and tomorrow's – skilled technical workforce.

“The reason we participate in the MATE ROV Competition has everything to do with the skills our students receive from designing, manufacturing, and selling their ROV. These skills have opened doors to companies like Eaton Aerospace, Toyota, and Oceaneering. MATE is an excellent program, and after ten years of competition, I have nothing but high praise for what they have given our students.”

Kevin McKone
Chair & Faculty Member of Physics Division
Copiah-Lincoln Community College
Wesson, MS



ROV pilots and technicians are integral members of science, engineering, and technology teams that support research projects in deepwater and coastal habitats.



Students at an NCAT camp experience UAS flights via virtual reality 360-degree videos.

NCAT

National Center for Autonomous Technologies

NCAT Uses Social VR for Instruction

Despite COVID-related limitations on in-person gatherings, NCAT staff conducted research and introduced novel approaches to professional development that expanded access and equity. Early in the pandemic the center offered educators opportunities to learn how to teach in social virtual reality (VR). Then NCAT became a leader in the use of social VR to provide high-quality professional development when it offered the Autonomous Vehicle Technology Sensors Educator Workshop through VR in October 2020. By utilizing social VR for professional development activities, NCAT increased access and inclusivity for educators unable to travel to in-person activities.



From July 1, 2020, through June 30, 2021, NCAT reached more than 5,200 people at 45 events. Most were virtual due to public health precautions. These events included 14 speaking engagements by center leaders at conferences, 10 webinars, 15 professional development programs, and five STEM challenges.

Key Activities

- Leads the process of defining skill standards for teaching autonomous technologies (AT)
- Offers professional development for educators and industry
- Connects workforce and community stakeholders to exchange ideas for AT
- Inspires students to engage in high-impact, hands-on STEM activities
- Offers curricula, interactive content, applications, and mentoring



A graduate from Northland, which is NCAT's host institution, prepares a drone for a ditch survey.





“We could not be more pleased with the NCAT-hosted Unmanned Aircraft Systems Collegiate Training Initiative (UAS-CTI) repository and the support we receive from NCAT staff! The repository has information, forums, a link to the UAS-CTI ESRI map, recorded webinars, and an abundance of other resources available for professors and instructors.”

Diana Robinson
Project Specialist, AUS-410
Unmanned Aircraft Systems Integration Office
Federal Aviation Administration
Washington, DC

NCAT Hosts Hub for UAS Collegiate Training Initiative

NCAT has taken a significant leadership role in the Federal Aviation Administration (FAA) Unmanned Aircraft Systems Collegiate Training Initiative (UAS-CTI). Since launching in 2020 this initiative has had significant coast-to-coast impact, reaching more than 83 member organizations across 39 states. Most of the organizations are two-year colleges. The UAS-CTI mission is to collaborate with selected colleges and other organizations to deliver up-to-date UAS training tools, resources, and guidelines to prepare students for UAS careers.

As the designated repository and resource hub for the UAS-CTI community, NCAT provides access to its extensive collection of interactive educational content, curriculum, workshops, presentations, and other resources. The website has become a forum for exchanging ideas and a platform for launching new initiatives.

NCAT’s relationship with the FAA is a model for the ways in which academia and government organizations can work together to create resilient partnerships that prepare the nation’s workforce for the future.

NCAT Audiences July 2020 to June 2021

Facebook	206,923 Interactions
YouTube	76,900 Views
10 Conferences	1,458 Participants
4 Presentations	173 Participants
10 Webinars	916 Participants
15 Professional Development Programs	1,570 Participants
5 STEM Events	1,145 Participants
Newsletter	1,623 Subscribers

From July 1, 2020, to June 30, 2021, NCAT engaged with more than 5,200 individuals through in-person and virtual workshops, presentations, webinars, and STEM events. Through targeted outreach on Facebook and YouTube, NCAT had more than 280,000 impressions.



SCA builds industry connections to inform educators about the latest supply chain technologies.

Key Activities

- Unites employers and educators for programs that increase the number of highly skilled supply chain technicians
- Builds industry connections with experts to inform educators about the latest trends and technologies transforming supply chains
- Offers students three certifications developed with industry partners



SCA

National Center for Supply Chain Automation

Participation in SCA Annual Symposium Grows

Although COVID-19 initially seemed like it could be a barrier to operations, SCA's online



National Center for Supply Chain Automation

presence flourished during the pandemic. When SCA's Annual Symposium went online in 2021, it led to an 86% increase in participation from the March 2020 in-person symposium that 40 people attended. The 2021 conference had 570 registrants and more than 40% attendance each day. Presentations and materials, which were sent to all 570 registrants, had a 95% view rate.

In the two months immediately after the symposium sessions that promoted SCA's e-textbook, *Introduction to the Automated Warehouse*, 95 educators downloaded it. The 13-chapter book is freely available from SCA's website and is supported by an instructor's manual that contains lab activities. The second edition of the book will be released in 2022.

SCA Website & Social Media Activity July 31, 2020, to July 31, 2021

• • • • •
7 Website Articles

on

**Mechatronics, Supply Chain Technician & Robotics
Technician Qualifications, and SCA Certifications**

• • • • •

139 Social Media Posts

Led to

58,779 Page Views

251 Facebook Likes

259 Post Clicks

230 New Facebook Followers

• • • • •

SCA took COVID lockdowns as an opportunity to grow its social media presence and add content to its website. As a result, in 2021 SCA was among the top 10 sites in "supply chain" Google searches.

SCA-Target Corporation Partnership Improves Technicians' Skills

After years of preparation the Certified Technician Supply Chain Automation certificate was launched in 2020 by the Manufacturing Skill Standards Council (MSSC) in collaboration with SCA, other council education partners, and Amatrol, Inc., a manufacturer of technical training equipment.

This industry standards-based certification recognizes the competencies of supply chain technicians who install, operate, support, upgrade, or maintain the automated material handling equipment and systems that support the supply chain.

The certificate program has grown SCA's relationship with Target Corporation. In 2021 the international retail company – in partnership with SCA and the Riverside Community College District (RCCD) Apprenticeship Program – gave three cohorts of Southern California employees the opportunity to earn the certification. Target paid the employees to attend 20 hours of classes each week for 10 weeks during their normal work schedules. All 20 employees in the first two cohorts (that completed prior to the publication deadline) earned certificates and were promoted from technician trainee to maintenance tech 1 with significant wage increases.

SCA and Target plan to expand this aspect of their partnership nationally. Norco College also offered the program in 2021 to a cohort of nine recent high school graduates that included four women.

"You folks have done a nice job with the curriculum package for students and schools and with the certification process for students. Thanks for a great product."

Roy Brixen
Adjunct Instructor of
Electronics Technology
College of San Mateo
San Mateo, CA



Supply chain technicians install, operate, support, and maintain material handling equipment and systems.



South Seattle College
Seattle, WA

<https://southseattle.edu/MOET>

Key Activities

- Offers an accelerated STEM associate degree that awards academic credit for military or industry experience and training and that also articulates to applied baccalaureate degrees
- Designs and offers STEM field experiences to increase the energy efficiency of buildings
- Convenes an accelerated STEM degree network

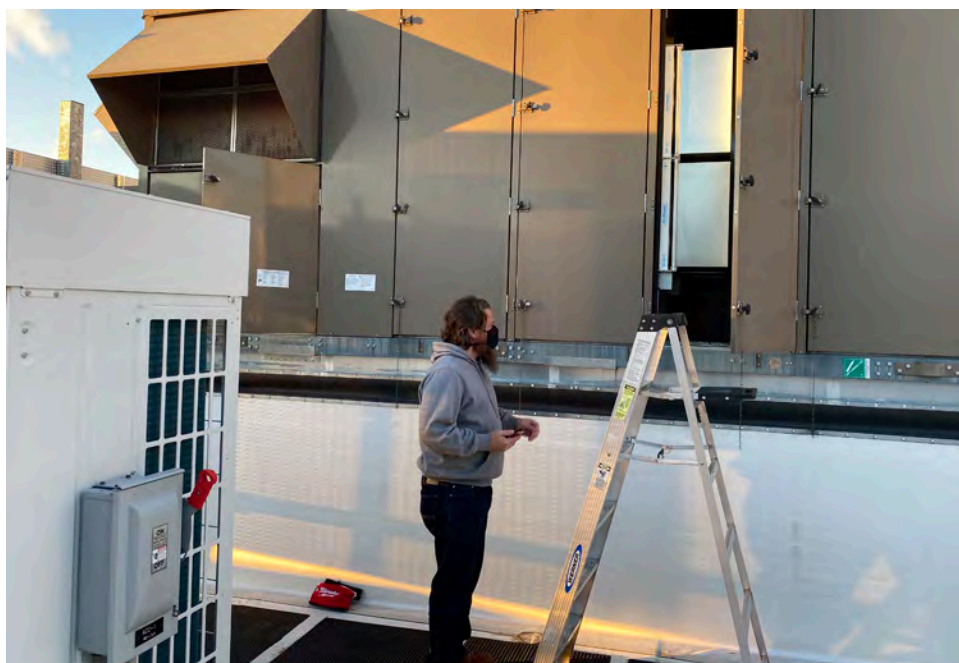
Accelerated Degree Improves Associate Degree Completion & Increases Pathways to Applied Baccalaureate Programs

ASAP developed the Multi-Occupation in Engineering & Technology (MOET) as an accelerated degree to help students succeed in college. It features an active-learning introductory course that covers digital literacy; classroom success strategies and resources; and career pathways in engineering and technology.

Throughout this course, which may be taken over one or two quarters, students develop portfolios that document their work and training history. Experienced faculty members guide students to ensure that each individual qualifies for the maximum number of college credits.

The MOET degree is built to articulate to engineering and technology baccalaureate of applied science programs and serves as a template that can be adopted elsewhere.

ASAP is collaborating with the Washington Council for Engineering and Related Technical Education and the Baccalaureate Leadership Council to create a statewide network to foster the adoption of accelerated degrees. The network focuses on adult STEM learners, particularly historically underrepresented populations, to provide credit for prior learning to increase undergraduate pathways.



A student checks a rooftop air-handling unit at South Seattle College during a hands-on field experience.

Featured ATE Project Collaboration of Midwest Professionals for Logistics Engineering Technology Education (COMPLETE)



Three-College Collaborative Tackles Complex Industry Needs

COMPLETE unites the work of three Midwest colleges that are leading the way in logistics technician education. To meet increasingly complex technological industry needs, the COMPLETE partners created undergraduate courses and professional development programs that integrate data analytics and networking content.

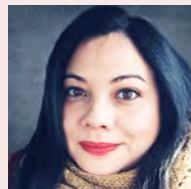
Columbus State Community College established O-SCAN. This network engages educators, retailers, service providers, and government agencies in building logistics career pathways, mapping touch points between academia and industry, and promoting logistics career awareness at K-12 schools.

Oakton Community College in Des Plaines, IL, offered faculty workshops on emerging logistics technologies.

To help military veterans embark on logistics careers, Sinclair Community College in Dayton, OH, developed prior learning assessment processes for articulated credit, proficiency testing, and competency-based education.

Educators learn how to characterize radio frequency identification (RFID) tags during a workshop at Oakton Community College.

“O-SCAN has created a valuable venue for MORPC [Mid-Ohio Regional Planning Commission] to engage with a comprehensive network of freight and logistics experts. Through O-SCAN, MORPC has a direct channel of collaboration with supply-chain businesses, academic institutions at the forefront of workforce development, and various public agencies responsible for the maintenance and development of freight multimodal infrastructure. Within its short life, O-SCAN has led to valuable relationships and expertise-sharing in a multidimensional way.”



Dina Lopez
Strategic Projects Manager
Mid-Ohio Regional Planning Commission
Columbus, OH



Columbus State
Community College
Columbus, OH

[https://csc.edu/community/
grants/recent-awards/
complete](https://csc.edu/community/grants/recent-awards/complete)

Key Activities

- Integrates data analytics and networking into logistics curricula
- Creates the Ohio Supply Chain Academic Network (O-SCAN), a collaboration between education and industry
- Establishes a professional development initiative for faculty
- Develops a protocol for prior learning assessment



**Northwest Arkansas
Community College
Bentonville, AR**

[https://nwacc.edu/
workforce/integrateddesign](https://nwacc.edu/workforce/integrateddesign)

Key Activities

- Creates and implements competency-based design thinking curricula for core courses of the integrated design certificate program
- Provides interdisciplinary, experiential learning environments for students & community
- Serves as technical and logistical hub for design-related technical workforce development

Modules Nurture Design Thinking

Curricula developed by IIDT are in use at Northwest Arkansas Community College. They include modules and integrated activities for three core courses: 3D Design, Materials of Construction, and Engineering Graphics. Due to challenges associated with COVID-19, the modules are integrated into courses three ways – fully online, fully in-person, and hybrid format – depending on the course format and public health precautions at different times.

The necessity to adapt the brand new curricula in novel formats allowed the IIDT team to experiment with the best ways to present information about design thinking. In general, instructors spend two-to-three weeks teaching the content, and then students complete a major project that integrates the framework of design thinking.

In spring 2021, 70 students completed the modules. Fifty-eight students or 83% agreed or strongly agreed that their use of design thinking either improved or developed as a result. One student describes what she learned as “a bridge between sides of her tool belt.” She explained that the modules allowed her to combine previous customer service experience with the technical skills she learned in courses that also integrated design thinking.



After completing the IIDT modules, a student begins work on a project that requires use of a table saw.



Project Weaves High-Value Industry Credential into Introductory Robotics Course

NextGen Technicians offers a credentialing opportunity for IST and IMM students enrolled in Introduction to Robotics. The course includes hands-on robotics labs and NC3 Level 1: Fundamentals of Robotics coursework and robotics credentialing. At the completion of the course, students are provided with the opportunity to take the NC3 Level 1 credentialing exam. In the past two years, 15 of 19 or 79% of IMM and IST students have successfully achieved the 70% accuracy rate on the credentialing exam.

Faculty Innovation Assures Course Success during COVID

COVID-19 forced face-to-face classes to be held online. The principal investigator (PI) utilized Zoom to instruct the course, videotaping each class. A Universal Robot and GoPro camera allowed the PI to demonstrate labs from home, which provided students with actual views of setting up and operating a Universal Robot. The PI worked with the college's Information Technology Department to gain remote access to the NC3 CIROS software and the college's Universal Robot simulator so students could complete the NC3 training.



Robot programming skills taught with the NextGen Technicians curriculum can be applied with other high-tech equipment.



*North Iowa Area
Community College
Mason City, IA*

<https://niacc.edu/nsf>

Key Activities

- Provides introductory robotics course for industrial systems technology (IST) and industrial mechanics and maintenance (IMM) students
- Prepares students for advanced manufacturing jobs by incorporating National Coalition of Certification Centers (NC3) credentialing coursework
- Partners with area industries offering NC3 credentialing for incumbent workers



Motlow State Community College
Smyrna, TN

<https://nsfsmart.org>

Key Activities

- Provides smart manufacturing workshops for STEM educators
- Develops educational modules on fundamental and advanced smart manufacturing concepts
- Connects academia with industry through short talks and collaborative activities with Industrial Assessment Centers (IACs)
- Introduces secondary school students to smart technologies in manufacturing

Project Builds Smart Manufacturing Expertise

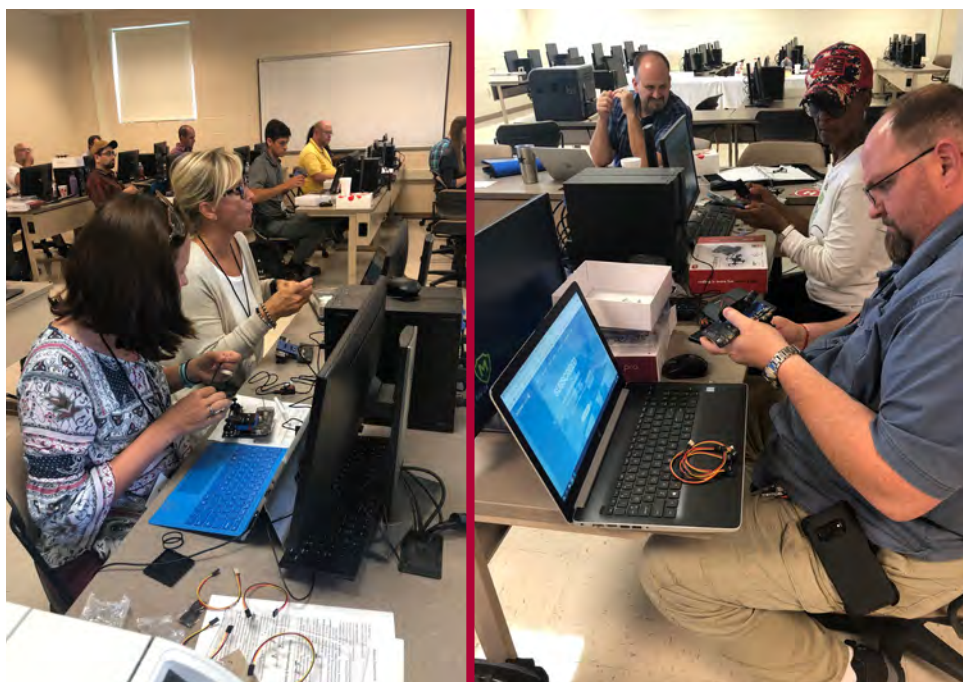
In 2010, the United States lost its position as the world's largest manufacturer to China. The gap between the two countries continues to widen due to the accelerated growth in the Chinese manufacturing industry and its rapid transformation to research and innovation.

SMARTT launched in 2018 in order to expand awareness of smart manufacturing. This initiative shares both instructional practices and information about emerging technologies, such as artificial intelligence and the Internet of Things, to improve the preparation of skilled technical workers throughout the US.

Online Workshops Attract Larger, Geographically Dispersed Audience

SMARTT converted its professional development workshops for online delivery due to the COVID-19 pandemic. Materials were sent to workshop participants in advance and participants carried out the hands-on portions of lessons simultaneously during the online sessions.

With the online conversion came a significant jump in diversity of participants. When the first and second workshops were held in person before the pandemic, the educators who participated were from only three states. When the third workshop was held online, participants were from 18 states. Advertising for the three workshops was nearly identical.



STEM educators learn to code drones at the Smart Manufacturing Workshop in July 2019.

ATE Alum: Adrian Barraza Built Versatile Skill Set through SCME Program



Adrian Barraza's curiosity about microelectromechanical systems (MEMS), which are micromachines about the size of a human hair, set him on his career path.

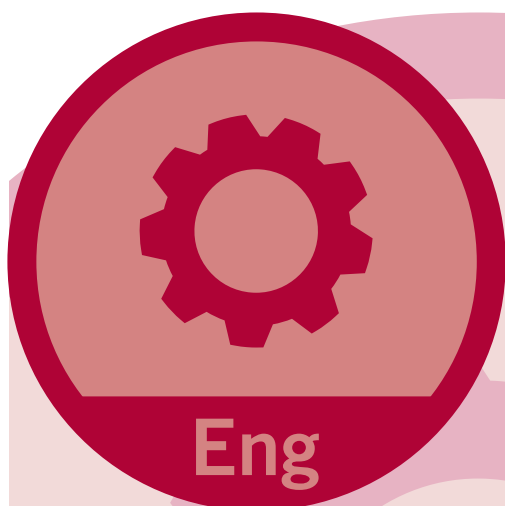
Right out of high school Barraza had an entry-level job at a manufacturer of mixed-signal optics and MEMS-based products. He liked learning about lithography and etching of silicon chips from the engineers there.

Then while working on the heating, ventilation, and air conditioning team at a semiconductor chip fabrication facility Barraza decided he just had to know more about micro and nanotechnologies. Later, he enrolled in Central New Mexico Community College's MEMS program. The MEMS curriculum used at Central New Mexico Community College was developed by the Support Center for Microsystems Education (SCME) and includes electronics instruction.

Since completing his associate degree in 2015 he has used his knowledge of MEMS, lasers, and silicon photonics at two manufacturers. He is now a biomedical technician for Agiliti Health Inc., which sends him to hospitals to repair and maintain equipment like ventilators, anesthesia machines, and infusion pumps embedded with MEMS technology.

Barraza says his education in micro and nanotechnology and electronics as well as his experience manufacturing MEMS helps him find and fix the root cause of malfunctions.

Whether the issue is with the internal components of an actuator or the fabrication of a micro machine built into a control board, he said, "The technology is almost the same."





General Advanced Technological Education

<https://ate.is/gen>





ATE Central

Supporting Advanced Technological Education

ATE Central encourages cross-disciplinary collaboration and learning with its searchable location map of ATE projects and centers.

Key Activities

- Cultivates collaboration within and beyond ATE community through in-person and virtual activities including workshops, webinars, and chats
- Provides systems and pathways that support the dissemination of ATE project and center deliverables and knowledge
- Sustains ongoing access to ATE-created resources through the ATE Central resource collection and archiving service

ATE Central Broadens Access & Accessibility

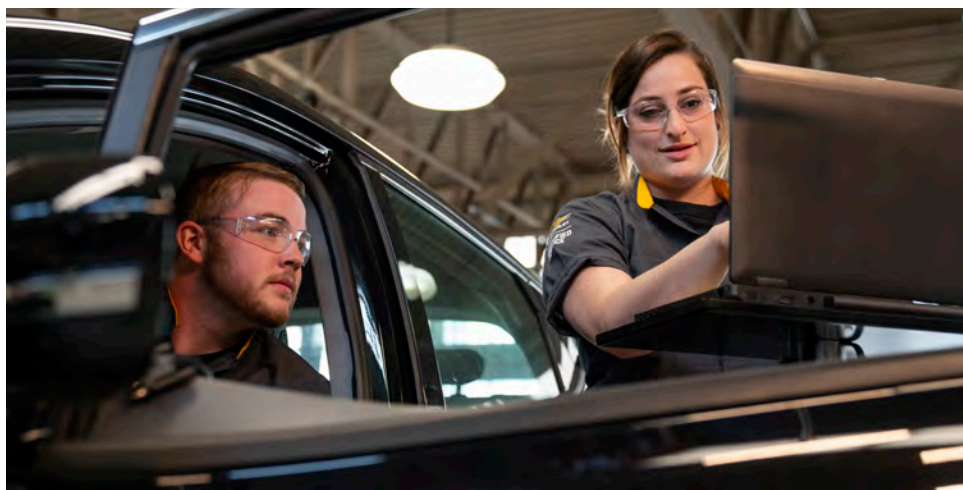
ATE Central helps broaden the impact of ATE project and center work through an archiving service that allows for ongoing access to valuable deliverables



created by NSF grantees. The project's portal showcases the efforts of the ATE community and allows users to utilize a variety of resources and materials – including curricula, learning objects, podcasts, and videos. ATE Central is committed to ensuring that all users have equal access to resources and encourages the ATE community to adhere to the tenets of Universal Design for Learning (UDL). UDL promotes inclusivity, with a focus on intentional design that reduces barriers and supports all learners, including those with disabilities.

"We've worked with ATE Central on various projects over the years, and they've been a wonderful dissemination partner and collaborator. They provide those within, and beyond, the ATE community with services and resources that support technician education and help broaden the impact of NSF's investment in STEM education and workforce development."

Ellen Hause
Program Director, Academic & Student Affairs
American Association of Community Colleges
Washington, DC



ATE Central disseminates information about ATE projects and centers via print and e-publications, social media posts, and its website.



ATE Central Amplifies Collaborations

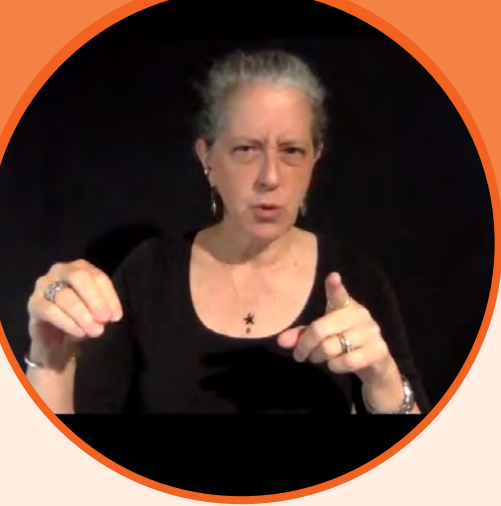
By providing searchable access to the full spectrum of ATE materials, resources, projects, centers, and events, ATE Central encourages cross-disciplinary collaboration and learning. By utilizing the ATE Central map interface, educators and other stakeholders can discover potential collaborators and partners from their field of study or their geographic region. ATE community members and others can adopt and adapt materials discovered on ATE Central to develop new STEM technical programs or strengthen existing educational efforts at their home institutions.

Beyond its website, ATE Central provides a suite of dissemination pathways which include publications, social media, a community-wide chat service, and its popular ATE Office Hours sessions. ATE Office Hours provides monthly video calls that focus on a variety of topics and fosters ATE community connection opportunities and information sharing.

ATE Office Hours Topics & Registrants

Jun 2020	Accessibility for HI-TEC Presenters	26
Sep 2020	Accessibility for NCPN Presenters	23
	Outreach & Dissemination Strategies	37
Nov 2020	Aligning Your Mission with NSF ATE	35
	Getting Started Follow-Up Session - Part I	45
Dec 2020	Getting Started Follow-Up Session - Part II	49
Jan 2021	NSF ATE New Year Update	108
Feb 2021	Sustainability Series - Part I	26
Mar 2021	Sustainability Series - Part II	49
	Sustainability Series - Part III	55
Apr 2021	Working Partners Workshop Information	36
	How to Engage Community College Presidents & CEOs in Your ATE Grant-Funded Work	36
	Using Workforce & Employment Data for Program Improvement	48
Jun 2021	Structures that Promote Sustainability During COVID	23
Total		596

ATE Office Hours' monthly video calls provide opportunities for people working on ATE initiatives to discuss timely topics, share information about their work, and connect with colleagues to address challenges.



Dawn Kidd, host of the MODE webinar and a math teacher at the Texas School for the Deaf, discusses math topics in ASL with guests.

DeafTEC

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

DeafTEC Helps Create Inclusive Environments

DeafTEC's Project Access online and onsite professional development provides real-life strategies to optimize teaching in the classroom. Its extensive online resources also help educators modify their teaching behaviors to provide greater access to learning for deaf students that benefit all students in the classroom, particularly English-language learners.

RIT

National Technical
Institute for the Deaf
DeafTEC

DeafTEC's Working Together online and onsite workshops help employers develop the sensitivity and skills to communicate effectively with deaf/hh employees. The workshops also help deaf and hearing colleagues work together more productively.

DeafTEC Offers Monthly Webinar Series in American Sign Language

Math Observations in Deaf Education (MODE) is a monthly webinar featuring guests who discuss math education topics in American Sign Language (ASL). Each webinar is presented in an informal talk-show format, complete with visual aids, resource lists, and teaching tips. Voice interpreting and captioning are provided for each webinar.

Key Activities

- Improves access to learning for deaf and hard of hearing (deaf/hh) students
- Shares best practices via online clearinghouse for teaching and supporting deaf/hh students and student veterans with hearing loss in STEM programs
- Offers professional development for educators and employers



A teacher and student, both of whom are deaf, troubleshoot code during a mobile app course.



DeafTEC Builds Khan Academy American Sign Language Demonstration Website

DeafTEC is partnering with Khan Academy to create an ASL demonstration website for deaf/hh students, their parents, and teachers.

This project involves remaking Khan's 197 *Algebra-Basic* videos in ASL to gain insights about the best instructional technologies and pedagogies to use for teaching STEM courses online in ASL. The team is also developing a review process for evaluating videos that will allow deaf math educators to submit their ASL instructional videos for inclusion on the demo site. The demo site will set standards for further development toward a live site on the full Khan Academy platform with ASL as an official language.

DeafTEC Offers Strategies to Help Student Veterans with Hearing Impairments

Today nearly two million veterans suffer from tinnitus and more than one million veterans suffer from hearing loss. Many veterans, even those who were not deployed to conflicts, suffer hearing impairments from training exercises and work environments. Veterans serving after 2001 are four times more likely than nonveterans to have severe hearing impairment.

Student veterans with the invisible disabilities of tinnitus and/or hearing loss often do not self-identify or express a need for access services that would facilitate learning. Through its online resources, webinars, and onsite workshops, DeafTEC provides STEM faculty with best practices for teaching student veterans, information on understanding military culture and the veterans' transition experiences, and strategies for working with veteran resource centers and college disability service personnel to encourage veterans to seek accommodations. For more information see <https://good2go.org>.

"We are excited to partner with DeafTEC to improve access for deaf students to Khan Academy resources. The development of an ASL demonstration site will allow deaf students to learn mathematics through their native signed language and engage their cultural strengths to support their educational experience. It will also provide the foundation for ASL to become an official language of Khan Academy."

Charlotte Auen
Mathematics Content Creator
Khan Academy, Inc.
Mountain View, CA

Results from Surveys of Student Military Veterans in California and Ohio

- 56% Served in Non-Combat Deployments (n=236)
- 58% Have a Service-Connected Disability (n=228)
- 34% Have Hearing Loss or Tinnitus (n=168)
- 27% Have Both Hearing Loss and Tinnitus (n=168)
- 65% Do Not Use Disability or Accessibility Services on Campus (n=218)
- 14% Did Not Know That There Was a Disability Services Office on Campus (n=218)

Data from DeafTEC's surveys inform STEM faculty about student veteran demographics and experiences.



EvaluATE

Evaluation Hub of the Advanced Technological Education Program

EvaluATE's 2021 ATE Survey reports that 39,500 students were served by the ATE program in 2020; of those students, 4,110 participated in academic contests that develop STEM workforce skills such as MATE's Remotely Operated Vehicle Competition. Photo: Daniel S. Maupin

Key Activities

- Educates the ATE community, including project staff and evaluators, about evaluation
- Gathers data about ATE projects and centers
- Conducts research on ATE evaluation to advance evaluation practice
- Facilitates collaborations to support peer-learning among ATE evaluation stakeholders

EvaluATE Serves Many Audiences

EvaluATE serves multiple ATE audiences to encourage and facilitate a healthy evaluation community that leads to active, useful, and quality ATE evaluations. The EvaluATE team believes in the power of evaluations to facilitate innovation.



Those interested in submitting a proposal to ATE may have their evaluation plans reviewed by one of EvaluATE's evaluation coaches. This service, free to current and future ATE projects, can answer specific questions about evaluations within the context of proposed projects.

ATE principal investigators (PIs), project staff, and anyone who is interested in learning more about the value and use of evaluation may access EvaluATE's library of evaluation resources. All EvaluATE resources and webinars are open-access and aim to increase the quality and utility of evaluations.

ATE evaluators can join colleagues and other ATE community members for monthly webchats to continue conversations from webinars, to discuss open topics, and to share promising practices.



Evaluation can illuminate a program's opportunities, strengths, and outcomes. Using that insight to make changes in real time allows principal investigators to adapt and grow their initiatives.



Shift to Virtual Events Leads to Positive Outcomes

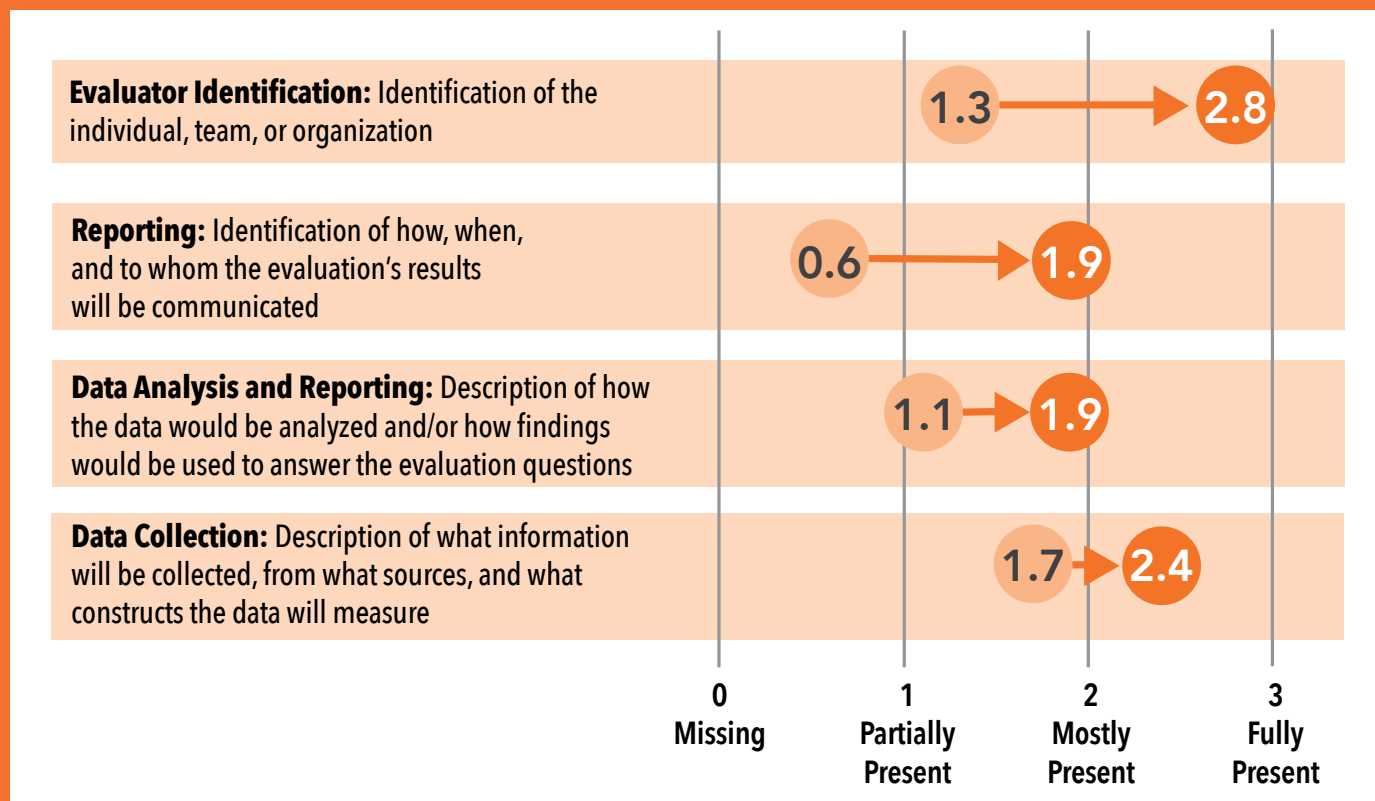
In 2020, COVID-19 made planning virtual events a priority. EvaluATE hosted a virtual networking event during the ATE-PI Conference, presented a webinar specific to navigating the unknown and to using virtual methods for data collection, continued to engage and meet the needs of stakeholders through virtual gatherings, and disseminated new and timely resources to the ATE community.

As a result, EvaluATE team members became more efficient, innovative, and engaging on virtual platforms. EvaluATE facilitated ATE evaluation conversations during its webchats in the first eight months of 2021 with 144 individuals.

"I appreciate the sense of community and the excellent resources, materials, and webinars offered by EvaluATE."

Sondra LoRe
Interim Director
National Institute for STEM
Evaluation and Research (NISER)
Knoxville, TN

Presence of Key Evaluation Elements in ATE Proposals Increase between 2004 and 2017



Through a review of 169 ATE proposals funded between 2004 and 2017, EvaluATE found that ATE evaluation plans increasingly contained key elements of quality evaluation plans. Spearman's rank correlation coefficient (ρ) was used to examine the direction and magnitude of the relationship between the ratings for each element and award year. For more info see <https://bit.ly/proposalstudy>



*Prince William Sound College
Valdez, AK*

[https://pwsc.alaska.edu/
aktechlearners](https://pwsc.alaska.edu/aktechlearners)

Key Activities

- Increases computer science instruction throughout rural Alaska
- Provides learning experiences in computer science to both high school teachers and students
- Helps teachers facilitate dual enrollment courses so students earn college credit at their high schools

Project's "Shared Teaching Model" Helps Teachers & Students

ATL provides teachers and students with an enhanced and coordinated curriculum that prepares students to enter the information technology (IT) workforce as technician-level web engineers. The "Shared Teaching Model" created by the project gives high school teachers, who may not be computer science educators, the skills and know-how to support students taking college-level software engineering courses.

ATL boosts the skills of Alaska teachers by providing semester-based and week-long learning opportunities. In summer 2021, 43 rural Alaska teachers received instruction in Computer Foundations for Teachers, Programming for Teachers, and Robots, Rockets, and Drones for Teachers. This last project was also partially funded by the Alaska Space Grant from NASA.

Each course used place-based and culturally-oriented activities to help teachers provide appropriate instruction to students who view the world through a lens based in indigenous science and knowledge. Teachers also receive guidance to help them adapt their teaching of STEM concepts for different learning styles and to enliven STEM learning.



Alaska students learn about bytes and decimal value relationships as they build binary boxes at ATL workshops.

Using Assessment as a Teaching and Learning Tool in Course-Based Undergraduate Research Experiences (EvaluateUR-CURE)



Discussions of Assessments Help Build Students' Metacognitive Abilities

EvaluateUR-CURE has identified 10 outcome categories, each defined by several discrete components. Students in the course-based undergraduate research experience (CURE) complete an assessment at the beginning of the semester to introduce them to the range of undergraduate research outcomes. Mid-semester and near its end, both the course instructor and students complete identical assessments.

Student-instructor conversations follow to discuss the reasons for any differences in scores. These conversations – which may include all the course members, research groups, or individual students – provide students with feedback about their progress and help build their metacognitive abilities.

EvaluateUR-CURE Activities Support Learning & Entry to the Workforce

EvaluateUR-CURE developed a series of short metacognitive activities that encourage students to use strategies that emphasize their strengths when conducting research. Exercises span reading comprehension, problem-solving, critical thinking, and study skills. Project data indicate that as students become more aware of metacognitive habits they are better able to troubleshoot and adjust their approaches to learning. Metacognitive skills both support education and prepare students to enter the workplace.

Features of EvaluateUR-CURE

Method uses evaluation to obtain reliable student outcome data and to inform teaching and learning.

Process introduces students to a wide range of outcomes that are critical to their success in education and the workplace.

Scoring of same assessment by both student and CURE instructor at least twice – before and after the research experience – provides reliable outcome data.

Post-assessment student-instructor conversations are designed to provide feedback to strengthen students' metacognitive skills.

EvaluateUR-CURE's features meet the needs of entire classrooms of students who conduct course-based research.



SUNY Buffalo State
Buffalo, NY

<https://serc.carleton.edu/evaluateur>

Key Activities

- Provides students with constructive feedback about their research progress and growth of understanding on well-defined outcomes that include both disciplinary knowledge and critical workplace skills
- Fosters conversations between students and faculty to enhance students' metacognitive skills and learning strategies
- Provides evaluation instruments for one- and two-semester, course-based undergraduate research experiences



*City College of San Francisco
San Francisco, CA*

[https://ate.is/
Growing-CTE-STEM-Teachers](https://ate.is/Growing-CTE-STEM-Teachers)

Key Activities

- Fosters interest in STEM through hands-on learning experiences
- Introduces teaching careers to diverse groups of community college students
- Develops and offers future and current teachers curriculum that utilizes makerspaces
- Teaches problem solving, creativity, and other Next Generation (NEXTGEN) Skills

Clever Recruitment Utilizes Makerspaces to Build Interest in Teaching

Growing CTE-STEM Teachers uses makerspaces to recruit career and technical education (CTE) teachers and STEM teachers among the general community college student population. The project's recruitment strategies focus first on what students are passionate about such as sharing new skills, helping others, addressing environmental issues, and making a difference.

It then encourages students to consider teaching through presentations and discussions, recruitment and resource materials available at the college. It also promotes teaching through direct email invitations to the virtual teacher conference and other events. The project links the need for a diverse and local teaching workforce through shared student stories and observations. In surveys, students reported they have more favorable views of teaching as a career after taking any of the five makerspace courses the project developed.

In addition to hands-on activities, the project also utilizes a multifaceted social media campaign to promote STEM teaching careers.

There is evidence that interest in teaching is growing: 2,774 people participated in Teach for the Bay, a virtual conference that project leaders organized with City College of San Francisco colleagues; and there were 24,000 views in two months of videos on www.teachforthebay.com. Workshop presenters included area colleges and San Francisco State University's Math/Science Teacher Initiative (MSTI).



The project fosters success in the makerspace and teaches NEXTGEN skills to encourage students' interest in STEM teaching.

Engaging Projects Catch Students' Attention & Change STEM Attitudes

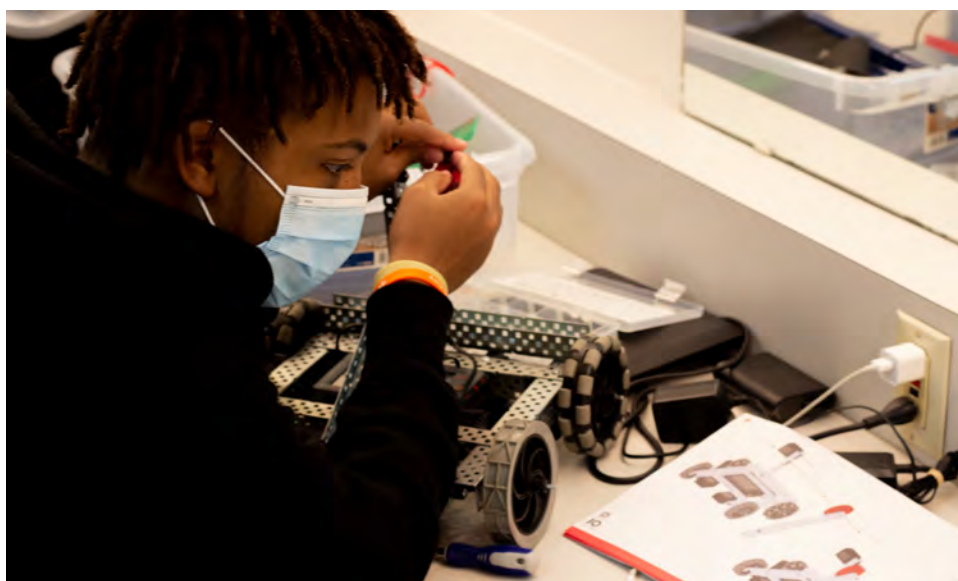
GRRATE seeks to increase diversity in the STEM technician workforce. To accomplish this, it developed a project-based course – Wide World of Science – that uses guitar-building, robotics, and rocketry to introduce students to STEM technician skills and careers.

Through GRRATE's professional development, educators learn to teach thematically by using practical examples that students find interesting and relatable. Instructors use hands-on, high-interest projects to draw student interest to technical skills such as tool literacy, computer-aided design, mathematics, and scientific reasoning. Students' attitudes about STEM skills and careers are examined through pre- and post-course surveys.

GRRATE Combines Project-Based Curriculum with Culturally Responsive Pedagogy

Project leaders recognize that many students avoid STEM technician fields because of obstacles such as stereotype threat, bias, and microaggressions that interfere with their sense of belonging. GRRATE's success stems from its utilization of project-based learning in combination with culturally responsive pedagogy.

Both techniques require a great deal of professional development, which GRRATE has provided to 11 educators. From 2019 to July 2021, these educators taught Wide World of Science to 141 students. Most were female, residents of rural areas, or from groups historically underrepresented in STEM fields.



How to read schematics is one of the many cross-disciplinary skills the GRRATE curriculum covers.



Santa Fe College
Gainesville, FL

<https://sfcollege.edu/grrate>

Key Activities

- Develops a project-based learning course to introduce students to STEM technician skills
- Leverages culturally responsive pedagogy to lead underrepresented student populations to STEM technician degrees
- Provides professional development in culturally responsive pedagogy
- Connects students with local employers through presentations and videos



Utah STEM Action Center
Salt Lake City, UT

<https://ate.is/LABS2>

Key Activities

- Assesses perceptions and attitudes influencing decision-making around career and technical education (CTE) pathways
- Creates communication strategy that is data-driven and includes social media
- Uses augmented reality and virtual reality to inform students about technical careers

Innovative Survey Gathers Info for Stakeholder Groups

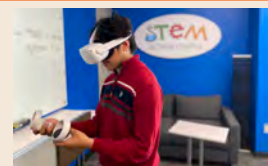
LABS2 collects data from students, parents, counselors, and educators to inform communication strategies that promote advanced technology careers. Survey questions focused on perceptions and attitudes that can influence how parents and counselors communicate the value of CTE to students. Findings have been integrated into the communication strategy, social media content to promote STEM technical careers, and augmented reality and virtual reality experiences that focus on high-demand technician careers.

The initial survey was developed based on the presumption of existing biases and negative perceptions of CTE. The key unanticipated finding was an absence of negative biases or perceptions toward CTE. The responses were not only positive, but indicated that the lack of participation in CTE was due to a vacuum of knowledge and awareness, not negative impressions.

These unexpected results prompted rethinking by the project team, which then shifted to investigate how teens choose careers. A new scenario-based survey gathers information about how students select courses. Analysis of this qualitative data identified decision-making styles common among students who choose CTE pathways.

Qualitative Survey Data Identify How Students Make Career Decisions

Decision-Making Styles Identified by Student Survey	→	Led LABS2 to Create Differentiated STEM Career Messages
43% Rational	→	Social Media Content about STEM Career Options
22% Intuitive	→	Augmented Reality and Virtual Reality Interactions that Immerse Students in STEM Workplaces
22% Dependent	→	Communications under Development
9% Avoidant	→	Communications under Development
4% Spontaneous	→	Communications under Development



Qualitative survey results prompted LABS2 to develop messages that address what matters to various types of decision-makers. n = 3,318 Students



Former Mentees Reflect on the Benefits of Mentor-Connect

Mentor-Connect provides mentoring and real-time technical assistance, as well as curated and annotated ATE-related resources for technician educators. It uses evaluation and research data to improve its initiatives. Mentor-Connect created a Mentor Fellows program to facilitate knowledge transfer from experienced mentors to ATE principal investigators who did not have mentoring experience. Data-informed refinements are developing a new generation of STEM leaders and improving the success of community college faculty applying for new-to-ATE and next-step funding.

Most community college instructors have no experience with the ATE program before becoming Mentor-Connect mentees. Their feedback informs Mentor-Connect's continuous improvement.

"Mentor-Connect was wonderful. It allowed us to get our first NSF grant. It built better connections with the community, not only the manufacturers but with the high schools Then, through my experience with Mentor-Connect, I got grant-writing experience so I was able to write other, small, community-based grants."

Sharon Gusky, Biology Professor
Northwestern Connecticut
Community College
Winsted, CT

"Mentor-Connect has had a profound and transformative experience for every member of our team."

Laurie Miller McNeill, Director
Institutional Advancement
Westchester Community College
Valhalla, NY

Mentor-Connect Results

383

Faculty Participants
(10 Cohorts from 2012 to 2022)

604

Total Mentees
(Includes Grant Writers
& Administrators)

210

Participating Colleges
in 41 States & 2 US Territories

155

ATE Proposals Submitted

94

ATE Awards to Mentor-Connect
Mentees in Cohorts 1 to 8*

* Cohort 9 submitted proposals fall 2021;
NSF announces decisions spring 2022.



Florence-Darlington
Technical College
Florence, SC

<https://Mentor-Connect.org>

Key Activities

- Mentors faculty as they develop proposals for Small Projects for Institutions New to ATE and other ATE project tracks
- Offers technical assistance for prospective grantees, grant writers, and institutions
- Provides resources about proposal development, NSF's funding process, and project start-up and implementation
- Prepares future mentors



**Asheville-Buncombe Technical
Community College**
Asheville, NC

<https://ate.is/SSGJ>

Key Activities

- Offers YouTube videos about technology and engineering careers and programs for school personnel and students
- Hosts Virtual Innovative Expo for high school personnel
- Hosts focused Zoom meetings to spark action steps
- Presents STEM career info to high school students

Project Casts Big Net Among School Influencers

For nearly two years Skilled Workers Get Jobs 2.1 focused on in-person presentations at high schools to engage students and inform school personnel about two-year technology and engineering careers. Aware that many adults influence students' career decisions, project personnel invited participation of support staff and school administrators along with teachers.

Project's COVID Pivot Creates Long-Term Outreach Resources

Project leaders' creative response to COVID challenges developed assets that ultimately served more adults and teens than would have been reached by in-person activities.

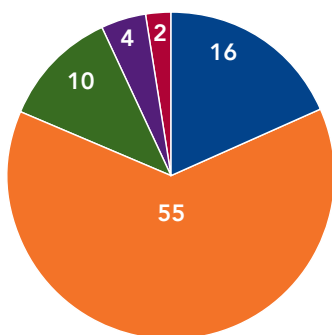
When its professional development workshop – Innovative Expo – had to move online, 100 people enrolled.

Eighty-seven attendees completed all the requirements, and 32 were invited to attend the Zoom focus groups afterward. As a result, virtual presentations were given to 13 classes with 403 students.

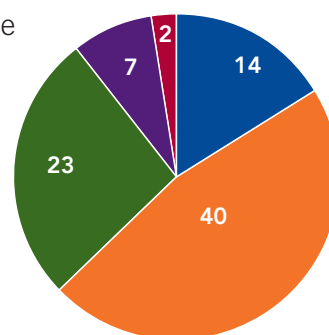
The project also created YouTube videos (<https://tinyurl.com/SkWorker2>) for school personnel, students, and parents. "Quick Bite" videos for school personnel provide helpful guidance to engage students during remote instruction. The videos are a sustainable asset that will continue to share information about STEM careers, promote science and math skills, and direct individuals to community college technician education programs.

Virtual Innovative Expo Impacts STEM Career Knowledge

As a result of watching the video(s), I have a better understanding of technology or engineering-related jobs.



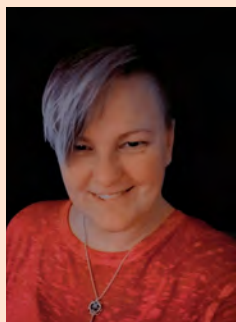
As a result of watching the video(s), I am better able to articulate what an engineer or technician does.



■ Strongly Agree ■ Agree ■ Neither Agree or Disagree ■ Disagree ■ Strongly Disagree

A majority of school personnel who participated in the project's Virtual Innovative Expo reported they gained knowledge about what technicians and engineers do and possible career paths.

ATE Alum: Kendra Joyner Gains Foothold in IT Career Through Women in Tech Club Experiences



Kendra Joyner joined Women in Tech a few weeks after starting digital media courses at Asheville-Buncombe Technical Community College (A-B Tech) in Asheville, NC.

It was 2015 and at 40, Joyner, who had previously earned one bachelor's degree and other postsecondary credentials, was in the midst of a career reset following a divorce.

Talking with other women about their STEM classes, hearing presentations by female technicians, and learning career tips during biweekly Women in Tech meetings became integral to Joyner's success. Computer Technologies Instructor Pamela Silvers started Women in Tech as part of her ATE-supported Skilled Workers Get Jobs projects that developed strategies to recruit and retain women in STEM careers.

"I wasn't young and I was a full-time student and it was not easy to sit in class with these younger students, and do everything I was trying to do," she said. Networking at club meetings and becoming a Women in Tech student ambassador boosted her confidence.

Having to do all her assignments in the college's lab because she did not own a computer was another challenge for Joyner. But her helpful replies to other students' questions led to her being offered a tech support job. Joyner continued as a part-time employee of A-B Tech's Information Technology Department after earning an associate degree in digital media technology in 2017 and an associate degree in software and web development in 2019.

A-B Tech named Joyner 2021 Part-Time Staff Member of the Year for her outstanding work during the COVID-19 pandemic when she set up socially distanced computer stations in the college's conference center and staffed a tech support chat line for faculty and students.

In 2022 Joyner transitioned into a full-time role as digital specialist and print administrator at A-B Tech.





Information and Security Technologies

<https://ate.is/info>

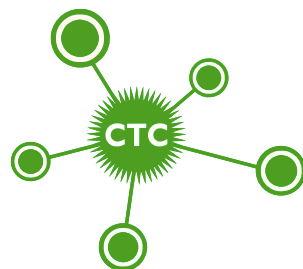




A technician manages the IT network for a suite of networking classrooms.

Virtual Version of Working Connections Attracts Many Newcomers

The annual Working Connections (WC) professional development event for faculty continues to strengthen information technology (IT) programs across the country. WC sessions cover a range of in-demand topics in sufficient detail for attendees to implement the content in their classrooms right away, either by creating a new course or supplementing an existing course.



Key Activities

- Engages with Business and Industry Leadership Team (BILT) that co-leads efforts aligning curricula to future workforce needs
- Facilitates collaboration across 86 institutions to share curricula and best practices
- Delivers comprehensive faculty professional development nationally guided by the BILT
- Leads development of regional hubs strengthening 2+2+2 transfer pathways

The COVID-19 pandemic forced Summer Working Connections to move online in 2020 for the first time. The 2021 event was virtual, too.

Going virtual vastly – and unexpectedly – expanded the program’s reach and impact. In-person Working Connections events typically average 95 attendees, but the 2020 online edition attracted 184 two-year and four-year college instructors. Sixty-six of those were “first-timers” who had never before attended the in-person event. The trend of a large ratio of newcomers continued in 2021 when 27 of 126 were first-time attendees. Consequently, future face-to-face events will likely feature an online element.



Students check one another's work in a classroom networking lab.



BILT Model Adoption Expands

CTC leverages its successful BILT model as an effective strategy to engage employers and guide colleges across the country in aligning curriculum with workforce needs. Highly engaged employer co-leaders often provide professional development for faculty, and mentoring, internships, and mock interviews for students.

CTC data indicate that BILTs deepen connections between colleges and businesses by fostering a sense of employer ownership of the program and its graduates. BILTs also ensure that educators make curriculum decisions based on information about future business needs.

Numerous positive outcomes have led to BILT model adoption by 58 colleges and organizations in 30 states. In 2020 alone, 15 colleges in the CTC's community of practice reported they either converted their business advisory councils into more engaged BILTs or created BILTs from scratch.

Both Florida State College at Jacksonville and Crowder College recently began implementing the BILT model across all of their technical workforce certificate and degree programs.

"As a member of the BILT for over 15 years, I've seen how well the process works to deepen the connection and engagement between industry and educators. The BILT model helps provide employers a wider pipeline of qualified workers and it helps deliver high-paying careers to graduates."

Vincente D'Ingianni
Director of Professional Services
Binary Systems, Inc.
Dallas, TX

Working Connections (WC) Participants' Survey Responses about Teaching New Topics

Year Attended	Total Respondents	Before WC	After WC	
		Teaching Topic	Teaching Topic	Planning to Teach Topic Soon
2018	50	18%	68%	32%
2019	83	12%	49%	51%
2020	124	9%	48%	52%
Totals	257	12%	52%	48%

The vast majority of educators who attend Working Connections not only select sessions on IT topics that they are not already teaching, but they quickly incorporate Working Connections content in their lessons or plan to add it soon.



GeoTech's curriculum prepares students to use geospatial technologies in a wide array of industries.

Key Activities

- Provides high quality professional development programs
- Creates model courses and concept modules
- Develops skill standards such as the Geospatial Technology Competency Model used by the US Department of Labor
- Offers the Geospatial Educator Certification Program



GeoTech Center

National Geospatial Technology Center of Excellence

Switch to Virtual Programs Works to GeoTech's Advantage

In response to COVID-19 GeoTech shifted all of its professional development to virtual formats while maintaining the signature components

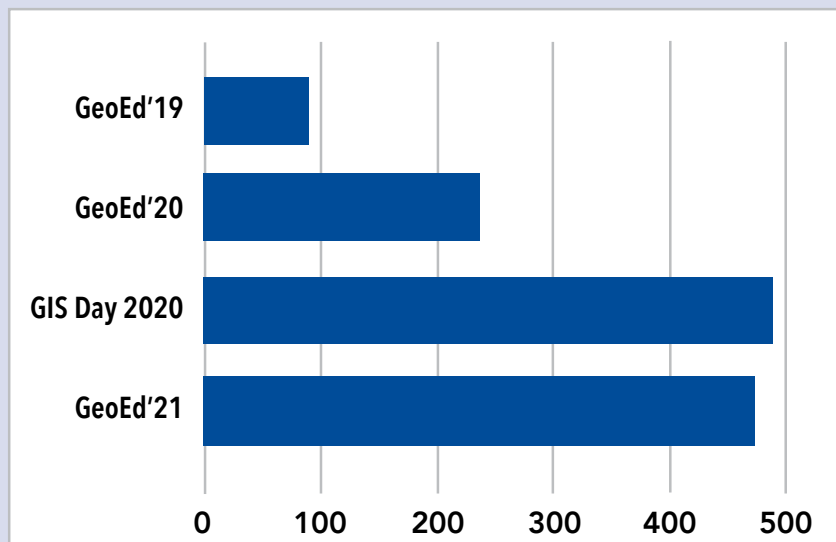
of its programs: nationally recognized speakers, up-to-date technical content, networking opportunities, and award presentations.



The results have been extremely positive, especially for GeoEd, the center's annual conference. In 2021 it had 475 registrants – hundreds more than the in-person meetings ever had – and almost an equal number of men and women from 48 states and 40 countries.

By utilizing synchronous and asynchronous delivery, offering some presentations in Spanish, and adding other features to serve more diverse audiences, GeoTech attracted nearly 500 registrants to its 2020 GIS Day program.

Registration Data for Annual GeoTech Professional Development Programs



Registrations for GeoTech's annual GeoEd Conference increased significantly in 2020 and 2021 when it was offered virtually due to COVID-19. Even more people registered for GeoTech's first virtual GIS Day program in 2020.

GeoTech Unifies Geospatial Education across Industry Sectors

GeoTech is the unifying voice in the field of geospatial technology education and works across numerous industry sectors – from cartography to remote sensing to geospatial analysis. The center creates dynamic geospatial curricula across all sectors while maintaining a presence in the unmanned aircraft systems (UAS) sector.

In its role as a developer and disseminator of skill standards for geospatial technicians, GeoTech has collaborated with numerous educational organizations, government agencies, and both nonprofit and for-profit organizations. These partnerships have led to several memoranda of understanding and informal working relationships. Two of the most recent are between GeoTech and the UAS component of the Federal Aviation Administration (FAA) and the Nature Conservancy.

The FAA and GeoTech have worked collaboratively to create an online dashboard that includes information about UAS programs across the US at community colleges and universities. GeoTech keeps the site operational and periodically updates information about the various programs.

GeoTech's partnership with the Nature Conservancy involves team members working together to incorporate scientific data and real-world case studies in courses.

"The GeoTech Center has created and continues to produce and update unsurpassed standards, content, and tools specifically designed for geospatial educators, thus dramatically elevating the expectations and career pathways outcomes of stakeholders in the Commonwealth of Kentucky as well as the nation."

Demetrio P. Zourarakis
GIS & Remote Sensing Analyst
Frankfort, KY



Following protocols covered in GeoTech's curriculum, students prepare for a UAS test flight.



National Cyber League competitions sharpen students' teamwork skills while exposing them to time-sensitive tasks in high-stakes environments.

Key Activities

- Leads the shift toward a competency-based mastery learning (CBML) curriculum for cybersecurity technicians
- Utilizes evidence-based technologies to revamp cybersecurity education
- Partners with industry, academia, and government agencies to strengthen the cybersecurity workforce



NCC

National CyberWatch Center

NCC Creates More Virtual, Social, Collaborative & Adaptive Learning Opportunities

At NCC the pandemic sparked disruptive innovations. The center's leaders accelerated implementation of evidence-based technologies and learning science practices. The center became particularly focused on the use of learning analytics to create more virtual, social, collaborative, and adaptive learning opportunities.

NCC innovations include developing instructional design methods that facilitate the transition to competency-based, mastery learning courses that resulted in dramatic gains in students' proficiency; shifting from content-based and instructor-centered teaching systems to practice-based and student-centered learning systems that increase student engagement; and reinventing the annual Community College Cyber Summit to facilitate peer-to-peer learning. At the 2019 summit, presentations were followed by focus groups where conversations about the topic continued among participants. This professional dialog continued in 2021 via NCC groups on social media outlets.



NATIONAL
CYBERWATCH
CENTER

"I am very impressed with the content and offerings at CyberWatch. It's very helpful to have access to info from the academic community on 'best practices' as we build up our program."

Bob Burke
Associate Director
Cybersecurity Education &
Research Center
Howard University School of Business
Washington, DC



NCC partners with numerous national organizations to increase diversity in both academic and workforce settings.

NCC Leads Competency-Based Curriculum Revisions That Raise Capabilities of Cybersecurity Workforce

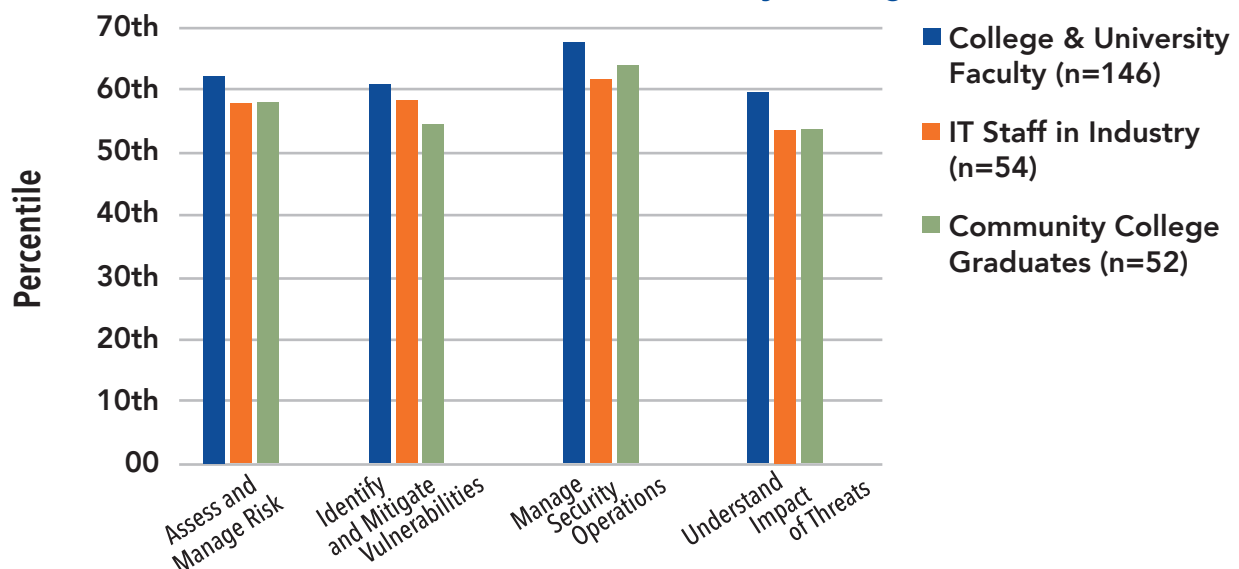
NCC has led the shift toward a competency-based mastery learning (CBML) curriculum that research shows dramatically increases student readiness to develop the skills required to succeed in a cybersecurity career. The CBML Curriculum Standards Panel program involves hundreds of subject-matter experts to identify the proficiency and competency requirements for a certificate program in cyber foundations. This stackable certificate provides the opportunity to master more than 2,500 concepts.

National CyberWatch Center has mapped the CBML curriculum to multiple workforce frameworks from the National Initiative for Cybersecurity Education (NICE) to the Occupational Information Network (O*NET) to industry-specific job specifications. This research established the capability profiles and underlying knowledge, skills, and abilities required to perform the cybersecurity-related jobs with the highest number of current and projected job openings.

Industry has found the CBML assessments have eliminated bias and broadened participation. The 2020 NCC Member Survey found 61% of the 310 member colleges and universities incorporated NCC curricular resources into their cyber-related degree programs.

In sum, NCC is establishing evidence-based practices that raise cybersecurity capability maturity that is critical to closing the skill gap threatening our national security and prosperity.

National Comparison of Cybersecurity Skills of Educators, IT Workers & Recent Community College Graduates



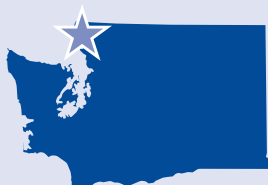
Recent community college graduates' cybersecurity skills are on par with experienced information technology workers and not far behind college and university cybersecurity instructors in a national study by NCC's Raise the BAR (Behaviorally Anchored Ratings) program. The chart shows the average percentile for each group.



Cybersecurity instructors access curricula and teaching resources at NCyTE's one-stop repository for cybersecurity education.

Key Activities

- Expands cybersecurity education pathways
- Develops and implements leading-edge curricula
- Cultivates industry engagement and career opportunities
- Supports faculty and leadership development in cybersecurity education



NCyTE

National Cybersecurity Training and Education Center

New Secondary Education Pathway Supports Future Workforce

NCyTE partnered with CodeHS to develop a new Advanced Placement® high school curriculum. AP Computer Science Principles: Cybersecurity is a College Board-endorsed introductory course that melds computer science and cybersecurity. Exposing high school students to cybersecurity concepts will promote more secure coding and support more students entering this field. The web-based curriculum is available at https://codehs.com/course/ap_csp_cyber/overview

NCyTE CENTER

NCyTE Sponsors National Cybersecurity Virtual Career Fair

NCyTE sponsors the National Cybersecurity Virtual Career Fair in partnership with the Centers of Academic Excellence (CAE) community. This event connects thousands of cybersecurity students and alumni from CAE-designated institutions with internship and employment opportunities. In 2021, nearly 1,400 students and graduates attended the career fair, meeting with employers from 51 organizations.



NCyTE's curricula incorporate cybersecurity concepts in college information technology and networking courses.

NCyTE Faculty Membership Benefits Students

NCyTE's educational membership has grown from 33 colleges in 2013 to more than 330 educational institutions including high schools, community colleges, and universities in December 2021. Access to NCyTE's up-to-date resources has led to better-developed educational programs that provide students with the skills they need to enter the cybersecurity workforce of tomorrow.

NCyTE's members have access to a wide variety of valuable materials and opportunities. Faculty members receive invitations to professional development webinars, workshops, and networking events; access to leading-edge curricula and program creation tools; and assistance building internship programs. NCyTE-sponsored networking events help educators keep up with rapidly evolving cybersecurity skills and knowledge in their region and facilitate collaboration on shared workforce development goals.

New Workshops Help Faculty Create Courses to Meet Emerging Needs

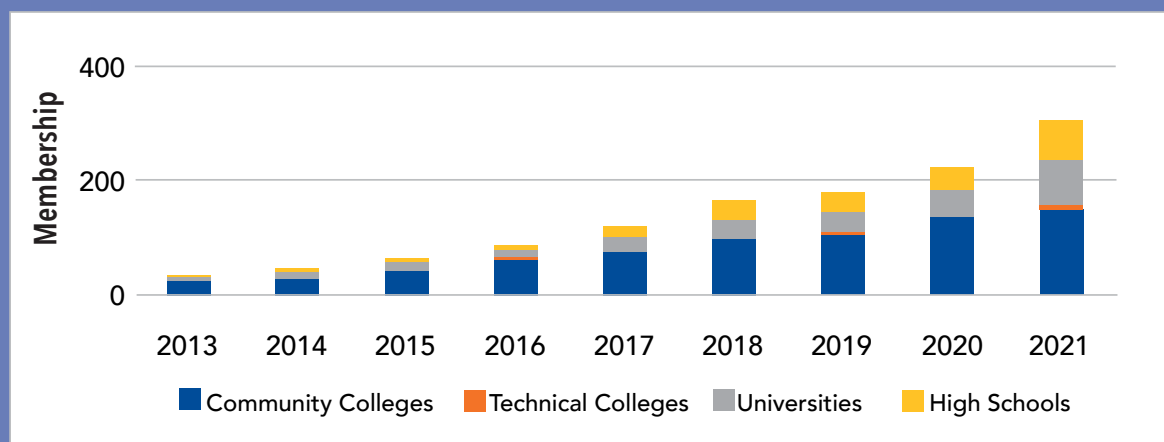
In 2021, NCyTE conducted four online workshops on the Cybersecurity Maturity Model Certification (CMMC) framework for nearly 100 community college instructors. This framework unifies the cybersecurity standards the Department of Defense (DoD) requires its 300,000 contractors to meet.

NCyTE's workshops provide an overview of DoD's methodology. They also cover how to provide students with the knowledge and skills they need to enter vital positions in various industries. The workshop materials are available to download, for free, on the NCyTE website.

"NCyTE's rapid growth to a national program will ensure that the next generation of cybersecurity professionals is ready and available to protect national and economic threats. I have confidence that this program produces more quality graduates capable of meeting the demanding challenges in cybersecurity and to fill the increasing demand for qualified candidates."

Darren Alleyne
Enterprise Cybersecurity Architect
Lockheed Martin Space
Sunnyvale, CA

NCyTE Membership by Year



NCyTE member institutions receive access to leading-edge curricula, professional development opportunities, networking events, and program-building assistance.



*Miami Dade College
Miami, FL*

<https://www.mdc.edu/entec/grants/compass.aspx>

Key Activities

- Builds the capacity of community college and high school educators to teach cybersecurity courses
- Integrates industry credentials into college curricula
- Recruits underrepresented populations to cybersecurity degree programs and facilitates their persistence
- Offers summer camps for high school students

Cybersecurity Camps Lead to Dual Enrollment & Industry Credentials

COMPASS increases diversity in the cybersecurity workforce by providing students with opportunities to earn both cybersecurity industry certifications and college credit in associate degree programs simultaneously.

In preparation for the 2019 launch of the associate in science (AS) cybersecurity degree program, COMPASS facilitated four Miami Dade College faculty members' earning of 11 industry credentials and more than 30 high school educators' earning of one industry credential each.

A free cybersecurity summer camp for high school students is the key recruitment vehicle COMPASS uses. In 2019, 52 of the 60 students – all from populations underrepresented in STEM careers – who participated in the camp enrolled in dual enrollment courses in the fall; 36 earned a cybersecurity industry credential.

COMPASS Results Since 2018

63

Students Enrolled in AS Cybersecurity in 2019-20

262

Students Enrolled in AS Cybersecurity in 2020-21

91%

of Students Are from Populations Historically Underrepresented in STEM

222

Students Earned Industry Credentials

35

High School Instructors Attended Cybersecurity Workshops

60

High School Students Attended Cybersecurity Summer Camps

52 of 60

Campers Became Dual Enrollment Students



ATE Alum: Elias Marcet Uses Cybersecurity Skills on the Job Prior to Graduation

Elias Marcet is a star of the cybersecurity program started by COMPASS. In 2021 Marcet was Florida's New Century Workforce Pathway Scholar. In 2020 he led a five-student team that placed second in a national hackathon.

While completing his cybersecurity degree at Miami Dade College, Marcet was hired as an information technology technician at an Amazon Pharmacy. There he supports fulfillment center users and programs robotic equipment.

CyberSecure: Extended Cybersecurity Education, Curriculum and Workforce Development

Featured ATE Project



Project Teaches Cross-Discipline Cybersecurity Skills

CyberSecure introduces cybersecurity concepts to students majoring in criminal justice, accounting, hospitality and tourism, allied health, and electronics. The project developed interactive, hands-on instructional modules and instructed faculty in multiple disciplines about how to incorporate cybersecurity concepts into their courses that prepare technicians for a wide range of careers.

The basic concepts covered in the modules complement the informal lessons that dual enrollment students – a key CyberSecure audience – learn during cybersecurity competitions.

Students who wish to pursue additional studies in cybersecurity are provided with paid internships.



For their capstone projects, ABIT students present their start-up business plans, which must incorporate cybersecurity elements.



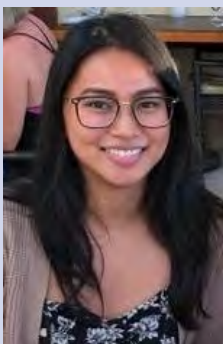
University of Hawaii Maui
College
Kahului, HI

<https://ate.is/CyberSecure>

Key Activities

- Implements multidisciplinary cybersecurity education and workforce development initiatives
- Fosters interdisciplinary collaboration
- Creates engaging cybersecurity education modules

ATE Alum: Leslie Ramos Completes Two Cybersecurity Internships & Presents Research at Professional Conference



Leslie Ramos distinguished herself by completing several outstanding cybersecurity projects in the process of completing her bachelor of applied science degree in the Applied Business and Information Technology (ABIT) program in 2021.

With support from the CyberSecure project, she completed two internships. During the first internship at the university, she created a primer and demo instructional tool on lock-picking techniques. Ramos also wrote a research paper about the privacy and confidentiality issues of COVID-19 contact tracing apps and presented the paper at the 2021 Hawaii International Conference on System Sciences.

During her second internship she conducted a cybersecurity audit at the Pacific Disaster Center.



Wake Technical Community College
Raleigh, NC

<https://ate.is/DCTAPTA>

Key Activities

- Provides faculty externships
- Offers new certificates and four new courses, which prepare students for jobs in the simulation or game development industry
- Teaches students in a state-of-the-art motion capture and photogrammetry studio
- Provides student internships
- Recruits underrepresented populations

New Courses Teach High-Demand Skills for Game Developers

Educating students to use the high-demand technologies of tech art and photogrammetry gives them the advantage of advanced skill sets as they begin game-development careers. Wake Tech's proximity to game industry giants Red Storm Entertainment, Ubisoft, and Epic Games offers additional opportunities for students to find their dream jobs.

Project Provides Faculty Externships & Student Internships

Epic Games and RTI International supported the grant by hosting faculty externships. During the externships the project's senior personnel and the co-principal investigator learned and practiced the skills that students need to be hired for game development positions. Knowledge gained during the eight-week externships informed the creation of new courses. Ongoing communication with trainers helps project personnel keep abreast of industry trends.

DCTAPTA uses ATE support to fund on-campus internships. Students who complete one or more of the new courses are eligible for paid internships to create training simulations for college departments. This opportunity gives students real-world experience and portfolio material. It also provides the college with virtual training modules that can be delivered in-person and in synchronous or asynchronous online environments.

A student photographs an artifact for a three-dimensional (3D) game asset and then uses Reality Capture to clean up the model before importing it into a game engine.



Competency-Based Curriculum Improves Outcomes

HHF developed a competency-based curriculum that provides students with improved learning efficiency through hands-on activities and mastery-based assessments.

Learning contracts between students and faculty result in more positive outcomes. Project data indicate that faculty success-coaching, coupled with CBML teaching materials – that have been translated from outcomes-based education – are increasing student engagement, confidence, and learning. Additional course time and instructional support also contribute to increased learning.



Harford Community College
Bel Air, MD

<https://ate.is/HHF>

Key Activities

- Adapts two essential courses that lead to industry cybersecurity certifications into competency-based mastery learning (CBML) that accelerates, broadens, and improves student learning
- Delivers supplemental learning opportunities that extend beyond course materials to address specific issues and misunderstandings
- Provides solutions for sticking points in students' learning

Results of the Knowledge Depth Analysis

Topics	First Attempt		Last Attempt		Knowledge Depth Index
	Accuracy for Correct Choices	Accuracy for Incorrect Choices	Accuracy for Correct Choices	Accuracy for Incorrect Choices	
Confidentiality, Identity, Availability Triad	71%	34%	83%	69%	3.04
Access Controls	81%	45%	88%	73%	3.74
Cryptography	75%	33%	88%	63%	2.33
Testing, Engineering, and Operations	79%	30%	86%	53%	3.28

n=30

The Knowledge Depth Index is a psychometric measure developed for HHF. It presumes that a master cannot only recall correct answers, but can determine when an answer choice is incorrect. The index uses a 0 to 5 scale to report the change in accurate recognition of incorrect answer choices over the change in accurate recognition of correct choices.

ATE Alum: Christopher Kim Becomes Cyber Range Instructor



In two years Christopher Kim went from a low-skilled position in a grocery store to teaching at the Baltimore Cyber Range (BCR) with the skills he learned in the information assurance and cybersecurity program at Harford Community College.

Kim was a student in the pilot of the CBML-version of the Fundamentals of Network Security course. He embraced the project's goal of students gaining mastery and participated enthusiastically in study sessions, a summer enrichment workshop, and cybersecurity exercises at BCR.

By the time he graduated in December 2020 with an associate degree, Kim had also earned a cyber defense certificate from the college and two industry certifications.



Collin College
Frisco, TX

<https://itskillstandards.org>

Key Activities

- Collaborates with information technology (IT) industry subject-matter experts (SMEs) to develop future-facing skill standards for the most critical job clusters
- Disseminates IT skill standards to educators, employers, and state agencies

Skill Standards Respond to Rapid Workplace Changes

Skill standards provide a blueprint for both how technical knowledge and skills are organized and how specific jobs contribute to the success of an enterprise. Skill standards make careers more accessible to students and employers alike by providing transparency of the necessary workplace knowledge, skills, and abilities (KSAs) and the performance needed for success in the job market. These tools are particularly important in high-performing, rapidly-changing industries like IT.

Educators use skill standards to create curriculum that is relevant and future-facing to better prepare students to meet employers' job requirements. Employers use skill standards to better address their current and emerging company needs by strengthening internal training and development and by improving job postings to attract the most qualified candidates.

The process for developing the IT Skill Standards has included close collaborations with other organizations, like the National Institute of Standards and Technology and the Department of Labor, that also create skill standards. These collaborations are creating a common language and providing opportunities to better connect and leverage all of that work.

Employers Inform Future-Facing Skill Standards to Prepare Right-Skilled Workers



After identifying six high-demand IT job clusters, thought leaders suggested the project focus on five IT skill sets used across all disciplines.

Colleges Launch Data Science Programs that Respond to Industry Needs

Mentoring New Data Pathways strengthens the capacity of community college faculty to design and launch new data programs that prepare data practitioners with the middle-level skills that are essential to data and artificial intelligence teams working across all industry sectors. Drawing on Creating Pathways to Big Data Careers, a previous ATE project, faculty at Bunker Hill, Sinclair, and Normandale community colleges are guiding mentee colleges in the use of EDC's Data Pathway Development Process. The process develops data science programs aligned with industry skill demands.

Project Facilitates Robust Community of Practice

To encourage information exchange from partner colleges to the colleges exploring new data science programs, project partners established an online community of practice. It meets monthly for facilitated discussions and grew to 40 members at 25 institutions during 2021. The community's expansion reflects the increased national focus on data education. It also indicates the increasing demand for data programs at two-year colleges and underscores the usefulness of the Data Pathway Development Process developed with ATE support.



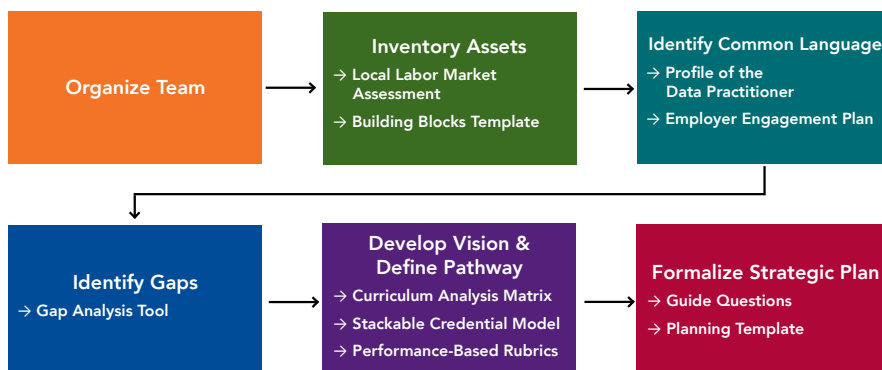
Education Development Center
(EDC) Oceans of Data Institute
Waltham, MA

<https://go.edc.org/ODI-DataPathways>

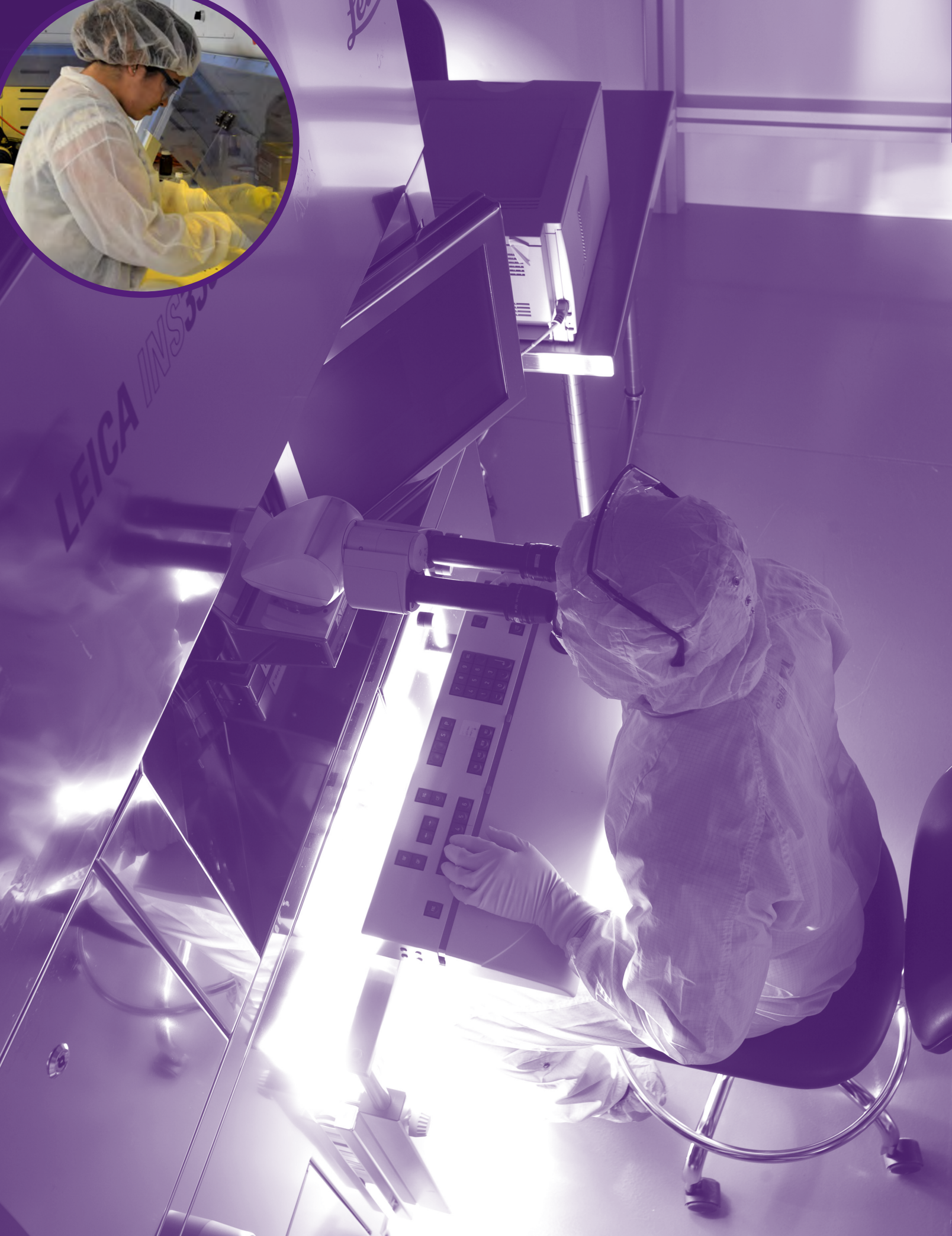
Key Activities

- Establishes a mentorship model guided by the Data Pathway Development Process
- Incorporates tools to engage local industries and align college curricula with skill demands for a middle-skilled data practitioner
- Engages additional colleges in a vibrant, online community of practice

Data Pathway Development Process

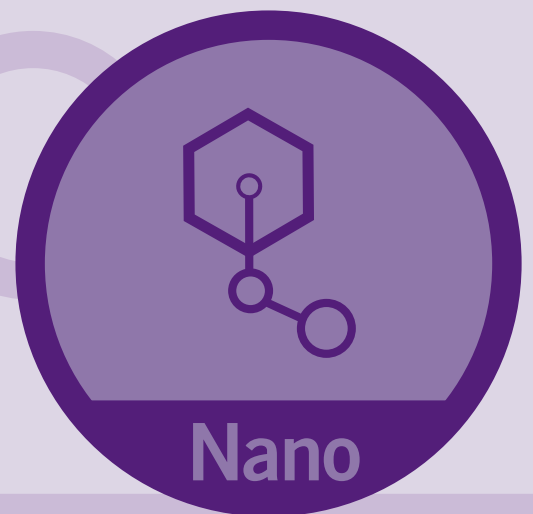
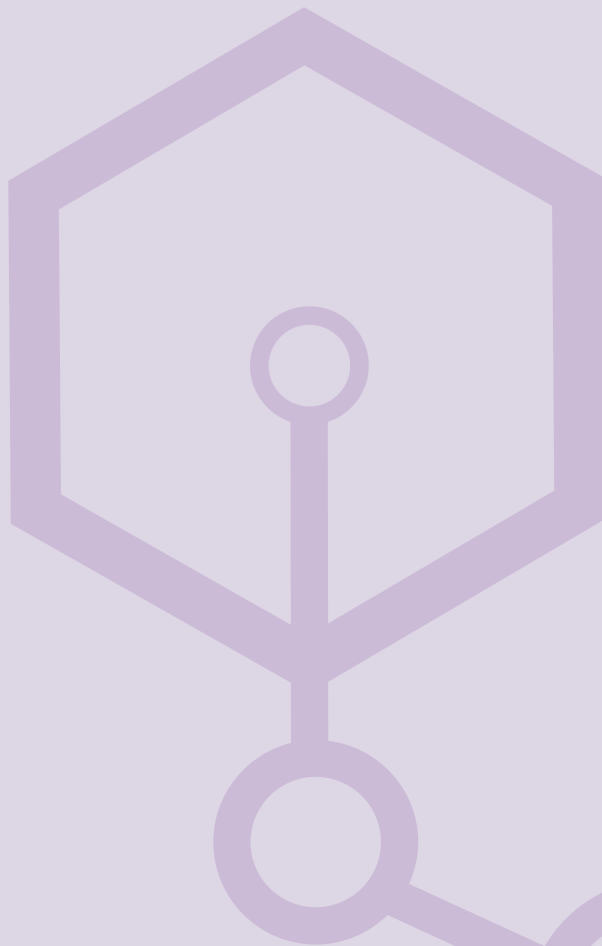


The process helps educators design and launch data science programs that teach the middle-level skills used by data and artificial intelligence teams in all industry sectors.



Micro and Nanotechnologies

<https://ate.is/nano>





Students participating in an MNT-EC-sponsored summer research experience make microneedles in a cleanroom.

MNT-EC

Micro Nano Technology Education Center

MNT-EC Launches First MNT BILT

MNT-EC established the first MNT business industry leadership team (BILT). With guidance from the National Convergence Technology Center, MNT-EC designed its BILT to prioritize the

knowledge, skills, and abilities that technicians should have upon graduating from a program. The BILT team will also inform the MNT academic community about future industry trends. The goal of this effort is to help community college faculty across the country prepare MNT technicians for careers in fast-evolving industry sectors.



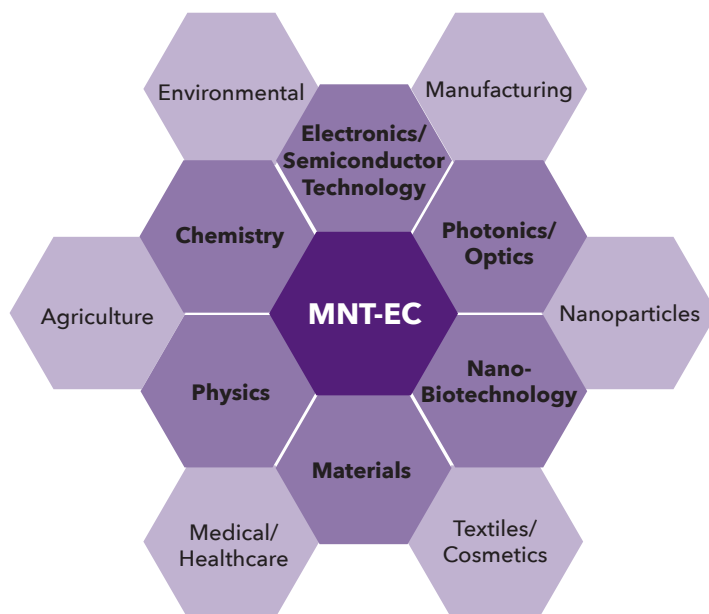
Key Activities

- Provides hands-on professional development activities, both in person and online
- Fosters collaborations within micro and nanotechnology (MNT) community to establish best practices
- Publishes *Journal of Advanced Technological Education* with other ATE centers
- Broadcasts *Talking Technicians* podcasts that feature MNT technicians discussing their careers

Center Leaders' Mentoring Assists New ATE Projects

Center leaders mentor community college MNT faculty as they prepare ATE proposals. They use a co-mentoring process developed with Mentor-Connect, another ATE project. All five faculty teams that MNT-EC mentored in 2020 were awarded ATE project grants in 2021.

MNT-EC Focuses on Workplace Convergence of Disciplines



MNT-EC facilitates educator and industry interactions for multidisciplinary programs in semiconductor technology, photonics, and nano-biotechnology. It also promotes micro and nanotechnology careers in chemistry, physics, and materials science.



MNT-EC Ramps Up Professional Development

MNT-EC's first year of operations coincided with the COVID-19 pandemic. To fulfill the center's mission and help MNT faculty, center leaders quickly developed online webinars instead of in-person professional development workshops. In its first 12 months, the center offered more than 20 online webinars on micro and nanotechnology topics. Topics included "Equity in STEM" and "Mentoring with a Co-Mentoring Model." All MNT-EC workshops can be accessed from the center's YouTube channel.

The webinars were well attended and well received by educators. In post-webinar surveys participants praised the quality of productions, diversity of topics, and inclusivity of participants who shared different skills and abundance of information. Many respondents stated that had the workshops been in person, they would not have been able to attend.

To provide more accessible and impactful workshops and seminar experiences, MNT-EC plans to offer asynchronous professional development modules for faculty. In the future, educators will need to complete modules to become eligible for paid hands-on workshops at the center's partner sites in different regions of the nation. The modules will be disseminated through the MNT-EC Professional Development Portal.

"Mel Cossette and Greg Kepner along with Jared Ashcroft and Elaine Johnson provided phenomenal guidance and expertise in facilitating a successful submission to NSF's ATE request for proposals. They were instrumental in addressing the key aspects of what the reviewers were looking for in a promising submission."

Kenie Moses
Chair of Engineering & Technology
Southern University at Shreveport
Shreveport, LA



MNT-EC leaders coached these Pasadena City College students who won the National Science Foundation's 2021 Community College Innovation Challenge for their proposal to use a nanoparticle of silver wrapped in gold for cancer treatment. The winning team members were (from left to right) Kirk Dolar, Richard Luu, Sophia Ibarguen, and Kit Cheung.



A technician guides a student who is learning to operate the field emission scanning electron microscope in NACK's teaching cleanroom.

NACK

Nanotechnology Applications and Career Knowledge
Resource Center

Redesigned Programs Bring Nano Info to Larger Audiences

Faculty workshops were redesigned to give instructors the opportunity to choose their attendance mode. Designed for both synchronous and asynchronous learning, the Intro to Nano Workshop and the Nano-Educator's Seminar Series (NETSS) give educators access to a vast library of resources that can be modified to fit their needs.

The Intro workshop was restructured to be more relevant to K-12 educators, along with community college educators. Fifty-three people attended the January 2021 workshop – a 250% increase from the average attendance of 15 at five workshops held from 2018 to 2020.

NETSS attendance has gone up about 70% from an average attendance of 16 at six sessions offered from April 2018 to May 2020 to 27 at eight sessions offered in the first six months of 2021. The seminars provide in-depth looks into nanotechnology topics such as deposition, wave-based characterization, microelectromechanical systems, and nanomedicine.



"While finishing the Nanofabrication Manufacturing Technology Program [capstone at Penn State], I was able to interview with a few companies. The program really helped set me on a path upwards, so I'm grateful for my time there."

Dylan Huska
Metrology Engineer
Northrop Grumman
Linthicum Heights, MD

Key Activities

- Creates internationally recognized nanotechnology skill certificates
- Implements partnerships for nanotechnology workforce development programs, particularly for military veterans and other populations underrepresented in STEM
- Promotes use of the Remotely Accessible Instruments for Nanotechnology (RAIN) Network
- Broadens nanotechnology educational resource dissemination



A student learns about low-pressure chemical vapor deposition in the hands-on portion of NACK's workforce development program.



New Program Prepares Military Veterans & Their Families for Nano Careers

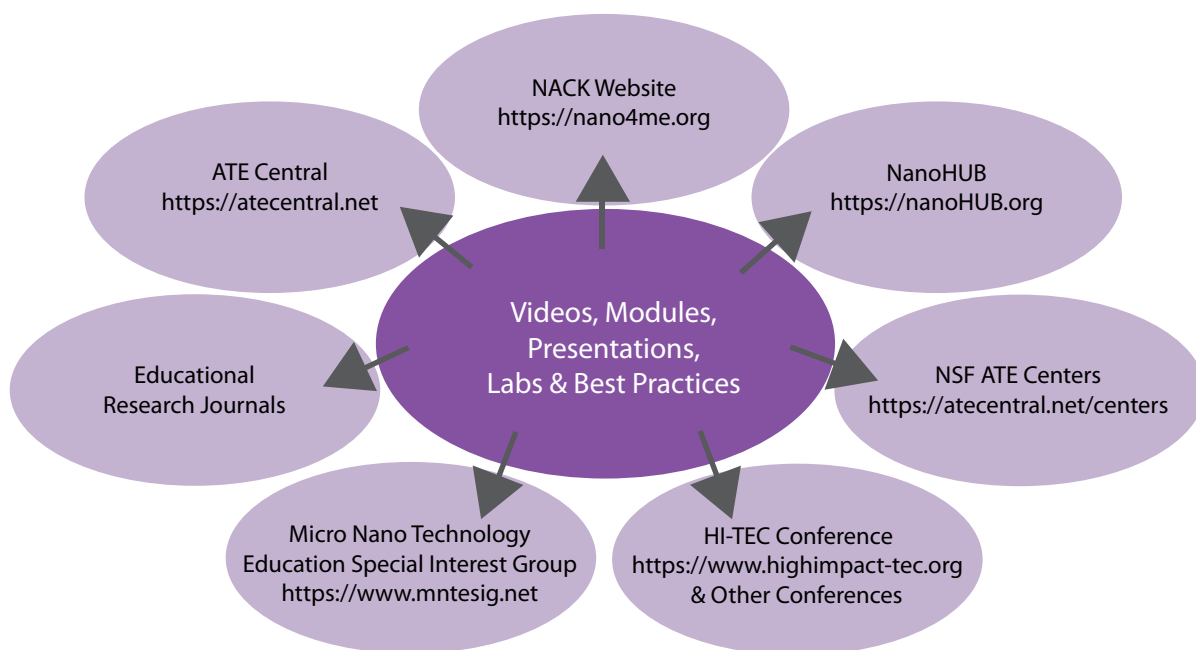
NACK partnered with Tidewater Community College (TCC) and Norfolk State University (NSU) to provide the Department of Defense SkillBridge-approved Nanomanufacturing Certificate Program for military veterans, transitioning military personnel, and their families. This program is based on NACK's Nanotechnology Manufacturing Technologies partnership with universities and community colleges in Pennsylvania and Maryland.

The program provides these military-affiliated populations, which have historically been underrepresented in nanotechnology, with hands-on exposure to nanofabrication manufacturing and characterization technology. Learning these skills helps individuals gain entry to modern industry positions, including openings in the growing semiconductor manufacturing market. The program also prepares individuals to obtain stackable nanotechnology certificates from ASTM International.

The program utilizes the strengths of academic institutions and their industry partners. NACK's personnel provide live-stream lectures and selected labs. NSU provides hands-on laboratory instruction in the Micron-NSU Nanofabrication Cleanroom. TCC provides continuing education credit and academic counseling. Industry partners introduce students to various career opportunities via presentations by company leaders.

The results of this initiative are so promising that NACK is developing partnerships with other colleges and universities to launch similar programs at military facilities near them.

Outlets for NACK Workshop Materials



More than 39,000 users accessed the materials on nanoHub from September 2020 through August 2021; there were more than 4,500 downloads from nano4me.org during that 12-month period.



Technicians load 300mm Front Opening Universal Pods (FOUP) onto a tool at SUNY Polytechnic Institute's semiconductor fabrication facility.

NEATEC

Northeast Advanced Technological Education Center

NEATEC Expands Internship Program

In spring 2021 NEATEC expanded its cleanroom technician internship program in partnership with NYCREATES, a research and



Northeast Advanced Technological Education Center

development and economic development organization. Seven interns from Hudson Valley Community College and Fulton Montgomery Community College were placed in 14-week, paid internships as process operators in NYCREATES' 300mm silicon wafer cleanroom in Albany, NY. Four interns' skillful operation of state-of-the-art semiconductor process equipment led to their full-time employment by NYCREATES.

In fall 2021 NEATEC expanded its internship program with AIM Photonics, a Manufacturing USA institute. NEATEC community college interns are expected to start in AIM Photonics' testing and packaging facilities by summer 2022.

Key Activities

- Disseminates lecture, lab, and online content to community colleges in the Northeast US
- Oversees paid internship programs in micro and nanotechnologies
- Provides professional development for community college and high school faculty in micro and nanotechnologies
- Offers advanced manufacturing workshops to incumbent technicians at chip manufacturers



An instructor guides students learning about radio frequency thermal plasma during a NEATEC workshop.





Vacuum & Plasma Instructional Materials Strengthen Region's Skilled Technical Workforce

Two community colleges are using educational assets created by NEATEC to teach vacuum and plasma technologies in response to skilled technical workforce needs in Upstate New York. Hudson Valley Community College in Troy, NY, is using NEATEC training systems and curricula to support its semiconductor technician programs. Mohawk Valley Community College in Utica, NY, is likewise utilizing NEATEC's vacuum and plasma system designs and curricula for its programs to support Cree Inc.'s new Wolfspeed silicon carbide fabrication facility in Marcy, NY.

NEATEC Boosts New Apprentices' Skills

NEATEC is deploying its 40-hour Advanced Workmanship Training curriculum to Hudson Valley Community College to provide training for a new apprenticeship program with GlobalFoundries in Malta, NY. Apprentices at GlobalFoundries' fabrication facility will receive this training in addition to the Hudson Valley Community College courses they attend online.

New Program Eases Military Veterans' Transition to Semiconductor Manufacturing Careers

Building on its education program at the US Army's Fort Drum near Watertown, NY, NEATEC developed VET STEP, which stands for Veteran Semiconductor Training & Experience Program. It combines hands-on technician instruction with on-the-job internships at regional employers. With an anticipated start in 2022, it will streamline veterans' transition from the military to careers in semiconductor manufacturing.

"Working as a workstation operator was a key factor in deciding that I want to continue an education in chip manufacturing. The internship not only expanded upon my understanding of how work is done in a fab, but also opened up brand new concepts from experience that one just can't grasp from a book. The internship wasn't only transporting FOUPs, it was also a practice of management skills with SiView [wafer processing system] and vigilant study."

Joshua Peck
2021 Graduate
Hudson Valley Community College
Student, SUNY Polytechnic Institute
Albany, NY

NEATEC Outreach Services in 2021

Education Kits for 210 High School Students

Professional Development for 81 High School Educators

Training for 60 GlobalFoundries Cleanroom Technicians

In addition to its college programs, NEATEC supplies nanotech education kits to high school students, provides professional development to educators, and educates entry-level technicians.



An Ivy Tech student loads a wafer into a sputter deposition tool to create a micro-pressure sensor during an SCME undergraduate research experience.

COVID Response Leads to Higher-Level Collaborations

COVID-19 served as a catalyst for SCME and its partners to improve their online instruction, meeting planning, and presentation skills. Everyone in the micro and nanotechnology (MNT) community across the US saw colleagues more often via videoconference calls and became better acquainted.



In the early months of the pandemic, SCME convened its annual MNTeSIG conference online rather than in person. With 140 people participating, attendance at the 2020 virtual conference was more than double the 62 who attended the 2019 in-person meeting.

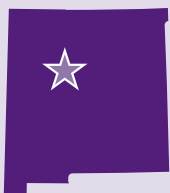
By spring of 2021, SCME and the micro-nano community of educators were ready for a more interactive online conference. Sixty people attended MNTeSIG Live! 2021. The unique feature of this two-day meeting was a virtual poster session. The poster presenters were 14 students and one faculty member who participated in SCME undergraduate research experiences. The presenters were given virtual reality headsets to facilitate their interactions with the students and the educators who attended the session. In surveys, attendees reported the session was both informative and fun.

Key Activities

- Provides undergraduate research and professional development for students with their instructors during week-long, hands-on cleanroom experiences
- Offers online short courses, educational materials, and hands-on kits
- Leads the Micro Nano Technology Education Special Interest Group (MNTeSIG.net) and annual conference
- Supports integration of microsystems and biotech education



Ivy Tech students and faculty learn together in the University of New Mexico's Manufacturing Training and Technology Center cleanroom during SCME's summer research experiences.



Center Provides Cleanroom Learning & Research Experiences

An area of burgeoning high impact is the center's undergraduate research experience initiative. This program restarted in summer 2021 with 14 community college students and nine educators traveling to learn in the university's cleanroom. The weeklong sessions were short, intense versions of semester-long lab courses.

Among the outcomes from their time learning in the cleanroom with guidance from university researchers were pressures sensors, which participants fabricated using newly acquired microelectromechanical process skills. The students were encouraged to take the sensors on job interviews so they could explain the tools and processes they used to create them.

SCME Facilitates Industry & Educator Connections

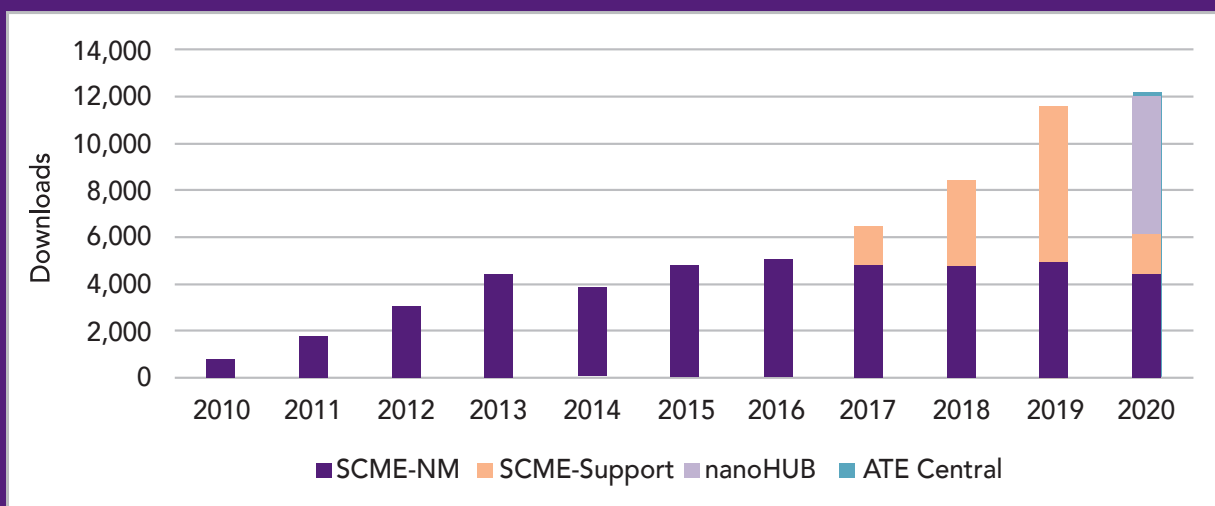
As a support center, SCME assisted the Micro Nano Technology Education Center (MNT-EC), a new Advanced Technological Education (ATE) center that started in 2020. SCME leaders helped coordinate meetings and actively recruited several SCME industry advisory board members to serve on the MNT-EC business and industry leadership team (BILT). SCME leaders continue to lead the MNTeSIG Industry Working Group meetings and activities.

The center also continues to work with its education partners, industry, and SEMI WORKS, an ATE project, to maintain a mapping database of 3,000+ MNT employers.

"SCME not only sets the high standard for relevant and practical microsystems training but does so in a manner uniquely considerate of the critically important aspects of safety and quality."

Todd Christenson
Chief Technology Officer
HT Micro
Albuquerque, NM

Average SCME Downloads Per Month by Website



SCME's impact is growing as downloads of its materials increase from nanoHub, an online community for nanotech collaboration, and ATE Central, the ATE program's digital archive. SCME-NM started in 2009 with the Southwest Center for Microsystems Education; SCME-Support started in 2017 with the Support Center for Microsystems Education. Both were ATE-funded initiatives as is ATE Central.



*SUNY Polytechnic Institute
Albany, NY*

<https://semi-works.com>

Key Activities

- Leverages subject-matter expertise to recruit, educate, retain, and advance individuals in the semiconductor workforce
- Offers a comprehensive, industry-approved approach for developing the microelectronics design and manufacturing talent pipeline
- Supports a unified competency standard representing the knowledge, skills, and abilities of nanotechnology technicians for educational program certification

Project Offers Dynamic Connection Between Educators & Semiconductor Manufacturers

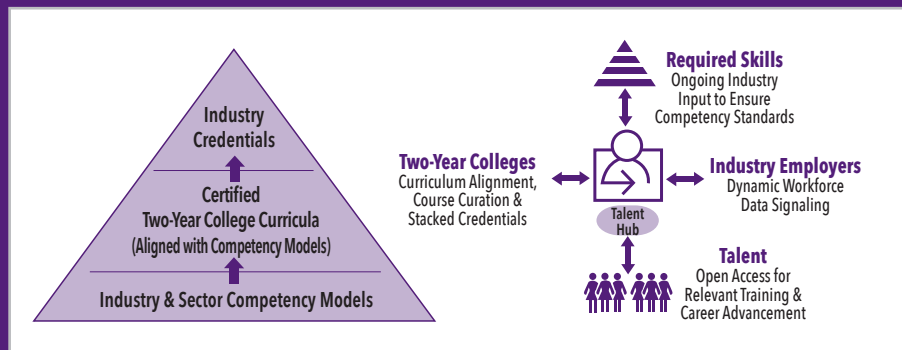
SEMI WORKS® is a collaboration of educators led by SUNY Polytechnic Institute, the National Institute for Innovation and Technology, and SEMI – a 2,400-member industry association for electronics manufacturing.

The SEMI WORKS Talent Hub is a cloud-based portal that offers employers, educators, employees, and job seekers a common platform to identify the knowledge, skills, and abilities essential to succeed in the microelectronics industry. This portal supports the SEMI CERTS workforce certification initiative, which identifies key semiconductor and advanced manufacturing competencies for technician and engineer degree programs. The degree programs certified via SEMI CERTS are dynamically linked to industry job profiles allowing educators to align content continuously to employer needs. The Hub also connects students with employers to promote job placement.

By engaging SEMI members and faculty from two-year and four-year colleges, SEMI WORKS drives a competency standard so that

- employers can find individuals that match their job profiles;
- educators gain access to the competencies required by SEMI employers for course alignment;
- individuals can find jobs that fit their interests and abilities; and
- individuals can identify gaps in their skills and locate education programs best suited to their needs.

SEMI WORKS Talent Hub Connections



Competency models, based on the knowledge and skills that microelectronics employers and advanced technology manufacturers need, are the basis for certified curricula and credentials within the SEMI WORKS Talent Hub.

Partners Test & Disseminate Vacuum Technology E-Book

Vacuum technology plays a critical role in the manufacture of the integrated circuits that determine the function of computers, televisions, cell phones, and other modern equipment.

The e-book and associated resources for vacuum technician education are being tested in the classrooms of Erie Community College, Normandale Community College, and other partner colleges. With licensing through Creative Commons, the free materials are available for adaptation. The Society of Vacuum Coaters and Kurt J. Lesker Company are helping to disseminate them.

"The importance of vacuum science as a general industrial skill set cannot be overstated. A program that trains future technicians, engineers, and scientists on this vital subject provides a solid career foundation with ample room for growth. Vacuum technology is widely deployed in many critical areas – such as medical, analytical metrology, reliability, food sciences, semiconductors, and optics, to name a few. As the technical needs in different professions grow, so will the application of vacuum science."



Jeff Salzmann
Senior Research Engineer
Integer Holdings Corporation, Clarence, NY



Photos of SUNY Erie students assembling a vacuum system illustrate the vacuum e-book created by community college faculty.



SUNY Erie Community College
Williamsville, NY

<https://ate.is/vacuum-tech>

Key Activities

- Improves the technician education experience in vacuum science and technology through utilization of open interactive curriculum resources
- Offers an e-book enhanced with interactive learning tools, a student laboratory manual, and an instructor guide
- Provides hands-on professional development workshops for faculty to use the project's resources



University of Washington
Seattle, WA

<https://bit.ly/data4dm>

Key Activities

- Unites University of Washington researchers with faculty at Seattle Central College, Green River College, and Renton Technical College to build capacity
- Creates faculty-informed tools using student outcomes data
- Uses data to shape improvements at community and technical colleges and in STEM career pathways

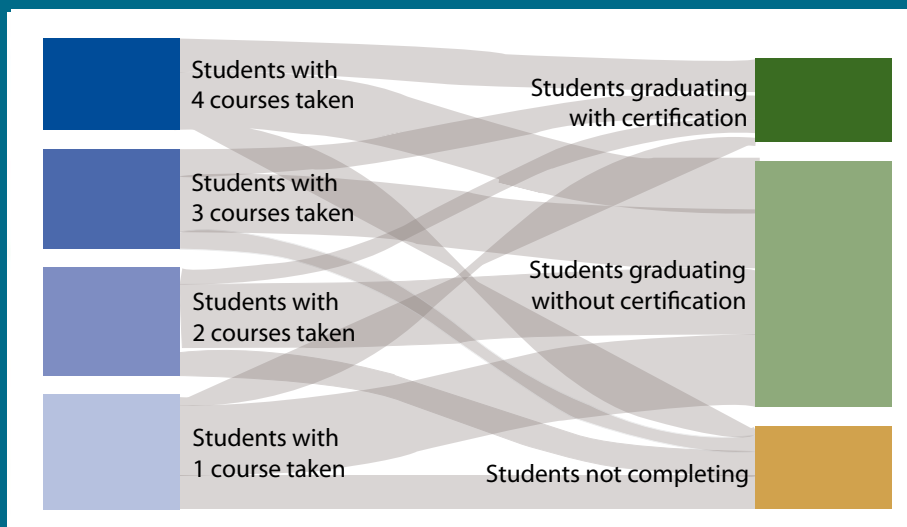
Cross-Sector Collaborations Create Better Tools for Analyzing Student Outcomes

The D4DM research project explores how to put student academic and employment outcomes data in the hands of technical educators at two-year colleges. The research team – composed of researchers from the University of Washington and faculty co-principal investigators at each of the three partner two-year colleges – works closely with other faculty and institutional research staff members at each college.

Utilizing an equity lens, the faculty-informed tools created by D4DM empower technical educators to examine their programs critically and to develop improvements. The research project draws from frameworks such as Guided Pathways, the Equity Scorecard, and Pathways to Results to bring data-informed decision-making into the context of multiple ATE projects that aim to develop the STEM technical workforce.

Collaborative partnerships have also been developed between the research team and the Washington State Board of Community and Technical Colleges and the Washington State Employment Security Department to obtain extensive student-level data on academic and employment outcomes.

D4DM Tool Under Development



The Sankey diagram illustrates how potential employment outcomes could be visualized relative to various stages of ATE program completion. This example portrays how labor market outcomes could vary for students who stop out of a program, complete a program, or complete a program and earn an industry credential.



Quantitative & Qualitative Data Inform Study of ATE's Influence on Economic Development

The Hidden Innovation Infrastructure research project aims to define the “hidden innovation ecosystem or infrastructure” that springs from Advanced Technological Education (ATE) grants and community college technical programs to inform regional economic development efforts. Findings are also expected to inform national conversations about the impacts of the community college workforce education ecosystems on regional labor markets.

The project goals include an ambitious, qualitative study of ATE-educated technicians at their workplaces and in the regional economy.

Successful educator practices emerging from the early data review of information from various sources include the following:

- Regular communication with employers
- Innovative models of program delivery
- Strong partnerships with workforce agencies

Early findings include the following:

- Short-term and stackable credentials are important to students
- Pathways are needed for students to acquire higher-level skills
- Post-completion employment data are challenging to find



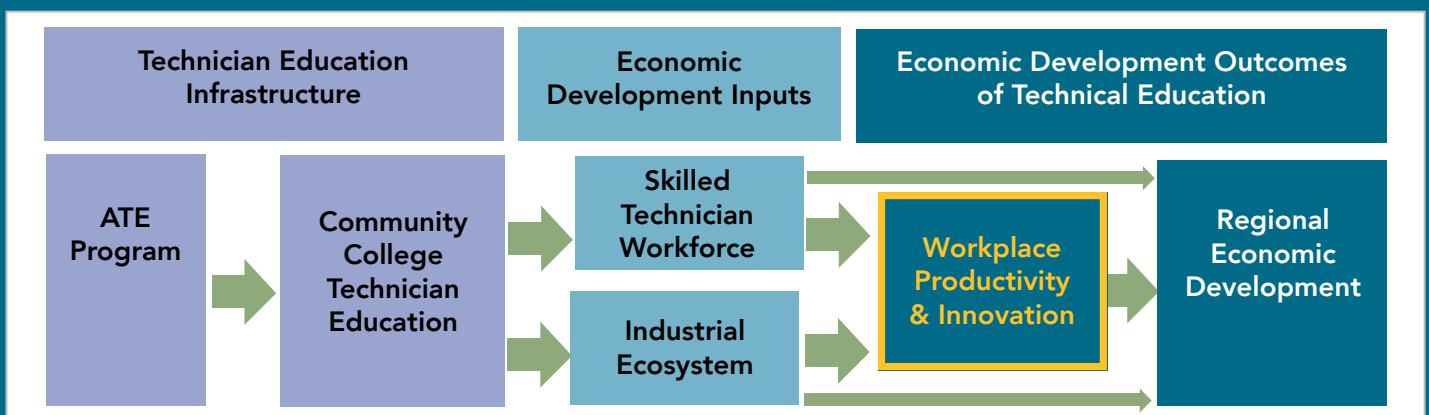
*Rutgers, The State University of
New Jersey
Piscataway, NJ*

<https://sites.rutgers.edu/eerc-hii>

Key Activities

- Uses multipronged approach to define the economic impact of ATE programs
- Analyzes past and current ATE grants for economic development activities
- Reviews relevant national student and industry data
- Develops detailed case study “deep dives” of four regions

Conceptual Model of Technician Education and Economic Development



The project's researchers use this conceptual model to frame their analysis of ATE program impacts on the innovation ecosystem and regional economic development.

Legend



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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.



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Advanced Manufacturing
Agricultural and Environmental
Biological and Chemical

Engineering
Information and Security
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