ATE Survey 2020

Findings from the Annual Survey of Principal Investigators in the National Science Foundation's Advanced Technological Education Program

EvaluATE

www.evalu-ate.org/annual_survey

CONTENTS

1 Introduction
2 How to Use This Report
3 ATE Grantee and Project Characteristics
9 Academic Programs, Courses, and Pathways
15 Educational Material Development
17 Student Service and Support
21 Workplace-Based Learning
23 Professional Development for Educators
25 Professional Exchange
27 Research and Publications
29 ATE Program Services
31 Collaboration
34 Evaluation
36 Highlights
38 Technical Notes
39 References

Click any topic to jump to that section.

INTRODUCTION

The Scientific and Advanced-Technology Act (1992) called for establishing "a national advanced technician training program utilizing the resources of the nation's two-year associate-degree-granting colleges." In response, the National Science Foundation (NSF) created the Advanced Technological Education (ATE) program. The ATE program makes awards ranging from $70,000 to $7.5 million to support an array of initiatives to improve the education of technicians at undergraduate institutions and secondary schools, with an emphasis on two-year colleges. Examples of high-technology fields of interest include advanced manufacturing, biotechnology, energy and environmental technologies, engineering, information technologies, and nanotechnologies.

This report summarizes data gathered in the 2020 survey of ATE program grantees. EvaluATE, the learning and evaluation hub for the ATE program locate at The Evaluation Center at Western Michigan University, has conducted this survey annually since 2000. Included in this report are findings about ATE projects and their activities and achievements during the 2019 calendar year (and 2019 fiscal year for budget-related questions).

The 2020 survey was a census of ATE principal investigators (PIs) with active grants (N=325). Ninety-one percent (n=294) of PIs responded to the survey. The survey included sections about grantee characteristics and practices, evaluation, collaboration, academic program or course development, educational materials development, instrument acquisition, student services and support, professional development for educators or future educators, professional exchange, research and publications, and ATE program services. Grantees were asked to complete sections that pertained to their work.

Survey questions were substantially revised in 2018, resulting in the modification of existing questions and addition of several new questions to capture a wider range of activities supported by ATE grants. Readers are cautioned against comparing results of the 2020 survey with those prior to 2019. In some cases, changes in the survey questions and structure led to fewer respondents reporting in some areas. In a tradeoff, this report includes data on several types of activities not addressed by the ATE survey prior to 2019, such as workplace-based learning experiences for students, support for students transitioning into college, and acquisition of equipment for use in instruction.

Reported numbers of participants, products, and activities throughout this report are rounded to the nearest ten. The *n* that appears with tables and figures indicates the number of respondents for a given item.

Additional reports based on annual ATE survey data, dating back to 2000, are available at evalu-ate.org/annual_survey/reports. Custom reports may be developed upon request. For more information, contact valerie.marshall@wmich.edu.

HOW TO USE THIS REPORT

This report is intended for a broad audience, including ATE project staff, evaluators of ATE projects, those interested in submitting to the ATE program, NSF program officers, and others interested in learning more about advanced technological education. To encourage use of this report and translate findings into action, we have outlined how each of these audiences can use this report.

ATE project staff. ATE project staff, including PIs, co-PIs, and others who work on ATE-funded projects, can benefit from this report through an increased awareness of how their project fits into the larger ATE program portfolio. Reading about the activities and achievements of other projects can provide insights about the similarities and differences between their project and others'. Project staff can use this report to better understand how their project fits amidst the larger framework of ATE projects across the country. Additionally, the survey report can be used to identify potential practices to add to their current project or inspire ideas for future projects.

ATE evaluators. ATE evaluators can benefit from understanding standard practices for evaluations of ATE projects, including types of reports produced and use of those reports. Additionally, ATE evaluators new to projects gain insight on the types of data projects are already requested to collect in order to respond to this survey.

ATE program grantseekers. For those interested in submitting a proposal to the ATE program, this report provides a sense of what funded projects are already doing. A detailed understanding of ATE activities can benefit proposers in the planning stages, as well as in their final submissions to NSF. Grantseekers might use data from this report either to support the continuation of a common activity or to justify an alternative activity to fill a need or gap in ATE activities. The findings in this report may also inspire ideas for targeted research projects.

NSF program officers. The survey report provides a comprehensive overview of the ATE program, allowing NSF program officers to identify larger trends or needs in the ATE program. Additionally, this report can be shared with Congress as evidence of the program's achievements.

Others interested in advanced technological education. This survey report is freely available from the EvaluATE website, open to anyone who has interest in advanced technological education. Efforts to increase courses and programs in career and technical education are not limited to the ATE program. Other academic programs or projects intended to advance career and technical education can benefit from understanding ATE project activities.

ATE GRANTEE AND PROJECT CHARACTERISTICS

As context for the remainder of this report, this section provides basic information about the individuals and institutions that received ATE awards, as well as key characteristics of the funded work, such as types of awards, disciplinary emphases, and nature of activities.

ATE GRANT TYPES AND INSTITUTIONS

Most ATE grants support projects, and most PIs are located at two-year colleges.

ATE awards fit into four main categories: projects, centers, targeted research, and conferences and meetings. The ATE program has special funding tracks for institutions new to the program and for organizations developing plans for national centers. **Eighty-four percent of ATE grants were for projects (including a variety of subcategories of project types).** Among the 247 project grants, 62 were designated for institutions new to the ATE program, and 5 were coordination network grants. Of the 32 centers, 12 identified as support or resource centers, 11 as regional centers, and 9 as national centers.

The majority of ATE grants support **projects**.

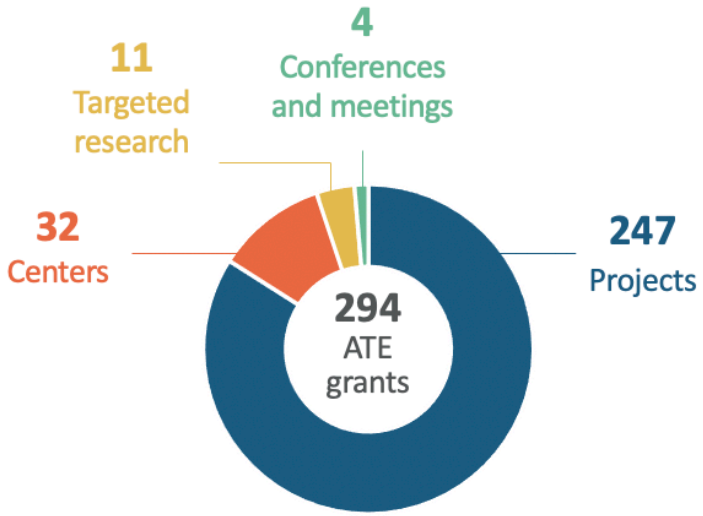


Figure 1. Types of ATE grants awarded (n=294)

Most ATE grantees are located at **two-year colleges**, followed by **four-year colleges** and universities and **nonprofits**.

Figure 2. Percentage of ATE grant recipients at institution types (n=294)

The ATE program solicitation states that the "program focuses on two-year colleges and expects two-year colleges to have a leadership role in all projects" (NSF, 2018, p. 4). Accordingly, most ATE grants are located at two-year colleges. The 225 grants awarded to two-year colleges supported 201 projects, 22 centers, and 2 targeted research studies. Most of the 11 targeted research projects (64%) are located at four-year colleges.

Unless specified, all types of grants—projects, centers, targeted research, and conferences—are referred to as *projects* in the remainder of this report.

ATE PROJECT DISCIPLINES

The majority of ATE projects are in the areas of advanced manufacturing technologies, information and securities technologies, and engineering technologies.

In alignment with the broad aim of the ATE program to improve the education of science and engineering technicians, the disciplinary emphases of ATE grantees are diverse.

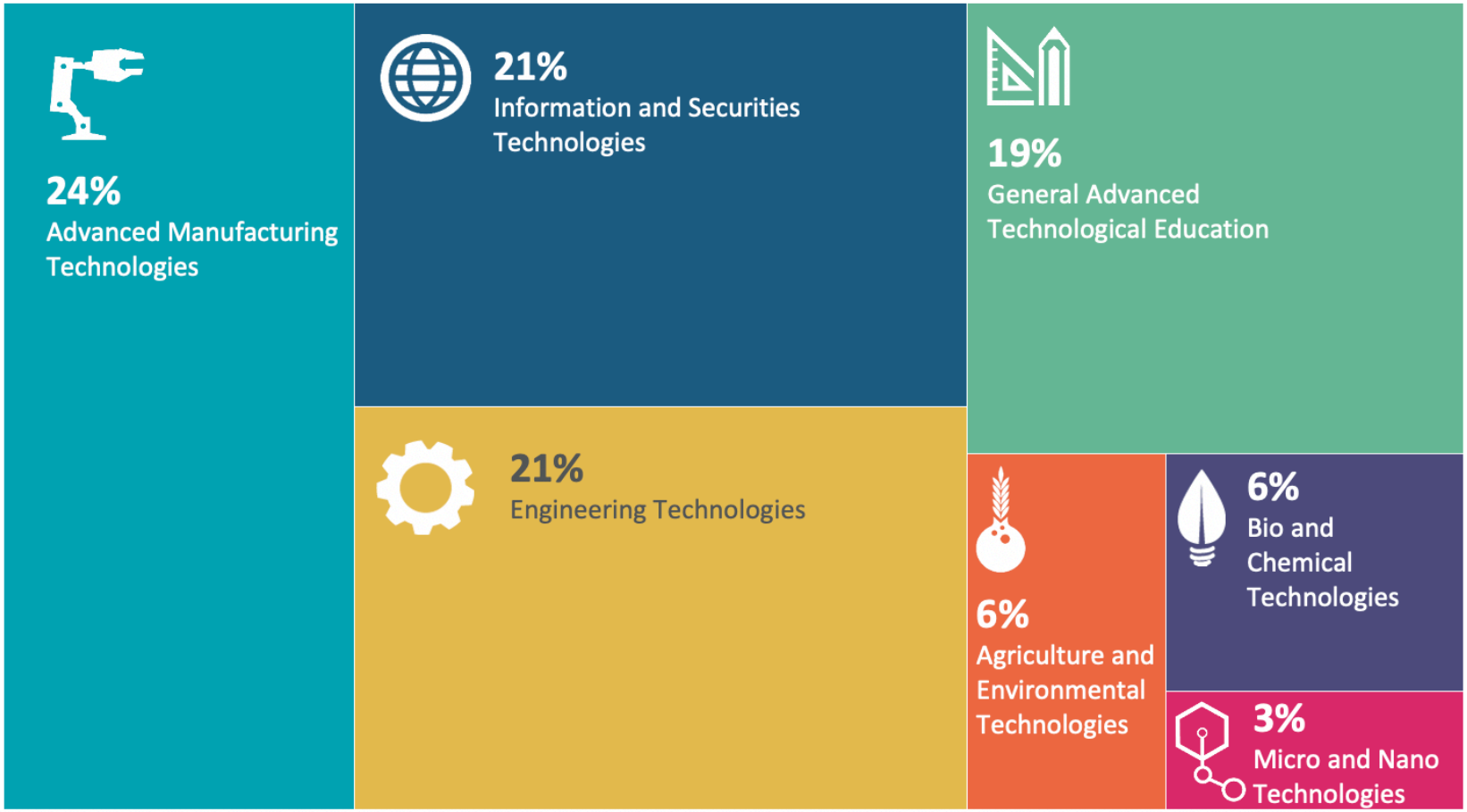


Figure 3. Disciplinary areas of ATE projects (n=294)

ATE PROJECT ACTIVITIES

ATE projects engaged in a variety of activities in 2019 to improve the education of science and engineering technicians.

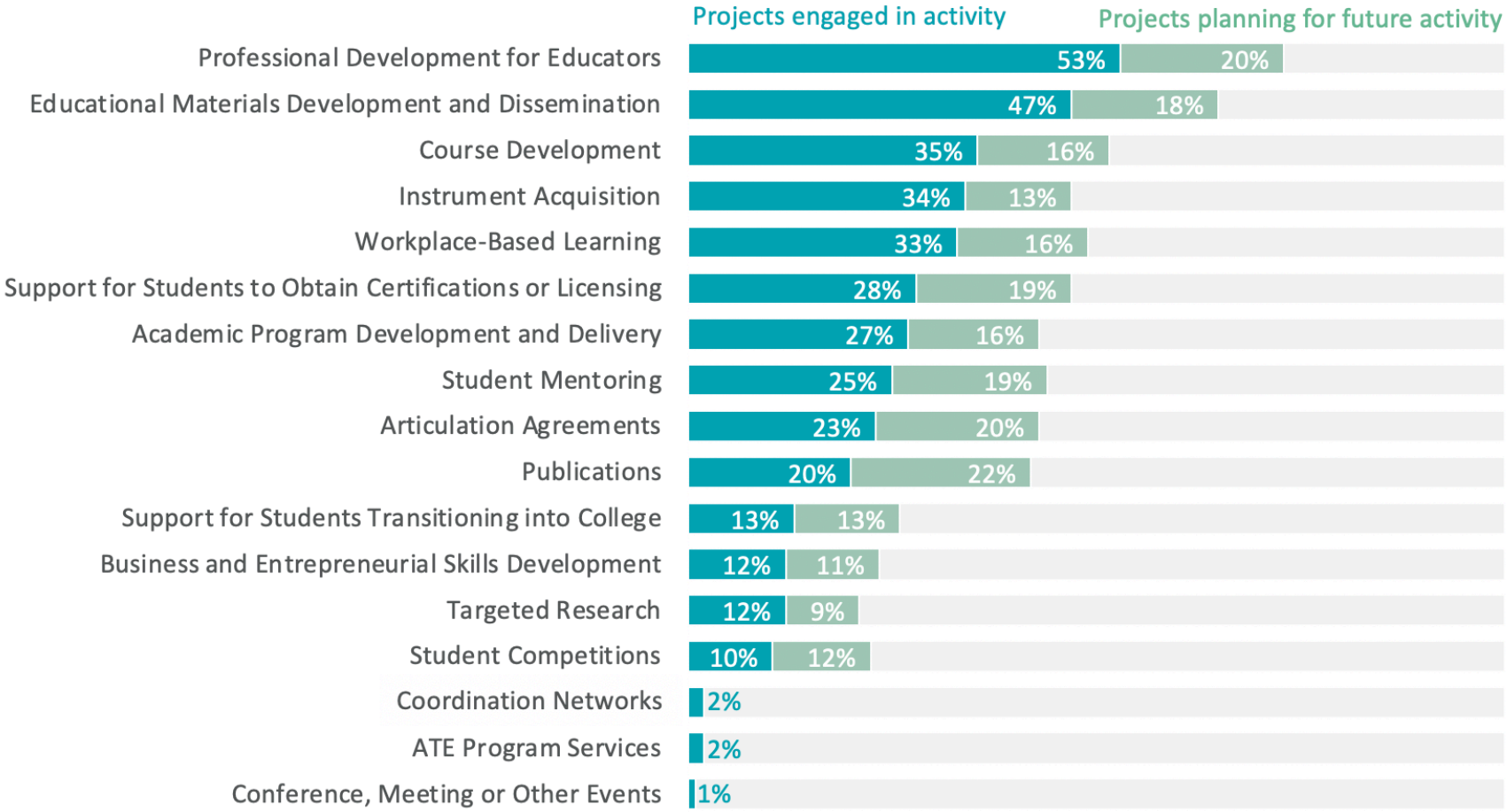


Figure 4. Percentage of projects that reported engaging in activities in 2019 and planning activities for the future (n=294)

ATE PROJECTS AT MINORITY-SERVING INSTITUTIONS

Twenty-four percent of ATE projects are located at minority-serving institutions.

Sixty-two ATE projects are located at **minority-serving** institutions of higher education (IHEs).

Forty-eight ATE projects are located at **Hispanic-serving** institutions of higher education.

Minority-serving institutions are defined in U.S. law under Title III of the Higher Education Act of 1965. Designation is based on the percentage of minority students enrolled in the school. **Of the 263 projects at IHEs, 24% are at minority-serving institutions.** The majority of these IHEs (77%) are Hispanic-serving. Predominantly Black or historically Black colleges and universities and Asian American and Native American Pacific Islander-serving institutions each make up 7% of the minority-serving IHEs that host ATE projects. Three ATE projects are located at Native Hawaiian-serving IHEs, one is located at a tribal college, and one is located at an Alaska Native-serving IHE.

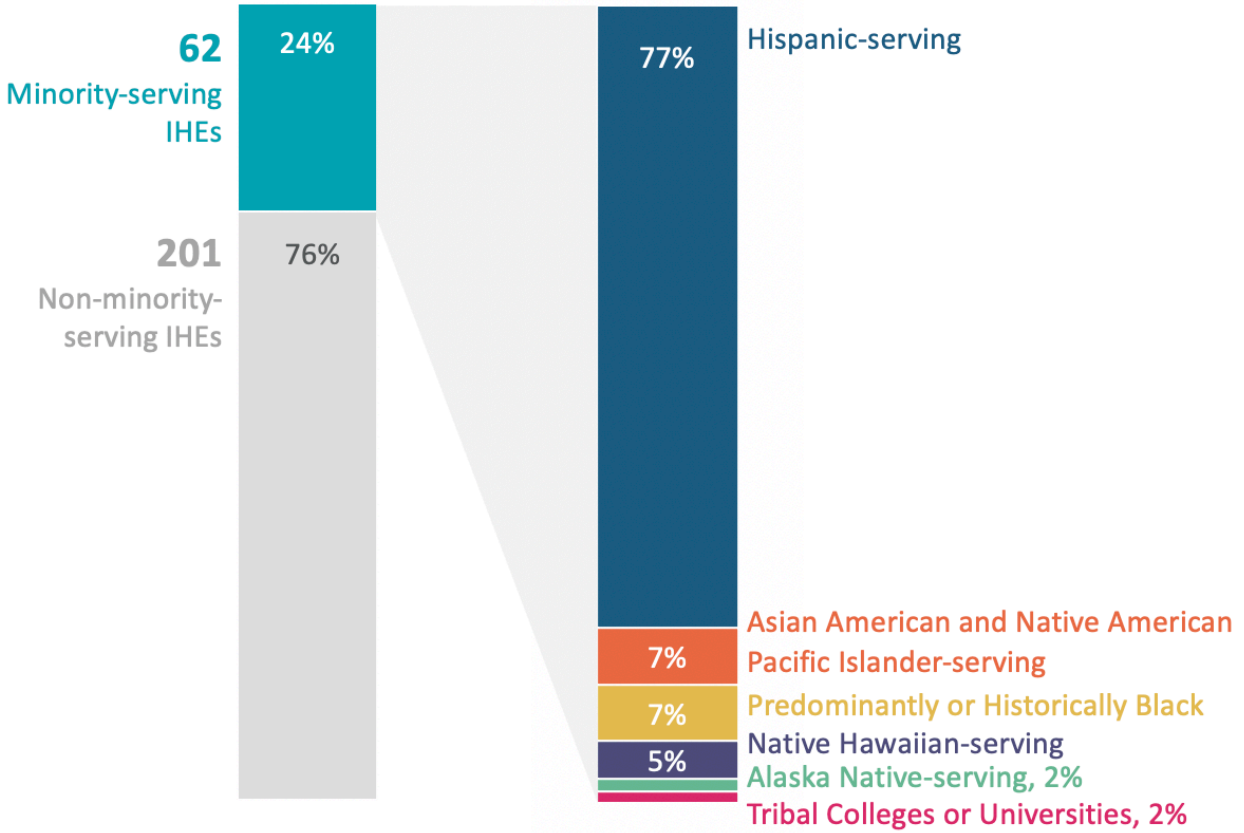


Figure 5. ATE projects at minority-serving institutions (n=62)

ATE PRINCIPAL INVESTIGATORS

Thirteen percent of ATE projects have PIs from racial and ethnic groups historically underrepresented in STEM.

The ATE community is still working towards increasing diversity among PIs. The typical ATE PI is male, white, and between the ages of 55 and 64.

The majority of ATE projects have a PI who identifies as **male**.

Figure 6. Gender identities of ATE PIs (n=294). Each icon represents 1%.

Fourteen percent of ATE projects have PIs who are over the age of 65, while 37% are between the ages of 55 and 64, 28% are 45–54, 18% are 35–44, and 3% are 25–34.

Thirteen percent of ATE projects have PIs from historically underrepresented racial and ethnic groups, which includes Black, Hispanic, American Indian or Alaska Native, and multiracial.

Seventy-nine percent of ATE projects have a PI who identifies as white.

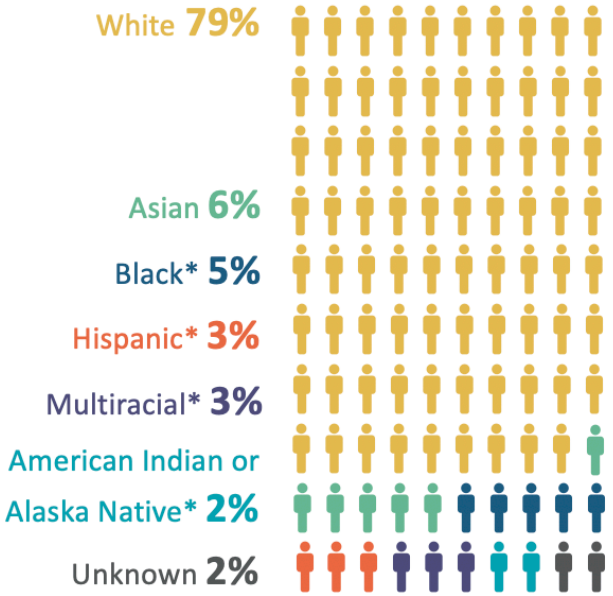


Figure 7. Racial and ethnic identities of ATE PIs (n=294). Each icon represents 1%. *Historically underrepresented racial and ethnic groups.

ACADEMIC PROGRAMS, COURSES, AND PATHWAYS

The ATE program supports the creation and improvement of programs that lead to "an appropriate associate degree or specific occupational competency or certification" (NSF, 2018, p. 5). Examples of funded activities include creating new degree or certificate programs or courses; modifying the content, instructional strategies, or delivery modes of existing programs and courses; enhancing programs through the acquisition of instruments or equipment for use in instruction; and developing educational pathways (including articulation agreements) that facilitate students' movement across education levels.

ACADEMIC PROGRAM DEVELOPMENT

Twenty-seven percent of ATE projects created or substantially modified an academic program.

The Committee on Science, Technology, Engineering, and Math Education's 2013 strategic plan called for graduating "one million additional students with degrees in STEM fields over the next 10 years" (p. 10) and increasing the number of two-year colleges with "effective STEM programs" (p. 30). One of the ways that ATE responds to this call is through the development of new STEM academic programs. ATE PIs were asked to identify the degree or certificate programs that their projects created or improved with ATE funding, and characteristics of students served by those programs.

A total of 153 academic degree programs were developed or substantially modified by 78 ATE projects in 2019. **Most of these programs award certificates (49%) or associate degrees (45%).** Three programs award bachelor's degrees, and six programs provide other types of credentials. **Nearly 10,570 students attended at least one course in these academic programs**, with a total of 1,672 completing a program in 2019; 550 students completed an associate degree program, while 891 students completed a certificate program. Programs with students completing certifications or degrees in 2019 graduated an average of 28 students.

75 Certificate programs served
3,760 students

68 Associate degree programs served
5,790 students

The Committee on STEM Education's 2018 report noted the persistence of labor shortages in STEM fields and underscored the importance of increasing diversity, equity, and inclusion in STEM. NSF (2019) has determined that women, persons with disabilities, and three racial and ethnic groups—Blacks, Hispanics, and American Indians or Alaskan Natives—are underrepresented in science and engineering.

Over 65 percent of the ATE projects that developed or modified academic programs emphasized recruitment of **women** or **underrepresented racial or ethnic minority students**.

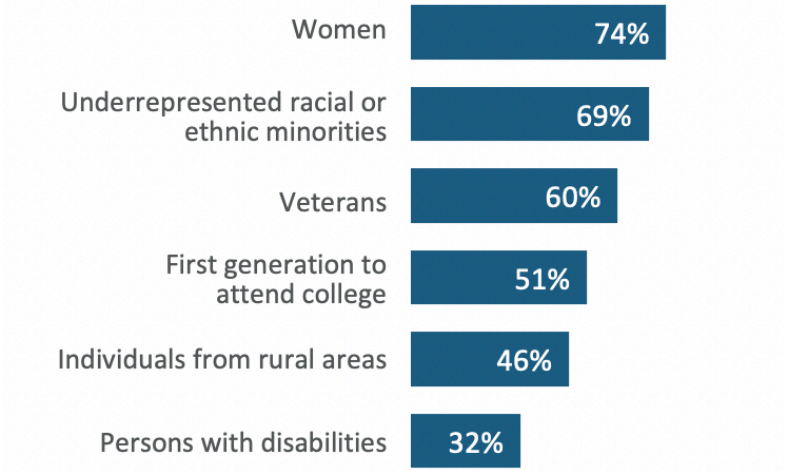


Figure 8. Percentage of projects that emphasized recruitment of students from specific demographic groups (n=65)

STUDENTS SERVED BY ATE ACADEMIC PROGRAMS

Students from groups that have been historically underrepresented in STEM have similar rates of participation in the ATE program.

Of the 153 academic programs that were developed or modified by ATE projects in 2019, 97 programs (63%) reported student characteristics. Due to this low response rate and changes in the survey questions, the numbers reported here do not represent the entire ATE program and should not be compared with previous years' data.[i]

The percentage of women in ATE-supported programs is similar to national participation rates. **Overall, 21% of ATE students are women, although the proportion of women varies by education level and discipline.** According to the U.S. Department of Education, 21% of students in technical programs at two-year colleges in the U.S. are women.[ii]

Like other STEM programs, ATE projects still face a challenge in attracting **women** to the field.

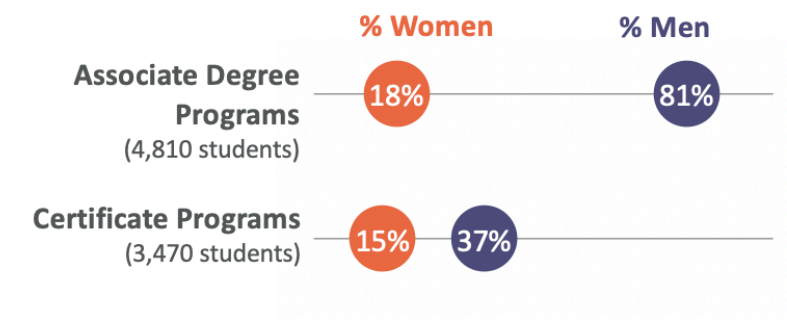


Figure 9. Percentage of women and men in ATE-supported academic programs by degree level (n=91)

Students who identify as Black/African American, Hispanic/Latino or Latina have slightly higher representation in ATE-supported programs than they do in the general population of students across types of educational degrees. (See the technical notes for a full explanation of comparison sources for national data.[iii])

The percentage of students who identify as Black/African American and Hispanic/Latino or Latina in the ATE program mimics national trends.

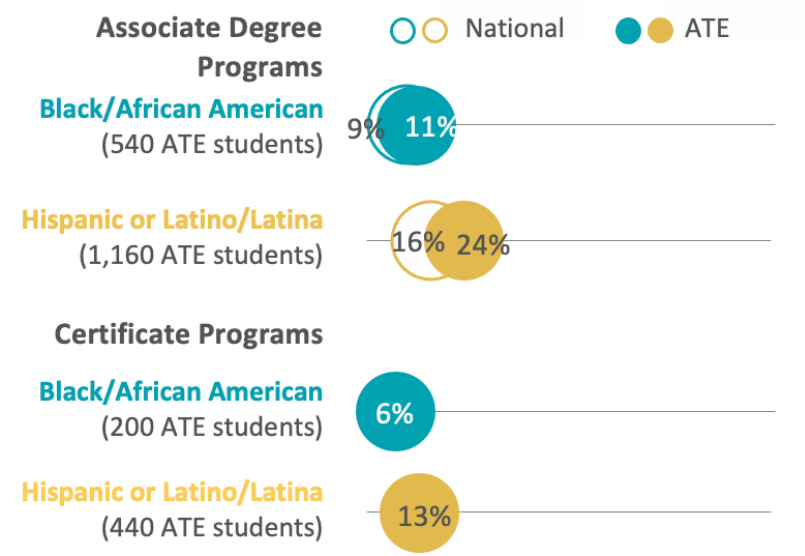


Figure 10. Percentage of students from underrepresented racial and ethnic minority groups in ATE-supported academic programs in associate degree programs, compared with national rates (n=91)

COURSE DEVELOPMENT

Thirty-five percent of ATE projects created or modified at least one academic course.

ATE PIs whose projects engaged in creating or substantially modifying academic courses were asked to identify the number and types of courses they created or modified, the academic levels of these courses, their primary delivery modes, and how many students enrolled in the courses. Some ATE projects engaged in course development as part of a larger initiative to develop or modify an entire degree or certificate program; others did so as a stand-alone effort.

A total of 454 courses were developed by 104 projects in 2019. The majority of these courses (84%) were for two-year college students.

26
High school courses were developed by
10
ATE projects

381
Two-year college courses were developed by
93
ATE projects

13
Four-year college courses were developed by
5
ATE projects

Sixty-three percent of these 454 courses were offered in 2019.

9,110 students
completed an ATE-developed or -modified course in 2019

ATE PIs were asked about the primary delivery modes for each of the courses they developed or modified. **Compared to 2018, more ATE courses are being developed for an online format.**

Most ATE courses were designed for face-to-face delivery, as compared with online or a hybrid of both.

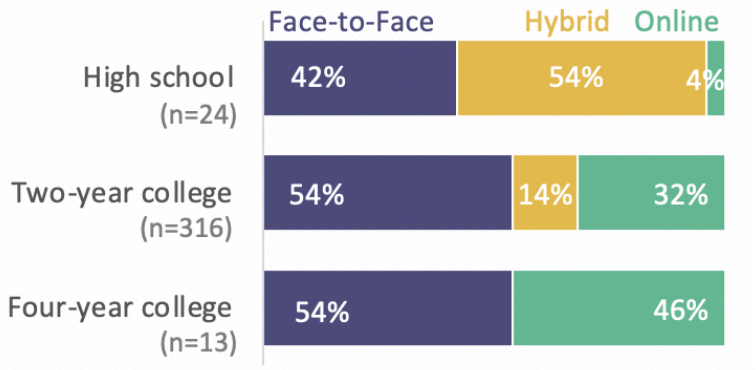


Figure 11. Percent of courses designed by differing delivery mode, by education level

INSTRUMENT ACQUISITION

Thirty-two percent of ATE projects acquired instruments or equipment to prepare students for work in business and industry.

Using state-of-the-art equipment contributes to the development of technical skills students will need for employment. Hands-on experience with such equipment has also been shown to contribute to students' self-efficacy and positively impact their longer-term career and educational goals (Amelink et al., 2015). The ATE program includes a funding stream to help grantees obtain instruments or equipment that can be used in instruction to prepare students for employment in business and industry.

Ninety-five ATE projects acquired instrumentation or equipment in 2019. Examples of instruments purchased and utilized by projects include 3D printers, computers, drones, virtual reality viewers, laser engravers, and laboratory equipment. Eighty projects reported the amounts they spent on instrumentation or equipment. **Projects spent between $160 and $375,000 on instrument acquisition in 2019.**

A majority of projects spent less than 25% of their grant funds on instrumentation in 2019.

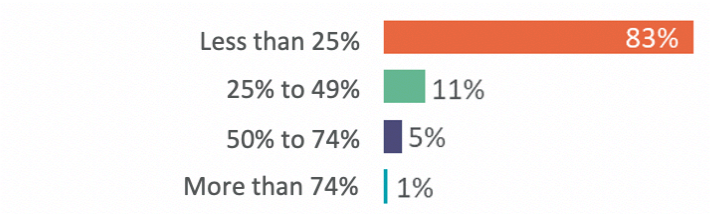


Figure 12. Percentage of total grant amount spent on instrumentation or equipment in 2019 (n=80)

Projects that used ATE funding to purchase instruments or equipment are expected to revise their academic programming to maximize the value of the items for student learning. In 2019, over 9,000 students used instruments and equipment, with one project making up over 25% of the total number of students.

A median of 30 students used the equipment or instrumentation acquired by each ATE project.

9,410 students
benefited from purchased equipment

540 educators
used the purchased equipment

330 courses
used the purchased equipment

Eighty-one projects reported acquiring instrumentation, equipment, or tools to give students hands-on experience with instruments used in the field. Six projects reported acquiring instruments to allow students to perform technical tasks in a simulated environment, and four projects noted other reasons, such as enabling students with disabilities to perform certain technical tasks and allowing remote students to participate in a live session or demonstration.

ARTICULATION AGREEMENTS

Twenty-one percent of ATE projects created or maintained articulation agreements.

Articulation agreements are formal agreements between educational institutions that provide students from secondary schools with pathways and education access to two-year colleges and four-year colleges. These agreements contribute to increasing the number and diversity of scientists, engineers, and technicians (National Academy of Engineering & National Research Council, 2012).

In 1992, Congress saw the importance of these agreements and required their use in NSF's ATE program. The current ATE solicitation calls for "developing life-long career and educational pathways for technicians to support the changing workplace" (NSF, 2018, p. 5).

Sixty-three projects developed or maintained articulation agreements in 2019. Note that one project was responsible for 10,621 out of 11,166 articulation agreements in place between high school to two-year colleges.

Most articulation agreements in created in 2019 were between **high schools and two-year colleges**, but more students matriculated between **two-year and four-year colleges**.

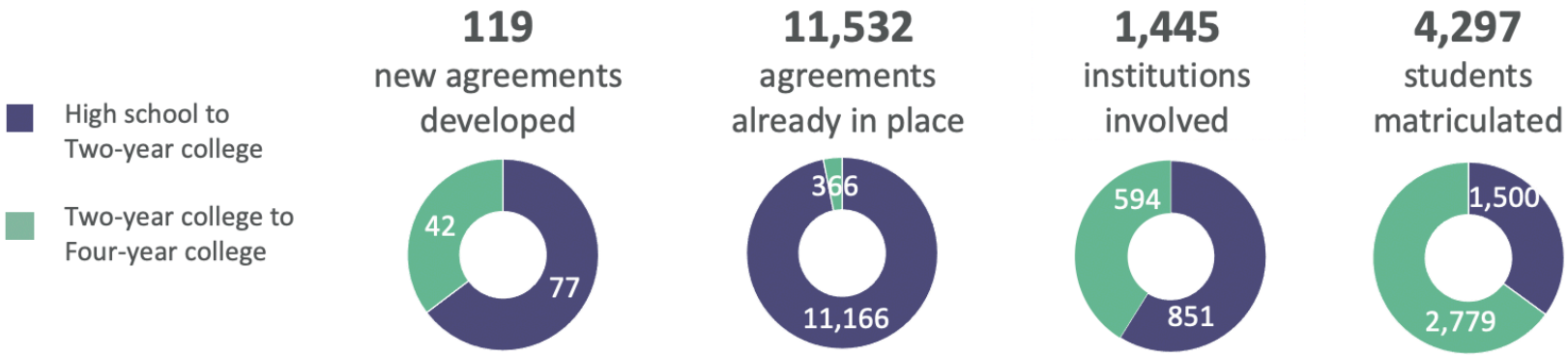


Figure 13. Number of articulation agreements, institutions, and students (n=63)

EDUCATIONAL MATERIAL DEVELOPMENT

Instructors' use of curriculum materials is believed to have three general types of outcomes: (1) improvement of educators' pedagogical knowledge and "design capacity"; (2) increased opportunities for students to engage in "ambitious science," aimed at developing their skills in both generation and use of scientific knowledge; and (3) improved student learning outcomes (Davis et al., 2016). The ATE program supports the creation, validation, and dissemination of educational material in print or digital formats to be used for instructional or assessment purposes. Such materials include—but are not limited to—tests, lab experiments, instructional modules, and textbooks.

The PIs whose projects developed educational materials were asked to report the type and number of materials they developed or adapted and how those materials were disseminated beyond their institutions.

EDUCATIONAL MATERIAL DEVELOPMENT

Forty-four percent of ATE projects created or substantially modified educational materials.

130 ATE projects developed or modified over 7,080 educational materials in 2019.

3,210
Assessment activities or tests

890
Modules or instructional units

930
Lessons or lesson plans

650
Lab experiments

460
Course curricula

240
Interactive simulations

Other materials developed include 220 case studies or problem sets, 170 program curricula, 150 instructor guides, and 40 textbooks.

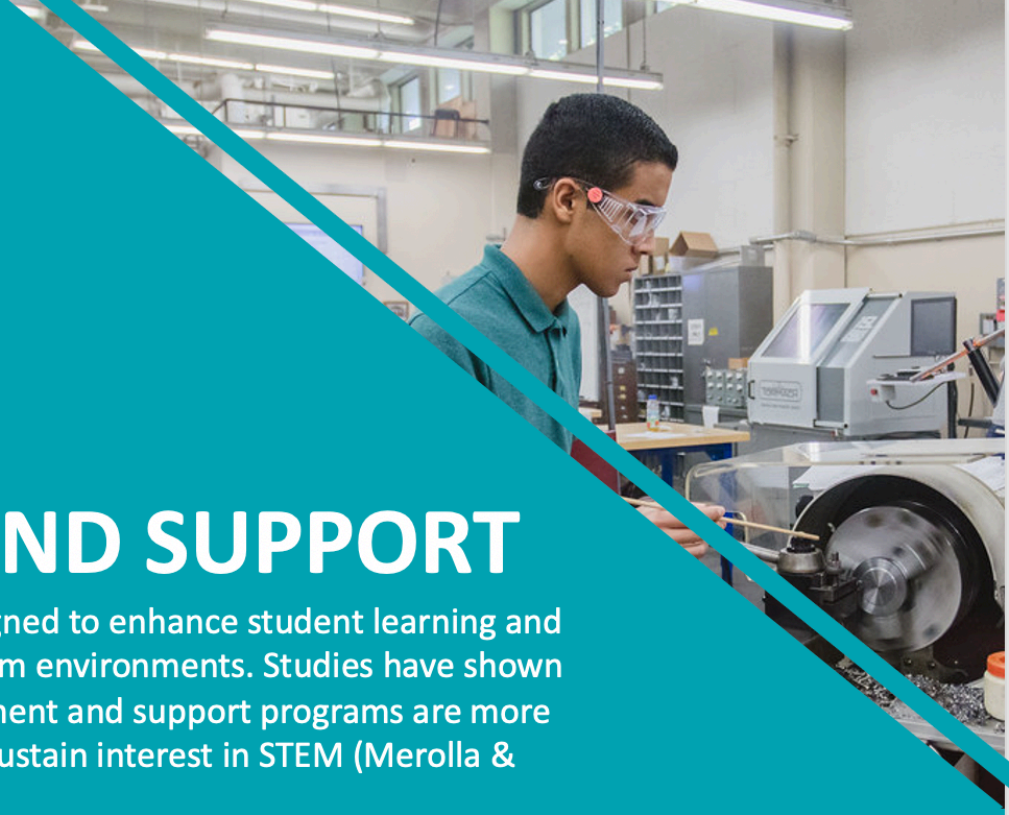
Educational materials created in 2019 by ATE projects were primarily disseminated through the projects' websites (62%) and workshops (62%), followed by ATE Central (the ATE program's archiving platform, 52%). Fewer than 15% disseminated their materials at conferences (14%) or through a clearinghouse or repository (11%). Twenty-seven projects indicated "other" modes of dissemination, with 12 projects noting they disseminated materials through commercial publications. Additional avenues of dissemination included sharing via academic and industry partnerships.

One-hundred twenty-two ATE projects disseminated educational materials that were created prior to 2019. These materials were primarily course curricula (59%), modules or instructional units (47%), and lesson plans (42%). ATE projects also reported continued dissemination of lab experiments (37%), assessment activities or tests (30%), and case studies or problem sets (18%) created in previous years.

Conferences were the most prominent avenue (71%) for disseminating materials that were created in previous years. Sixty-two percent of projects that developed educational materials in previous years posted materials to their websites, and 61% distributed materials at workshops.

Thirty-eight of the 130 projects that developed educational materials kept track of what other institutions are using their program and/or course curricula.

2,090 institutions
Used program and/or course curricula created by 38 ATE projects



STUDENT SERVICE AND SUPPORT

The ATE program supports an array of activities designed to enhance student learning and success in STEM programs outside of typical classroom environments. Studies have shown that students who experience these types of enrichment and support programs are more likely to have positive attitudes toward science and sustain interest in STEM (Merolla & Serpe, 2014).

ATE PIs were asked if their projects provided any of the following student-focused services: support for students transitioning into college, opportunities to participate in STEM competitions, mentoring, entrepreneurial skills development, or support for obtaining industry-recognized certifications or licenses. Respondents who answered affirmatively were asked additional questions about the nature of these activities and the number of students served.

STUDENT SERVICE AND SUPPORT

Fifty-one percent of projects provided at least one type of student service or support.

149 projects provided at least one type of direct student service or support.

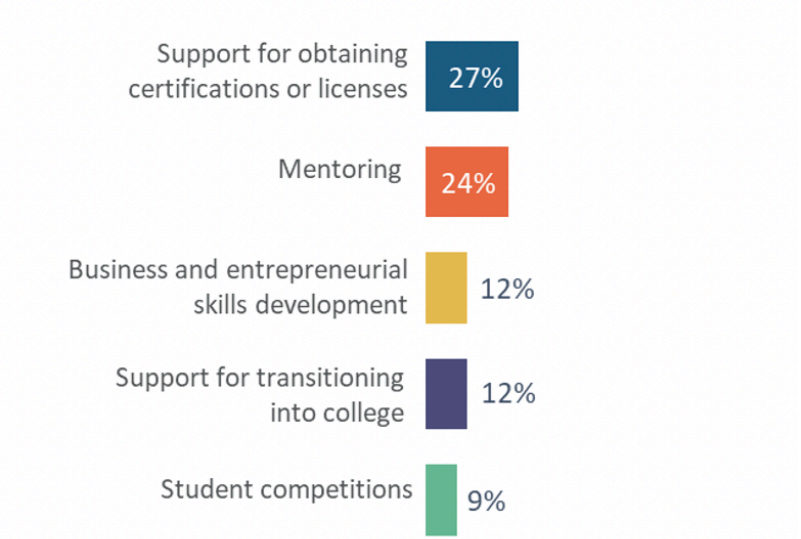


Figure 14. Percentage of projects that provided student services and support (n=294)

BUSINESS AND ENTREPRENEURIAL SKILLS

Business and entrepreneurial skills development involves working with students to develop their skills in areas such as business development, marketing, networking, and understanding the global marketplace. **Twelve percent of ATE projects engaged students in building their business and entrepreneurial skills.**

A total of 13,140 students received business and entrepreneurial skills development from 34 ATE projects in 2019.

ATE projects used a variety of strategies to develop students' business and entrepreneurial skills. Other strategies not reported in the graph below included engaging with local industry professionals (20%) and incubator programs (6%).

Mentoring, coaching, and **in-course units or activities** are the dominant ways of helping students develop business and entrepreneurial skills in the ATE program.

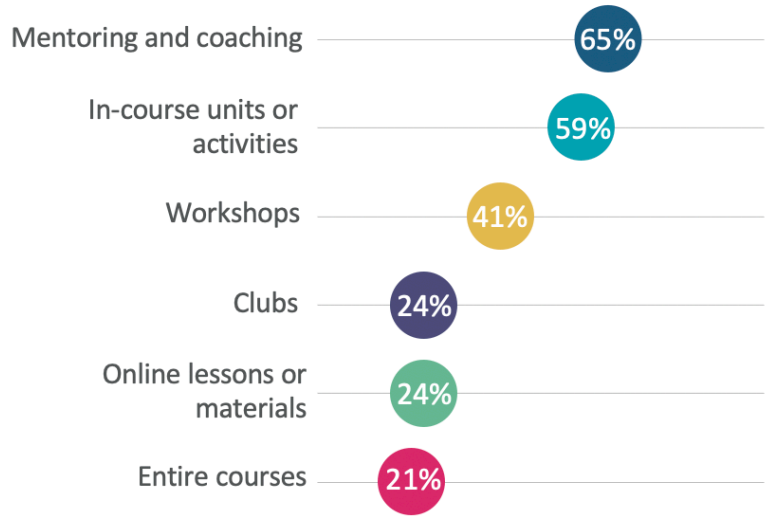


Figure 15. Percentage of skills development opportunities offered to students by ATE projects (n=34)

STUDENT SERVICE AND SUPPORT (continued)

Twenty-four percent of ATE projects provided students with mentoring or coaching, and 9% hosted or organized a student competition.

STUDENT MENTORING

Student mentoring involves an experienced industry professional, educator, or advanced student providing guidance and advice to help less-experienced students develop the skills and knowledge they need to enhance their academic and professional growth. Mentoring is a source of both psychosocial support and career advancement (Anderson et al., 2015). This type of support is especially important for students at two-year colleges, who typically face more barriers to degree completion than those at four-year institutions (Crisp, 2010).

Nearly **7,540** students received mentoring through ATE projects.

2,760
High school students

4,560
Two-year college students

220
Four-year college students

Mentoring was most often provided by educational faculty or staff (79%), followed by business and industry professionals (50%) and students or peers (49%). Thirty-one percent of projects that offered mentoring or coaching provided training to the mentors.

STUDENT COMPETITIONS

In student competitions, students compete as individuals or teams using skills related to a STEM discipline or industry, such as robotics, information technology, or engineering. Research shows that participation in STEM competitions has a positive impact on students' interest in pursuing STEM careers, even when controlling for prior interest and ability (Miller et al., 2017).

9,420 students participated in one of the 117 ATE-hosted student competitions. The most common areas for competitions included:

50
information securities competitions engaged
3,210
students

37
engineering technologies competitions engaged
5,080
students

22
advanced manufacturing technologies competitions engaged
675
students

Eight other competitions engaged 460 additional students in ATE disciplines including micro and nanotechnologies, agricultural and environmental technologies, and bio and chemical technologies.

STUDENT SERVICE AND SUPPORT (continued)

Twelve percent of ATE projects provided extra support for students transitioning into college, and 27% helped students prepare for certification or licensure.

TRANSITION PROGRAMS

Community colleges enroll disproportionate numbers of students who are economically disadvantaged and from underrepresented minority groups (Edgecombe, 2019). Programs that support students as they transition into college are an important means for enhancing academic persistence and completion among these and other students (Baber, 2018). **The ATE program supports efforts to facilitate students' transition into college and equip them with the skills they need to successfully navigate college.** Such programs include—but are not limited to—summer bridge programs, college readiness workshops or classes, first-year programs, and support for nontraditional students.

The majority of transition programs are for **high school students**.

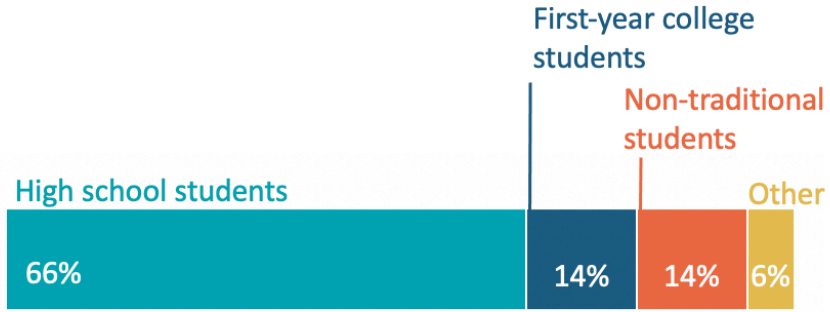


Figure 16. Primary audience for transition programs supported by ATE projects (n=57)

Over **11,000** students transitioning into college received support from ATE projects.

5,580
High school students

5,710
First-year college students

100
Non-traditional students

SUPPORT FOR CERTIFICATIONS OR LICENSURE

Professional certifications, typically awarded by industry groups or professional organizations, serve as verification that an individual has the knowledge and skills required for certain jobs. Many community colleges offer students assistance in obtaining these credentials. These efforts may involve aligning academic programming with certification exams, offering exam preparation support, or operating testing centers on campus (NAS, 2017).

Seventy-nine ATE projects provided students with support for obtaining certifications or licenses in 2019. Eighty-seven percent of ATE projects reported supporting students through aligning existing courses with licensing or certification requirements. ATE projects also provided test preparation workshops or learning modules (62%) and served as testing centers (41%). ATE projects involved in this activity were asked to identify the type of entity that awards the licenses or certifications they help students obtain. The most common response was non-governmental organizations (42), followed by for-profit companies (36) and government agencies (22).

WORKPLACE-BASED LEARNING

Workplace-based learning includes any situation in which a student gains experience at a work site, such as through internships, apprenticeships, co-op learning, and job shadowing. Research indicates that such experiences contribute to students' confidence in their abilities and enhance employability skills, such as problem-solving, communication, and professionalism (Jackson, 2014).

ATE PIs whose projects offered workplace-based learning were asked about key characteristics of the workplace-based learning opportunities they offered and about the number of students who participated in these activities in 2019.

WORKPLACE-BASED LEARNING

27 percent of ATE projects provided workplace-based learning opportunities for students.

In 2019, 3,410 students participated in workplace-based learning opportunities offered by 76 ATE projects. An additional 16 ATE projects reported offering field trips to business and industry sites.

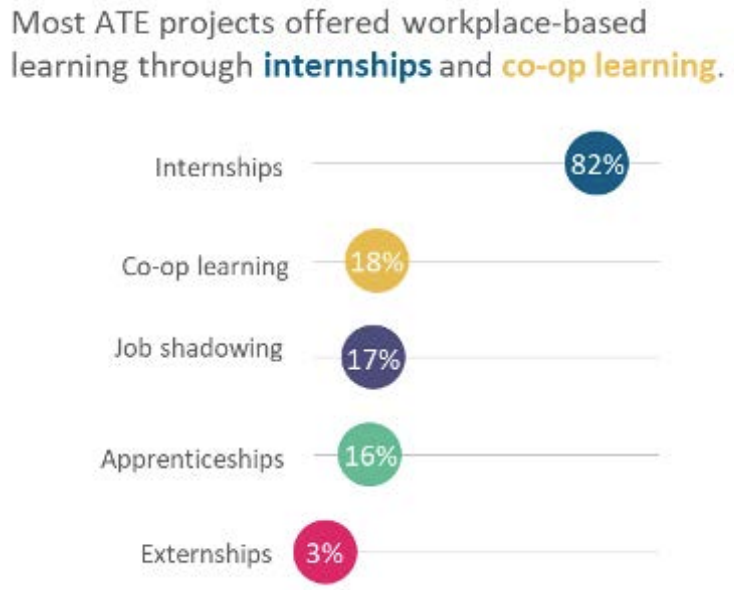


Figure 17. Percentage of ATE projects that offered each type of workplace-based learning (n=76)

The median number of weekly hours that students spent in a workplace-based learning activity ranged from 6 to 20 hours, and the median number of weeks spent in an activity ranged from 6 weeks (job shadowing) to 42 weeks (apprenticeships).

Respondents discussed a variety of benefits to both students and employers as a result of offering workplace-based learning. As one respondent noted, these opportunities:

> **"build avenues for students to connect with relevant real-world experiences ranging from specific case studies explored in class to internships, apprenticeships, and ultimately employment in the field."**

Survey respondents were asked to report on a series of characteristics about the workplace-based learning opportunity that was offered. Table 1 shows these characteristics for the three most frequently reported characteristics. As shown in the table, variation was seen both within and across different workplace-based learning activities.

	Internships (n=62)	Co-op learning (n=14)	Job shadowing (n=13)
Received Payment	65%	50%	15%
Academic Credit	66%	71%	23%
Coupled with a course	55%	57%	23
Required by program	53%	64%	38

Table 1. Characteristics of the three most frequently reported workplace-based learning activities

PROFESSIONAL DEVELOPMENT FOR EDUCATORS

Community college faculty have diverse responsibilities. They design and deliver courses and are often charged with responsibilities related to student retention or institutional administration. Incoming faculty are typically subject matter expects with minimal training in pedagogy (Strickland-Davis et al., 2019). Furthermore, instructors in advanced technological fields must keep pace with rapidly changing technology and workforce needs. Increasingly, secondary school teachers are being called up to play a part in building students' STEM knowledge and skills and instilling interest in STEM careers.

The ATE program provides support for projects to develop and deliver professional development for educators, with a focus on enhancing their "disciplinary capabilities, teaching skills, understanding of current technologies and practices, and employability skills" (NSF, 2018, p. 5). ATE PIs were asked to report on the focus, number, and length of professional development activities provided by their projects, as well as the number and type of participants and number of students subsequently impacted by those participants.

PROFESSIONAL DEVELOPMENT FOR EDUCATORS

Fifty percent of ATE projects provided training or professional development to current or future educators.

One-hundred forty-seven ATE projects provided 1,070 training or professional development activities for educators in 2019. Most of these activities were a day or less in length (56%), including webinars and one-day workshops. Almost a quarter lasted more than one day but less than a week (22%) including in-person multi-day workshops and online modules. The remaining 22% of activities lasted one week or longer, including courses, summer institutes, internships, and peer coaching.

Figure 18. Number of professional development activities for educators by length of time (n=145)

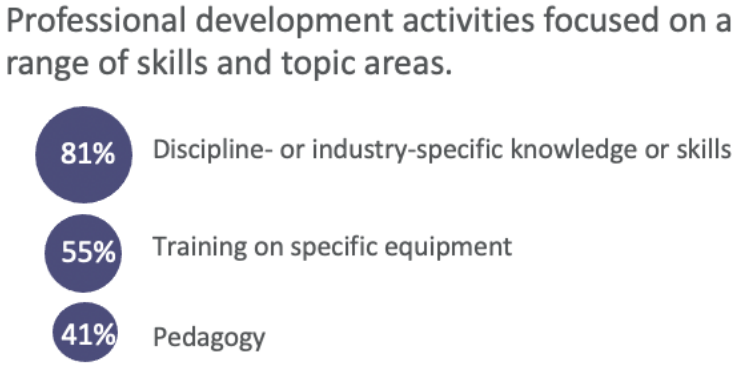


Figure 19. Top three professional development activities (n=143)

Additional professional development activities reported by ATE projects included recruitment or retention of students (23%) and other professional skills, such as communication (20%).

Fifty-five percent of educators served by professional development activities were two-year college faculty, followed by high school teachers (24%) and pre-service teachers (8%). Four-year college faculty made up 6% of professional development participants, and other types of educators made up 7%.

7,820 educators
participated in ATE-sponsored professional development in 2019 (n=108)

30,360 students
were taught by educators who participated in ATE-sponsored professional development (n=43)

PROFESSIONAL EXCHANGE

Bringing together professionals from different organizations and geographical locations facilitates knowledge diffusion, collaboration, and professional interaction (Chai & Freeman, 2019). Research has shown that "diverse collaborative networks" enhance innovation and complex problem-solving (Biancani et al., 2014).

The ATE program has two funding tracks that support activities to catalyze professional exchange. One such track supports **coordination networks**, which facilitate collaboration and communication about research, training, and education across disciplines, organizations, and geographical boundaries. The other track provides funding for **conferences, meetings, and events** to improve understanding of advanced technological education issues (NSF, 2018, p. 9).

ATE PIs whose projects hosted conferences or similar events were asked to identify the names and purposes of the events and the number of attendees. Those engaged in network coordination were asked to identify the purpose of their networks.

COORDINATION NETWORKS AND CONFERENCES

Only a few ATE projects are funded specifically to organize coordination networks and conferences, but many projects are actively engaged in professional exchange.

COORDINATION NETWORKS

Six ATE projects indicated that developing and facilitating coordination networks was the primary purpose of their grant.

- **Consortium for Advanced Manufacturing of Cell and Tissue-Based Products** aims to unify and scale the progress in workforce preparation for all levels of career tracks in biomanufacturing.
- **Impact of System-Wide Contextualization of Math in Rural Arizona Colleges on Producing More Qualified Technicians (SFAz+8 CXM)** encourages the integration of mathematics into technical education courses to encourage student completion.
- **Manufacturing Alliance Keeping Education Relevant to Technical Employee Competence (MakerTEC)** seeks to find solutions for the advanced manufacturing sector that result in meeting their skilled worker needs and reducing costs.
- **Technician Education in Additive Manufacturing and Materials (TEAMM)** is focused on identifying the ways in which the convergence of materials science and additive manufacturing can be addressed in technician education resources.
- **The Internet of Things Coordination Network** is designed to study the emergence of smart device technologies, including products, technologies, standards, and applications.
- **The Necessary Skills Now Network** facilitates collaboration between educators and employers to improve the employability skills of entry-level technicians in STEM fields.

CONFERENCES AND MEETINGS

Four ATE projects were explicitly funded to coordinate conferences or meetings in 2019. Nine additional projects indicated that hosting a conference was a main purpose of their grant. These 13 projects held a total of 16 conferences and meetings. Attendance at these meetings ranged from 15 to 600. ATE PIs identified the purpose of these events as networking and professional development, disseminating best practices, and bringing together stakeholders from industry and education.

16 conferences and meetings
were organized by ATE projects

1,450 people
attended conferences and meetings organized by ATE projects

Fifty-seven other ATE projects indicated that they organized 290 conferences, meetings, or similar events in 2019. The average attendance at these meetings was 150 participants, with a maximum of 3,760 at one event.

RESEARCH AND PUBLICATIONS

All NSF-funded projects are expected to advance the frontiers of knowledge (NSF, 2019). The ATE program's **targeted research track** funds studies to generate knowledge and build an evidence base for technician education and the development of a skilled technical workforce. ATE PIs whose projects engaged in research were asked about the purpose and status of their research, their methods and findings, and their dissemination strategies.

Publications are a vehicle not only for disseminating research findings, but also for sharing promising practices, lessons learned, and information about project developments and materials. Survey respondents were asked about the number and types of publications produced by their projects, such as articles, reports, white papers, and other documents of publishable quality (not including projects' annual reports to NSF, evaluation reports, or conference materials).

ATE TARGETED RESEARCH AND PUBLICATIONS

Twelve percent of ATE projects conducted some type of research, and 19% developed materials intended for publication.

TARGETED RESEARCH

Eleven ATE projects were specifically funded to conduct targeted research in 2019. At the time of the 2020 survey, 22% were collecting data, while 33% were analyzing data, 33% were writing up results, and 12% had findings published or submitted for publication.

Additionally, 34 ATE projects indicated they conducted some sort of research in 2019. Examples included conducting descriptive research (94%), document reviews (33%), correlational research (15%), experimental or quasi-experimental research (12%), meta-analysis (3%), and other research (3%).

Research findings were most frequently disseminated via conference presentations or posted online.

Figure 20. Percentage of projects that share their research via various dissemination channels (n=34)

PUBLICATIONS

While publication is an expectation for all projects engaged in targeted research, many other ATE projects also prepare publications of various types. Therefore, all ATE PIs were asked if their projects developed publications (excluding annual reports prepared for NSF, evaluation reports, and conference proceedings).

Fifty-five ATE projects prepared a total of 163 publications.

PIs reported 10,069 other publications of various types. According to their write-in responses, these included 69 other publication types, such as blogs, online news articles, and videos. Additionally, the ATE Collaborative Outreach and Engagement Project distributed 10,000 copies of the *ATE Impacts* book.

ATE PROGRAM SERVICES

For a few ATE projects, the primary purpose is to provide activities, materials, or services to enhance the capacity of ATE grantseekers, grantees, and affiliated stakeholders to plan and conduct successful ATE projects. In some other programs within NSF's Education and Human Resources Directorate, these types of program-oriented services are consolidated and provided by a single organization. The ATE program is configured differently; ATE program-specific support, technical assistance, and other services are delivered by multiple grant-funded entities that focus on narrower areas of expertise, with an array of other projects contributing to program capacity in various ways. The ATE program also has a culture of sharing and support to advance the shared interests of program stakeholders.

ATE PIs were asked to identify the ways in which their projects supported the ATE community and the number of people served through their service activities.

ATE PROGRAM SERVICES

Two percent of projects were funded specifically to serve the ATE program.

Six ATE projects are funded to provide services and support specifically for ATE grantseekers, grantees, and their affiliates. These projects include the following:

- **AccessATE** supports ATE projects in understanding and complying with accessibility requirements to make their materials and activities more accessible to all students and faculty, including those with disabilities.
- **ATE Central** is the ATE program's information hub dedicated to highlighting the work of ATE projects and supporting projects in various aspects of their work, such as archiving, outreach, and connecting with others in the ATE community.
- **ATE Collaborative Outreach and Engagement** raises awareness of the ATE program primarily through the publication of the *ATE Impacts* book.
- **Broadening the Impact of STEM Education** encourages collaboration between community colleges and ATE programs through the dissemination of resources and provision of technical assistance, including the MentorLinks program.
- **EvaluATE** strengthens the evaluation capacity of those involved with ATE projects through training, networking opportunities, and research, including administration of the ATE annual survey.
- **Mentor-Connect** is a mentoring and leadership development program for two-year institutions of higher education new to the ATE program.

Collectively, these six projects reported the following achievements:

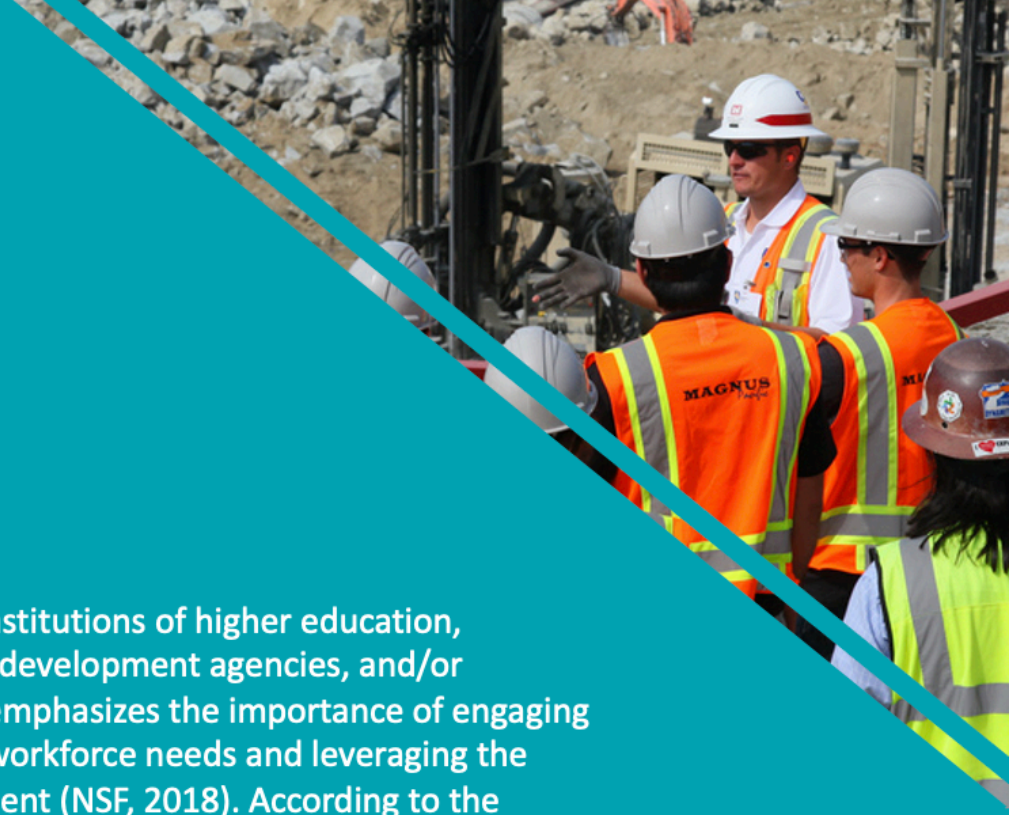
Delivered 5 workshops
that engaged an average of
180 people per workshop

Delivered 16 webinars
that engaged an average of
320 people per webinar

Provided over 490 people
with one-on-one technical assistance

All survey respondents were invited to report on the ways in which their projects served and supported the ATE program, even if that was not the main focus of their work. Thirty-five additional projects identified ways that their projects served the ATE community.

23 projects developed and disseminated resource materials
21 projects held in-person workshops
12 projects offered webinars
21 projects provided technical assistance to individuals



COLLABORATION

NSF encourages ATE projects to partner with other institutions of higher education, secondary schools, businesses, industries, economic development agencies, and/or government agencies. The ATE program solicitation emphasizes the importance of engaging with industry to ensure programs are responsive to workforce needs and leveraging the assets of industry in preparing students for employment (NSF, 2018). According to the Brookings Institution, hallmarks of successful community college based workforce training programs include employer involvement in curriculum development and workplace experiences for students (Soliz, 2016).

ATE PIs were asked about the types of entities with which they collaborated and the benefits of those collaborations, including monetary and in-kind support. Projects that collaborated with business and industry were asked to identify the specific ways in which they worked with these groups.

COLLABORATION

ATE projects collaborated with over 8,500 other organizations and institutions.

In 2019, ATE projects collaborated with 2,710 business and industry partners, 2,370 K–12 schools, 2,030 colleges, 470 entities within their host institutions, 340 public agencies, and 100 other types of partners. ATE projects collaborated with a median of five business and industry groups, four K–12 schools, two colleges, and two other ATE projects.

ATE projects most frequently collaborated with **business and industry** groups, followed by **other two- or four-year colleges**.

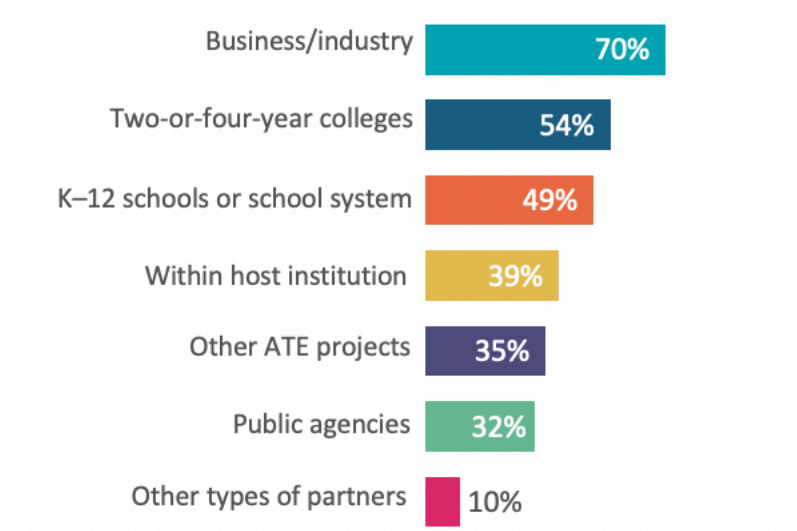


Figure 21. Percentage of ATE projects that collaborated with other groups, by type (n=294)

Most projects that indicated they worked with other types of partners identified these collaborators as nonprofit institutions and professional associations.

Collaborators provided over $16 million in monetary and in-kind support to 123 ATE projects.

$9,676,730 monetary support

$7,139,930 in-kind support

Nineteen percent of projects reported receiving monetary support from collaborators, while 33% reported receiving in-kind support. The median contributions for monetary support and in-kind support across projects were $29,000 and $10,000, respectively. A few projects accounted for a large proportion of the monetary and in-kind support received from external collaborators. Specifically, two projects reported 59% of the total monetary support, while four other projects reported 46% of the total in-kind support received by ATE projects in 2019. Projects reported that in-kind support primarily consisted of staff time (24%) and equipment (21%). Other types of in-kind support included access to facilities, materials, and software.

COLLABORATION WITH BUSINESS AND INDUSTRY

Sixty-four percent of ATE projects collaborated with business and industry partners.

A total of 187 projects reported collaborating with business and industry groups. Most used these partners to identify workforce needs, review and advise on curriculum, or assist with instruction.

Figure 22. Percentage of projects reporting contributions from business and industry partners (n=187)

Business and industry representatives serve on advisory boards for 159 projects. Most of these projects (60%) reported that their advisors from business and industry committed two to five hours per year to their ATE projects.

When asked to identify benefits of collaborating with different organizations and groups, such as advisory boards, PIs frequently pointed to the utility of the information that they received from them. For example, as one PI noted, they provide:

> **"an exchange of information that has ultimately made the project more successful. Shared information led to improvements in quality, speed, and overall project productivity."**

Collaborations with industry groups were also noted by PIs as important to project innovation and growth, allowing PIs' work to "reach a larger audience" and "understand industry needs."

Industry partnerships also benefited students by helping to

> **build avenues for students to connect with relevant real-world experiences ranging from specific case studies explored in class to internships, apprenticeships, and ultimately employment in the field."**

EVALUATION

Each ATE project is required to have an evaluation component to assess its quality and effectiveness. Evaluation of ATE and other NSF-funded projects is intended to serve two distinct purposes: (1) Produce information that can be used to improve a project as it is being implemented and (2) Determine and document a project's achievements (Frechtling, 2010).

ATE PIs were asked about their evaluators and interactions with them, as well as their projects' use and dissemination of evaluation results.

EVALUATION

Eighty-nine percent of ATE projects engaged an evaluator.

Two-hundred sixty-two ATE projects (89%) had an evaluator in 2019. Of the 32 PIs who said they did not have an evaluator, 16 were in their first year of funding. **Of the 262 projects with an evaluator, 87% reported having an external evaluator, with 10% having both an internal and external evaluator and 3% having only an internal evaluator.**

Thirty-two percent of PIs reported that they interacted with their evaluators continually (at least once a week) or often (two or three times a month), while 42% interacted with their evaluators occasionally (more often than quarterly) and 26% did so infrequently or rarely (once a quarter or less).

Almost half of ATE projects received **both oral and written** evaluation reports.

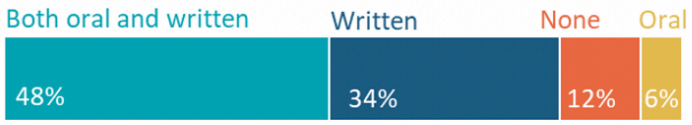


Figure 23. Types of evaluation report received by ATE projects (n=262)

Of the 231 PIs who received evaluation reports, 71% indicated their project's evaluation caused them to make a change in implementing their project, and 51% indicated the evaluation caused them to make a change in their project's goals, objectives, or target audience.

Most projects shared their evaluation results with NSF program officers, executive administrators, and their project advisory committee.

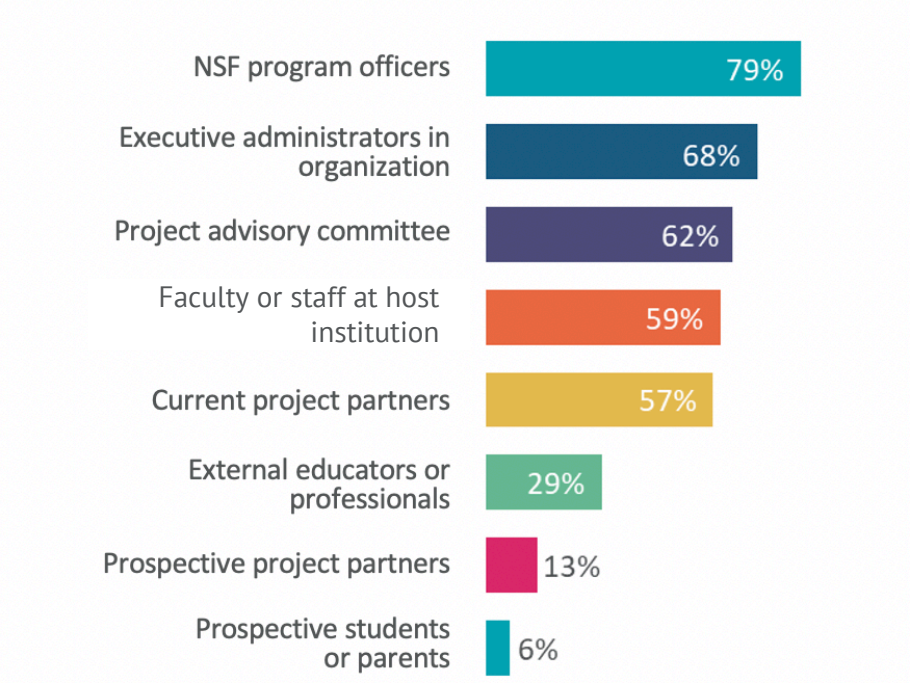


Figure 24. Percentage of projects that shared their evaluation results with various audiences (n=216)

ATE ANNUAL SURVEY
2020 HIGHLIGHTS

This summary of activities and achievements of the Advanced Technology Education (ATE) program is based on the 2020 ATE survey. Principal investigators for 91% (n=294) of ATE grants completed the survey, out of a total of 325 ATE grants. This included 247 projects, 32 centers, 4 conference grants, and 11 targeted research projects.

153 DEGREE PROGRAMS AND 454 COURSES
were developed by 125 ATE projects.

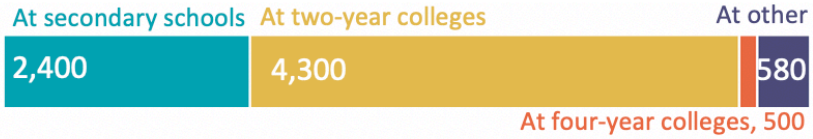
Almost half (49%) of all academic degree programs developed were certificate programs, and a majority (84%) of courses developed were at the associate degree level.

68
Associate degree programs served 5,790 students

75
Certificate programs served 3,760 students

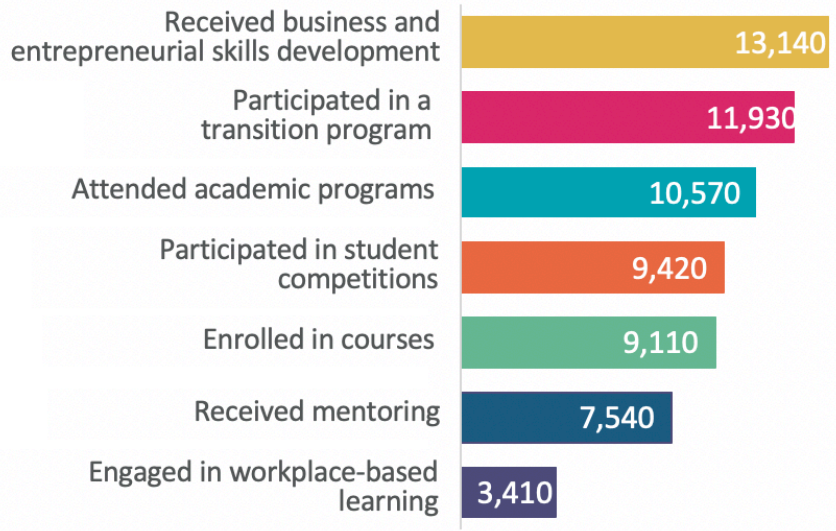
7,820 EDUCATORS
participated in 1,070 professional development activities.[1]

The main audiences for ATE professional development activities were educators at **secondary schools** and **two-year colleges**.



65,000+ STUDENTS
were served by ATE projects.

ATE projects served over 65,000 students through a variety of activities.[1]



[1] Due to the structure of the survey questions, educator and student counts cannot be combined because of the the high probability of double-counting individual students.

ATE ANNUAL SURVEY

2020 HIGHLIGHTS (continued)

7,110 EDUCATIONAL MATERIALS

were developed by 126 ATE projects.

Educational materials developed included assessment activities, modules or instructional units, lessons, lab experiments, curricula, case studies, instructor guides, and textbooks.

3,310
Assessment activities or tests

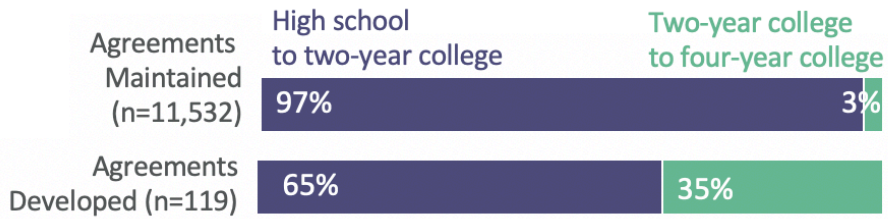
1,160
Modules or instructional units

1,010
Lessons or lesson plans

11,651 ARTICULATION AGREEMENTS

were developed or maintained by 62 ATE projects.

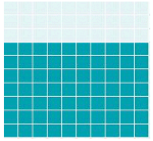
4,300 students matriculated to a higher-level education institution with the aid of an ATE-supported articulation agreement.



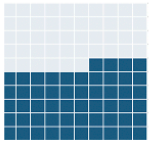
8,500 COLLABORATORS

were engaged by ATE projects.

ATE projects most frequently collaborated with business and industry groups and other colleges and universities.



70% collaborated with **business and industry groups**



54% collaborated with **other two- and four-year colleges**

OTHER ACTIVITIES were conducted by ATE projects in 2019 in support of advanced technological education.

ATE projects engaged in a wide range of activities. More information about those listed below and others can be found in the full report.

operated **5 coordination networks**

conducted **11 research studies**

hosted **16 conferences**

developed **163 publications**

This material is based upon work supported by the National Science Foundation under grant number 1600992. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

TECHNICAL NOTES

[i] The 2020 ATE survey asked about the racial, ethnic, and gender identities of students in alignment with how the National Center for Education Statistics requests student demographic data from colleges. This involves asking students' race, ethnicity, and gender in a single question. This approach differs from years prior to 2019, when PIs were asked to report on the race, ethnicity, and gender identities of their students in separate questions. Additionally, ATE PIs were asked to report demographics for only students who had attended at least one course in an academic program that was developed or substantially modified in 2019. Prior to 2019, projects reported student demographic information on students who attended at least one course in an ATE-supported academic program. This, in addition to a lower than usual response rate, resulted in a decrease in student demographic data for the 2020 report.

[ii] National data for two-year STEM programs are from the 2017–18 National Center for Education Statistics Digest of Education Statistics *Table 321.40 and Table 321.50.* (Retrieved from https://nces.ed.gov/programs/digest/current_tables.asp.) Selected fields of study include agriculture and natural resources, biological and biomedical sciences, communications technologies, computer and information sciences, construction, engineering and engineering technologies, mechanic and repair technologies/technicians, physical sciences and science technologies, precision production, and transportation and materials moving. While these are not exact comparison groups, they are as close as available data allow.

[iii] Comparison data for student demographics are from the National Center for Education Statistics. The referenced NCES tables were retrieved from https://nces.ed.gov/programs/digest/current_tables.asp. The national percentage of underrepresented minority students at the two-year level reflects STEM degrees conferred in the 2017–18 school year, derived from *Table 321.30*. Selected fields of study are the same as those listed in note ii. National rates for certificate programs are not presented because they are not reported by race and STEM field.

REFERENCES

Amelink, C. T., Artise, S., & Lue, T. K. (2015). Examining the self-efficacy of community college STEM majors: Factors related to four-year degree attainment. *Community College Journal of Research and Practice, 39*(12), 1111–1124.

Anderson, M. K., Tenenbaum, L. S., Ramadorai, S. B., & Yourick, D. L. (2015). Near-peer mentor model: Synergy within mentoring. *Mentoring & Tutoring: Partnership in Learning, 23*(2), 116–132.

Baber, L. D. (2018). "Living in the along": Validating experiences among urban community college students in a college transition program. *Community College Review, 46*(3), 316–340.

Biancani, S., McFarland, D. A., & Dahlander, L. (2014). The semiformal organization. *Organization Science, 25*(5), 1306–1324.

Chai, S., & Freeman, R. B. (2019). Temporary colocation and collaborative discovery: Who confers at conferences. *Strategic Management Journal,* 1–27.

Committee on STEM Education, National Science and Technology Council. (2013). *Federal science, technology, engineering, and mathematics (STEM) education 5-year strategic plan.* Washington, DC: Executive Office of the President. https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/stem_stratplan_2013.pdf

Committee on STEM Education, National Science and Technology Council. (2018). *Charting a course for success: America's strategy for STEM education.* Washington, DC: Executive Office of the President. https://www.whitehouse.gov/wp-content/uploads/2018/12/STEM-Education-Strategic-Plan-2018.pdf

Crisp, G. (2010). The impact of mentoring on the success of community college students. *The Review of Higher Education, 34*(1), 39–60.

Davis, E. A., Janssen, F. J. J. M., & Van Driel, J. H. (2016). Teachers and science curriculum materials: Where we are and where we need to go. *Studies in Science Education, 52*(2), 127–160.

Edgecombe, N. (2019). Demography as opportunity. *Community College Research Center Working Paper, 16.* https://ccrc.tc.columbia.edu/publications/demography-opportunity.html

Frechtling, J. (2010). *The 2010 user-friendly handbook for project evaluation*. Washington, DC: National Science Foundation.

Jackson, D. (2014). Employability skill development in work-integrated learning: Barriers and best practice. *Studies in Higher Education, 40*(2), 350–367.

Merolla, D. M., & Serpe, R. T. (2014). STEM enrichment programs and graduate school matriculation: The role of science identity salience. *Social Psychology of Education, 16*(4), 575–597.

Miller, K., Sonnert, G., & Sadler, F. (2018). The influence of students' participation in STEM competitions on their interest in STEM careers. *International Journal of Science Education, 8*(2), 95–114.

National Academies of Sciences, Engineering, and Medicine (NAS). (2017). *Building America's skilled technical workforce*. Washington, DC: The National Academies Press.

National Academy of Engineering and National Research Council. (2012). *Community colleges in the evolving STEM education landscape: summary of a summit.* Washington, DC: National Academies Press. http://www.nap.edu/catalog.php?record_id=13399

National Science Foundation (NSF). (2018). *Advanced technological education program solicitation* (NSF18-571). Washington, DC: Author. https://www.nsf.gov/publications/pub_summ.jsp?WT.z_pims_id=5464&ods_key=nsf18571

National Science Foundation (NSF). (2019). *Women, minorities, and persons with disabilities in science and engineering.* Washington, DC: Author. https://ncses.nsf.gov/pubs/nsf19304/digest/about-this-report

Scientific and Advanced-Technology Act of 1992, Pub. L. No. 102–476, 106 Stat. 2297 (1992). https://www.govinfo.gov/content/pkg/STATUTE-106/pdf/STATUTE-106-Pg2297.pdf#page=4

Soliz, A., (2016). *Preparing America's labor force: Workforce development programs in public community colleges.* Washington, DC: Brookings Institution. https://www.brookings.edu/research/preparing-americas-labor-force-workforce-development-programs-in-public-community-colleges/

Strickland-Davis, S., Kosloski, M., & Reed, P. A. (2019). The impact of professional development grounded in social learning on community college faculty efficacy. *Community College Journal of Research and Practice.*

ATE Annual Survey

2020 Report

December 2020

Valerie A. Marshall
Lyssa Wilson Becho
Lori A. Wingate
Arlen Gullickson

Suggested citation:

Marshall, V. A., Becho, L. W., Wingate, L. A., & Gullickson, A. (2020). *ATE annual survey: 2020 report*. Kalamazoo, MI: The Evaluation Center, Western Michigan University. Retrieved from http://www.evalu ate.org/annual_survey/

This material is based upon work supported by the National Science Foundation under grant number 1600992. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.