ATE Survey 2019

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

EvaluATE

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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 2019 survey of ATE program grantees. Conducted by EvaluATE (the evaluation hub for the ATE program, located at The Evaluation Center at Western Michigan University), this annual ATE survey was the 20th. Included in this report are findings about ATE projects and their activities and achievements during the 2018 calendar year (and 2018 fiscal year for budget-related questions).

The 2019 survey was a census of ATE principal investigators (PIs) with active grants (N=304). Ninety-two percent (n=279) 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 2019 survey with those of previous years. 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 never before addressed in the ATE survey's history, 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 lyssa.becho@wmich.edu.

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 focus, 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-two percent of ATE grants were for projects (which includes a variety of subcategories of project types). Among the 229 project grants, 50 were designated for institutions new to the ATE program and three were planning grants. Of the 32 centers, 11 identified as national centers, 13 as regional centers, and eight as support or resource centers.

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

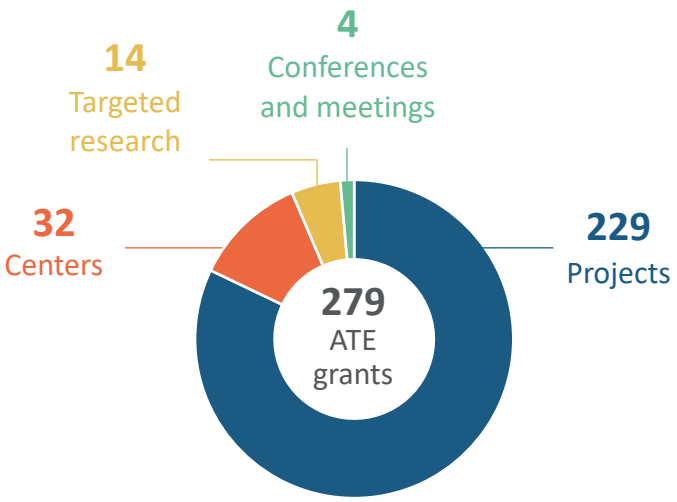


Figure 1. Types of ATE grants awarded (n=279)

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=279)

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 203 grants awarded to two-year colleges supported 175 projects, 23 centers, and five targeted research studies. Most of the 14 targeted research projects (57%) are located at four-year colleges, while conference grant recipients are mainly located at nonprofit organizations (75%).

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 general advanced technological education.

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.

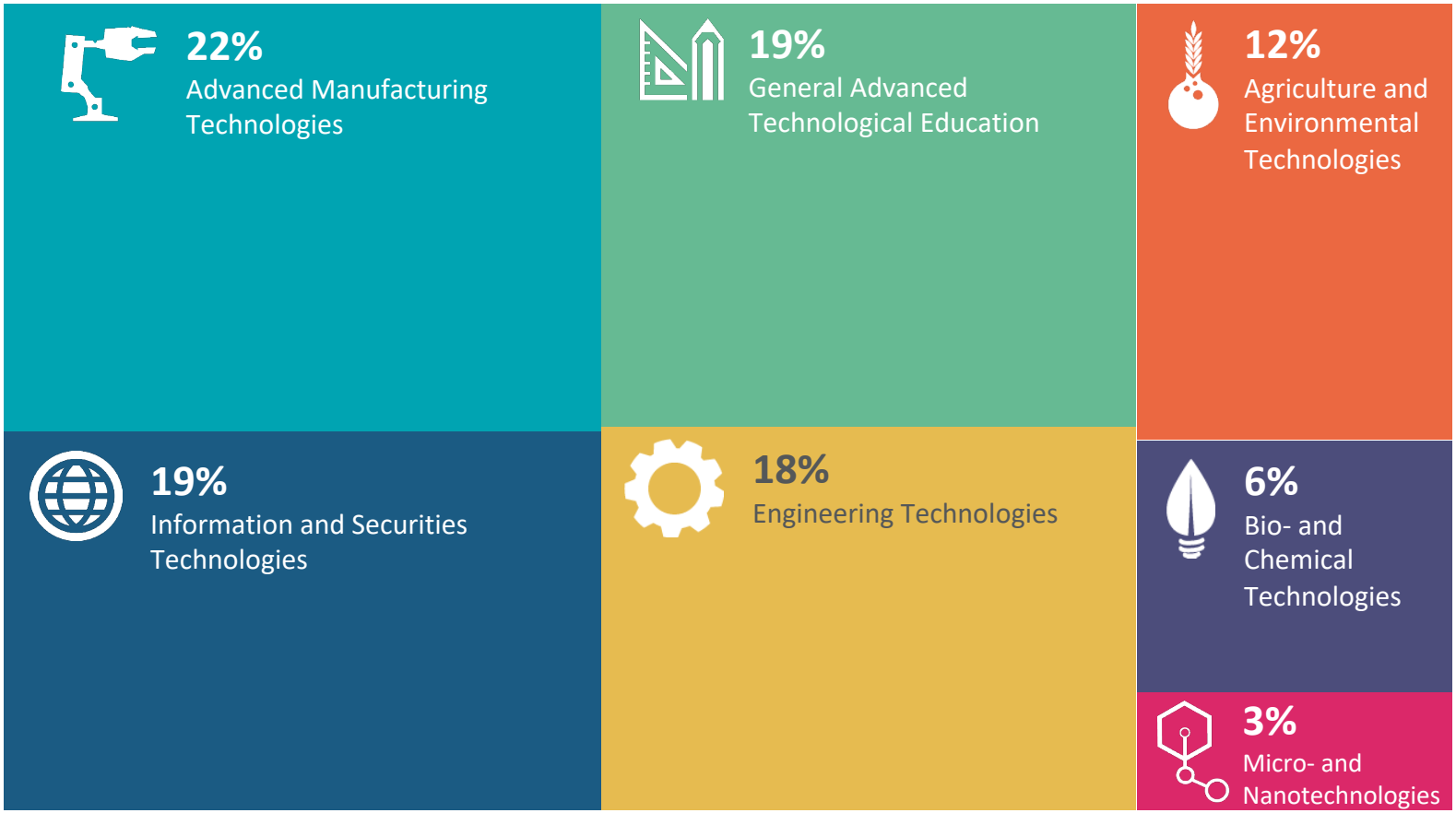


Figure 3. Disciplinary areas of ATE projects (n=279)

ATE PROJECT ACTIVITIES

ATE projects engaged in a variety of activities in 2018 to improve the education of science and engineering technicians.

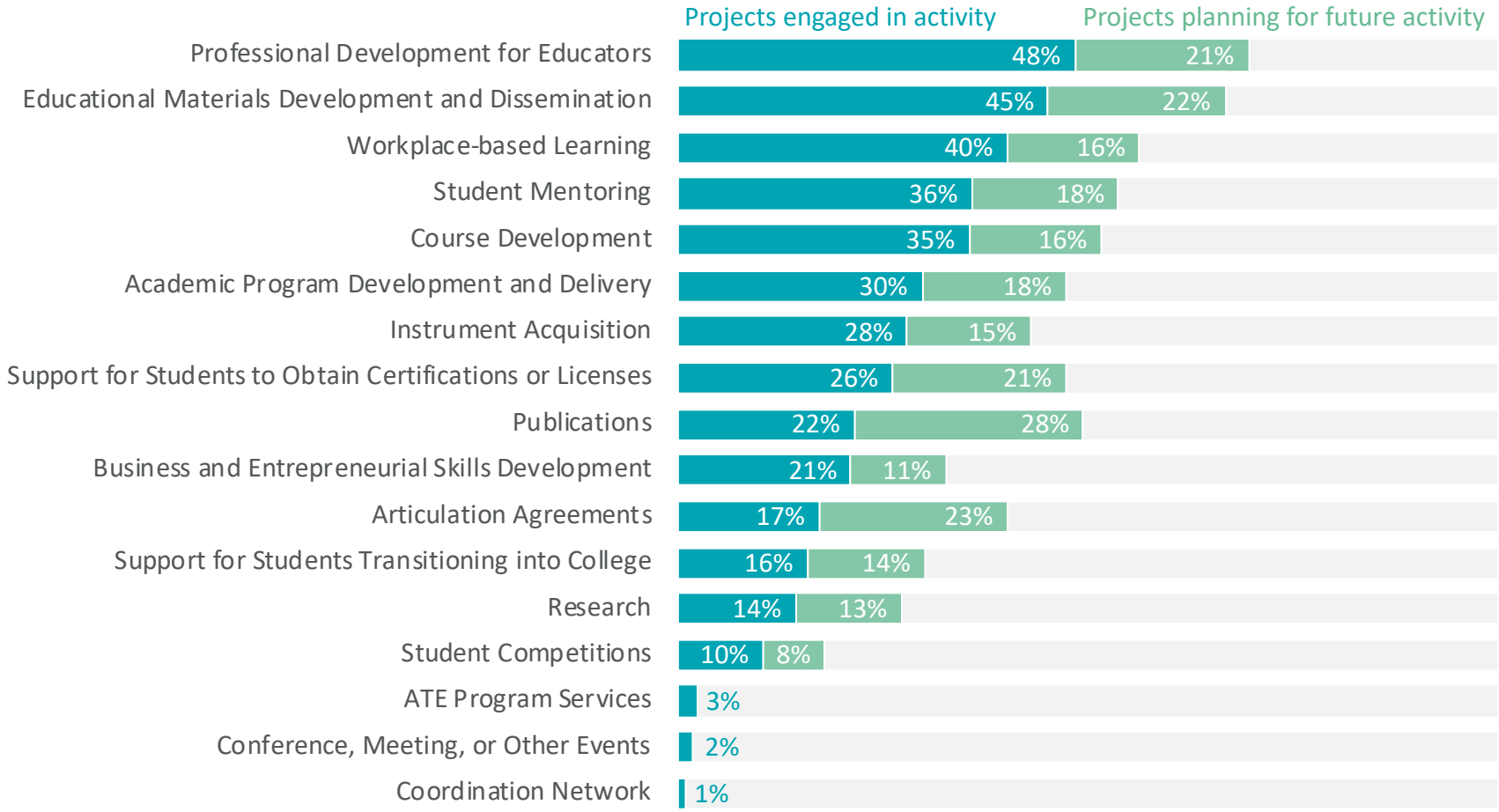


Figure 4. Percent of projects that reported engaging in activities in 2018 and planning activities for the future (n=279)

ATE PROJECTS AT MINORITY-SERVING INSTITUTIONS

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

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

Forty-nine 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 253 projects at IHEs, 26% are at IHEs that are designated as minority-serving. The majority of these IHEs (75%) are Hispanic-serving. Predominantly Black or historically Black colleges and universities make up 8% 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.

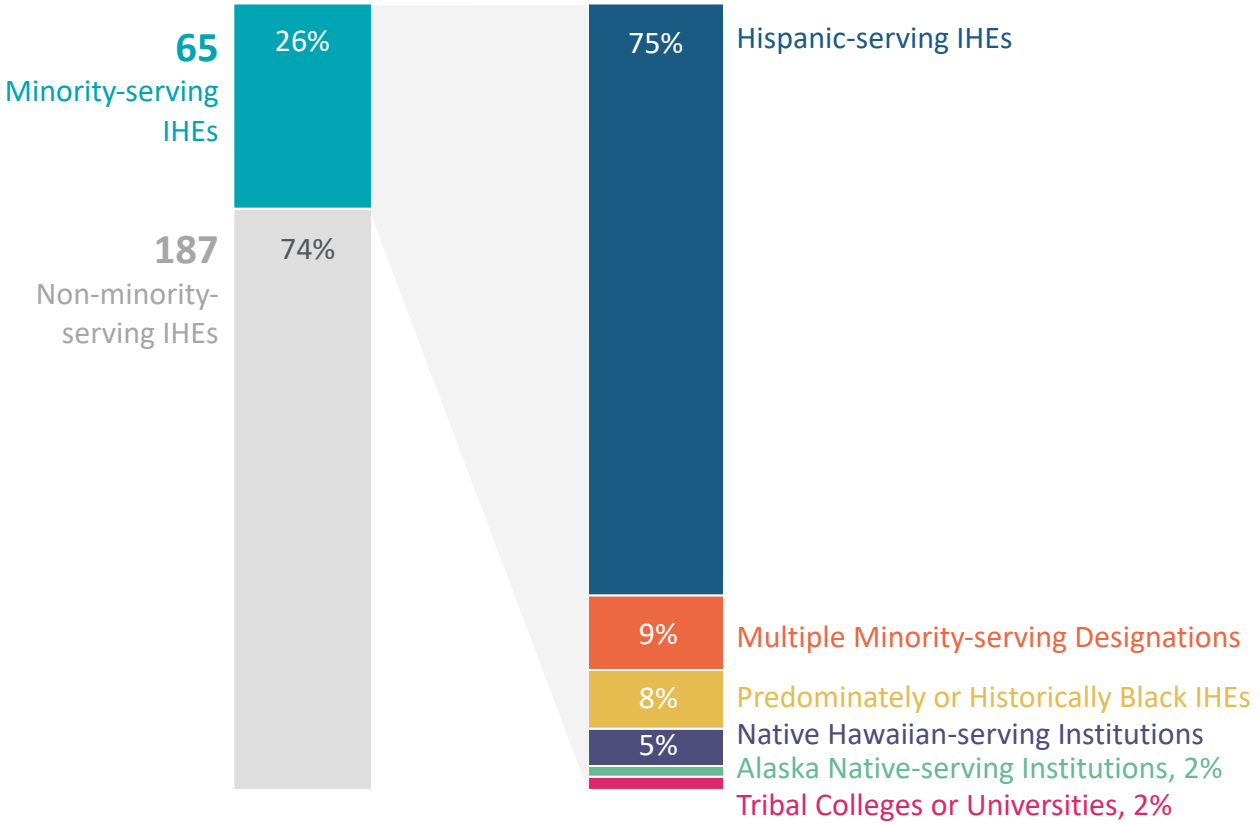


Figure 5. ATE projects at minority-serving institutions (n=65)

ATE PRINCIPAL INVESTIGATORS

Twelve percent of ATE projects have PIs from historically underrepresented racial and ethnic groups.

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 identity of ATE PIs (n=273). Each icon represents 1%.

Thirteen percent of ATE PIs are over the age of 65, while 33% are between the ages of 55 and 64, 29% are 45–54, 21% are 35–44, and 3% are 25–34.

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

Eighty-one percent of ATE projects have a PI who identifies as white.

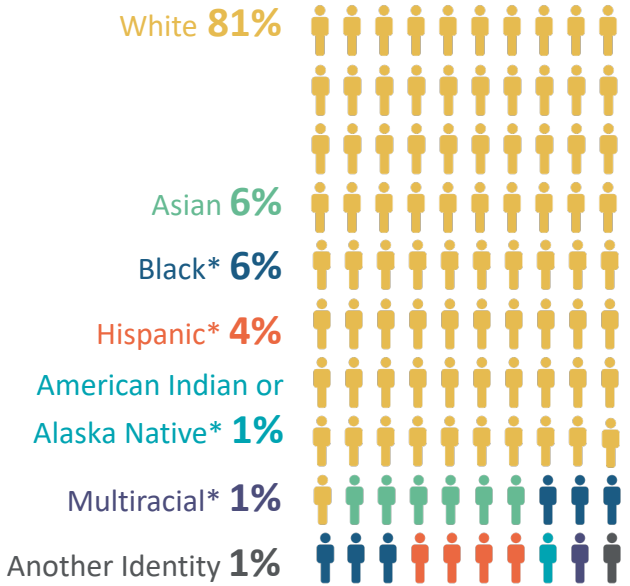


Figure 7. Racial and ethnic identity of ATE PIs (n=272). Each icon represents 1%. *Historically underrepresented racial and ethnic groups.

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

Thirty 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).

ATE PIs were asked to identify the degree or certificate programs that their projects created or improved with ATE funding, the demographic characteristics of students served by those programs, and how many students enrolled in and completed the programs.

A total of 160 academic degree programs were developed or substantially modified by 83 ATE projects in 2018. Most of these programs award associate degrees (51%), followed by certificates (40%). Four programs award bachelor's degrees and nine programs provide other types of credentials. Nearly 12,000 students attended at least one course in these academic programs, with a total of 710 completing the program in 2018; 410 students completed an associate degree program, while 300 students completed a certificate program. Programs with students completing academic programs graduated an average of 11 students in 2018.

82 Associate degree programs served
6,810 students

64 Certificate programs served
4,870 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 half of the ATE projects that developed or modified academic programs emphasized recruitment of **women** or **underrepresented racial or ethnic minority students**.

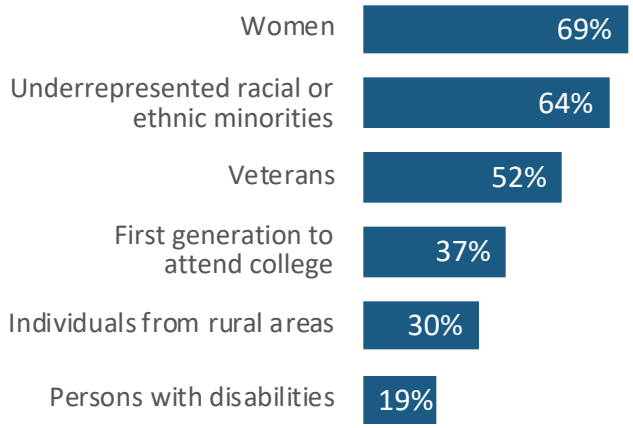


Figure 8. Percentage of projects that emphasized recruitment of students from specific demographic groups (n=70)

STUDENTS SERVED BY ATE ACADEMIC PROGRAMS

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

Of the 160 academic programs that were developed or modified by ATE projects in 2018, only 49 of them reported student characteristics. Due to this low response rate, and changes in the survey questions, the numbers reported here do not presume to 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, 28% of ATE students are women, although the proportion of women varies by education level and discipline. According to the U.S. Department of Education, 25% 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.

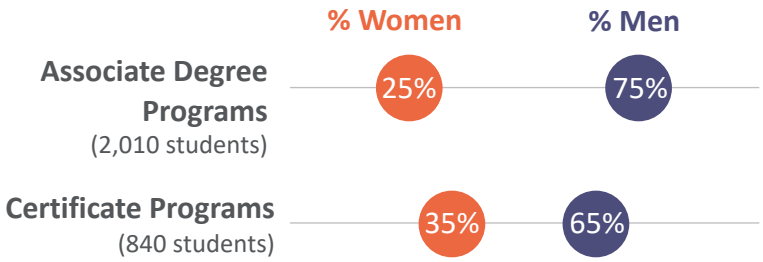


Figure 9. Percentage of women and men in ATE-supported academic programs by degree level (n=49)

Students who identify as Black/African American, Hispanic/Latino or Latina have a greater 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])

Students who identify as Black/African American and Hispanic/Latino or Latina are generally well-represented in the ATE program.

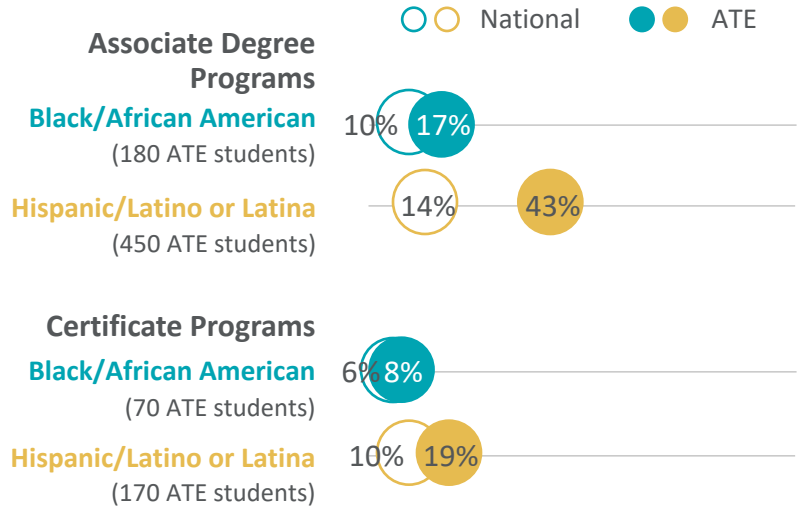


Figure 10. Percentage of students from underrepresented racial and ethnic minority groups in ATE-supported academic programs by degree level, compared with national rates (n=49)

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 level of these courses, their primary delivery mode, and how many students enrolled in the courses. ATE projects that engaged in course development may have done so as part of a larger initiative to develop or modify an entire degree or certificate program, or as a stand-alone effort.

A total of 423 courses were developed by 99 projects in 2018. The majority of these courses were for two-year college students (90%).

21
High school courses were developed by
10
ATE projects

380
Two-year college courses were developed by
89
ATE projects

15
Four-year college courses were developed by
6
ATE projects

Fifty-two percent of these 423 courses were offered in 2018.

6,900 students
were enrolled in an ATE-developed or -modified course in 2018

ATE PIs were asked about the primary delivery modes for each of the courses they developed or modified. While there is increasing demand for online courses, ATE courses are still primarily developed for face-to-face classroom instruction.

Most courses developed or modified are **face-to-face**, not **online** or a **hybrid** of both.

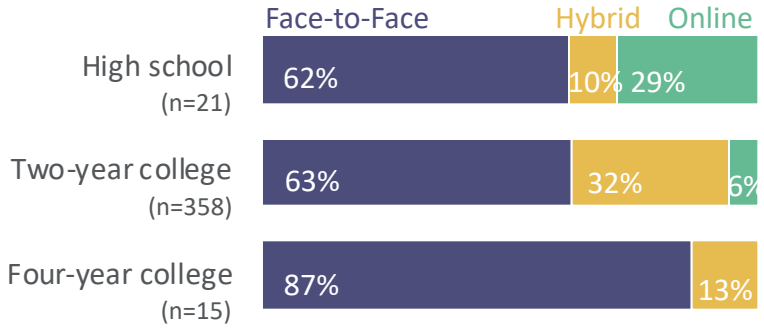


Figure 11. Percentage of course delivery mode by education level.

INSTRUMENT ACQUISITION

Twenty-eight 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.

Seventy-eight ATE projects acquired instrumentation or equipment in 2018. The PIs for these projects were asked to identify what they purchased (due to the diversity of responses to this open-ended question, their answers could not be readily classified).

ATE projects obtained a wide array of technical devices in 2018 to support instruction:

3-D printers

Virtual reality viewers

Computers

Drones

Laser engravers

Laboratory equipment

Projects that used ATE funding to purchase instruments or equipment are expected to revise their academic programming to maximize the value of the items to enhance student learning.

A median of 50 students used the equipment or instrumentation acquired by each ATE project.

3,450 students
benefited from purchased equipment

300 educators
used the purchased equipment

230 courses
used the purchased equipment

ARTICULATION AGREEMENTS

Seventeen 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).

Forty-eight projects developed or maintained articulation agreements in 2018.

ATE-supported articulation agreements involved almost 1,000 institutions and were used by 4,000 students in 2018.

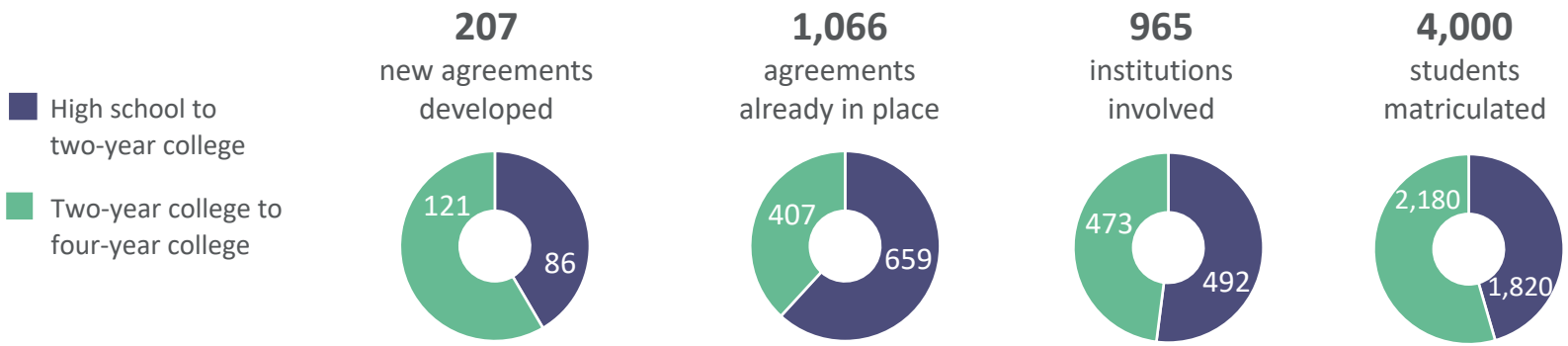


Figure 12. Number of articulation agreements, institutions, and students who matriculated in 2018 (n=48)

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 the 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-five percent of ATE projects created or substantially modified educational materials.

126 ATE projects developed or modified over 7,110 educational materials in 2018.

3,310
Assessment activities or tests

1,160
Modules or instructional units

1,010
Lessons or lesson plans

550
Lab experiments

340
Course curricula

330
Case studies or problem sets

Other materials developed include 130 instructor guides, 120 program curricula, 80 interactive simulations, and 50 textbooks.

The educational materials created by ATE projects were primarily disseminated through the projects' websites (66%), followed by clearinghouses or repositories maintained by other organizations (21%). Less than 10% pursued commercial publication as a way to disseminate their educational materials (8%). Fifty-two projects indicated "other" ways of dissemination, with 20 projects noting they disseminated materials at conferences and workshops. Additional avenues of dissemination included sharing via academic and industry partnerships.

Ninety-two ATE projects continued to disseminate educational materials that were created prior to 2018. These materials were primarily course curricula (53%), modules or instructional units (49%), and program curricula (45%). ATE projects also reported continued dissemination of instructor guides (39%), lab experiments (39%), and lesson plans (37%) created in previous years.

The most prominent avenues for continued dissemination mirror those for newly created materials. Sixty-seven percent of projects that developed educational materials in previous years posted materials on their websites, 28% disseminated materials at conferences or workshops, and 17% posted materials to clearinghouses or repositories maintained by other organizations.

Twenty-six of the 126 projects that developed educational materials kept track of what other institutions are using their program and/or course curricula.

540 institutions
Used program and/or course curricula created by 22 ATE projects

STUDENT SERVICES 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

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

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

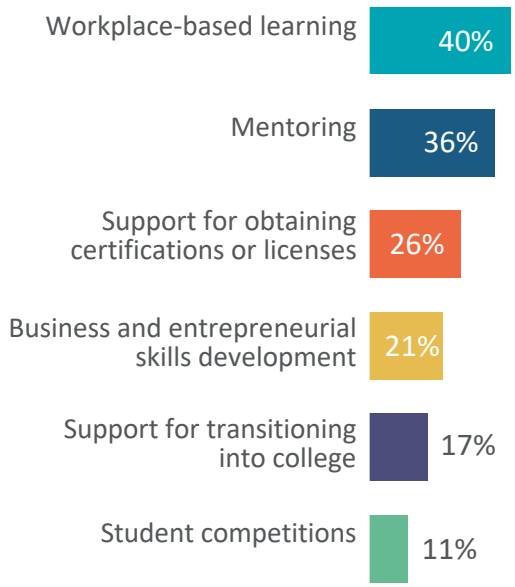


Figure 13. Percentage of projects that provided student services and support (n=279)

BUSINESS AND ENTREPRENEURIAL SKILLS

Business and entrepreneurial skills development involves working with students to develop their skills in areas such as — but not limited to — business development, marketing, networking, and understanding the global marketplace. While research on the impact of entrepreneurial education is mixed, it is generally agreed that it is an important component of STEM education and part of a national strategy to "accelerate innovation" (Winkler, et al., 2015). Twenty-one percent of ATE projects engaged students in building their business and entrepreneurial skills.

A total of 7,380 students received business and entrepreneurial skills development from 59 ATE projects in 2018.

The three most frequently used strategies for this skill development were in-course units or activities (56%), mentoring or coaching (53%), and workshops (36%). Projects also reported developing students' business and entrepreneurship skills through clubs (25%), entire courses (17%), and incubator programs (5%).

STUDENT SERVICE AND SUPPORT (continued)

Thirty-six percent of ATE projects provided students with mentoring or coaching, and 10% 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 **9,700** students received mentoring through ATE projects.

4,700
High school students

4,390
Two-year college students

600
Four-year college students

Mentoring was most often provided by educational faculty or staff (88%), followed by business and industry professionals (51%) and students or peers (39%). Twenty-six 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).

8,570 students participated in one of the 84 student competitions hosted or organized by ATE projects. The most common areas for competitions included:

47
robotic competitions engaged
7,780
students

13
cybersecurity competitions engaged
150
students

6
bio- and chemical-tech competitions engaged
370
students

Eighteen other competitions engaged 270 additional students. Topics ranged across ATE disciplinary areas, including cyberdefense, welding, manufacturing, and vegetable crop judging.

STUDENT SERVICE AND SUPPORT (continued)

Sixteen percent of ATE projects provided extra support for students transitioning into college, and 26% 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 aimed at **high school students**.

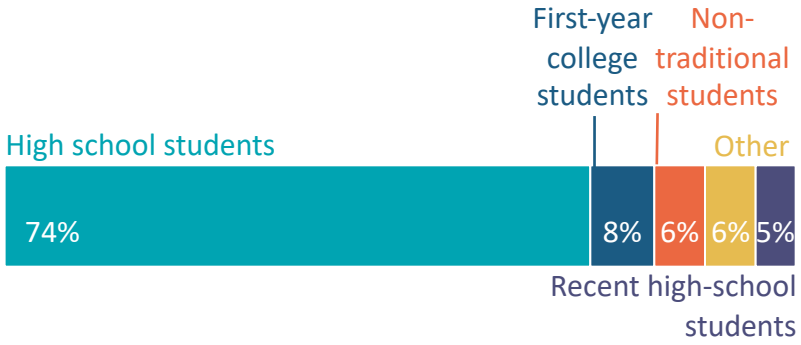


Figure 14. Primary audience for transition programs supported by ATE projects (n=62)

Over **5,000** students transitioning into college received support from ATE projects.

4,730
High school students

120
First-year college students

140
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 student 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-three ATE projects provided students with support for obtaining certifications or licenses in 2018. Open-ended survey responses indicate that the ATE projects that supported students in obtaining certifications or licenses did so primarily by embedding certification requirements within courses, offering preparatory courses, paying students' testing fees, or serving as a testing center.

WORKPLACE-BASED LEARNING

Workplace-based learning includes any situation in which a student gains experience at a work site, such as through internships, apprenticeships, job shadowing, and field trips to industry sites. 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 2018.

WORKPLACE-BASED LEARNING

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

A total of 7,290 students participated in workplace-based learning offered by 112 ATE projects in 2018. Internships, apprenticeships, and co-op learning were the most time-intensive opportunities. Participating students committed a median of 20 hours per week over 12 weeks per year to internships, 24 hours per week over 42 weeks per year to apprenticeships, and 16 hours per week over 13 weeks per year to co-op learning.

Students were paid and/or received academic credit for most internships, apprenticeships, or externships offered by ATE projects.

71%
of workplace-based learning opportunities **paid students**
(n=72)

61%
of workplace-based learning opportunities included **academic credit**
(n=72)

ATE PIs were asked to identify the types of workplace-based learning their projects offered. Definitions of the types of learning opportunities listed on the survey were not provided since there is substantial variation in the literature in terms of how these activities are conceptualized and implemented.

Internships made up almost half of workplace-based learning opportunities offered by ATE projects.

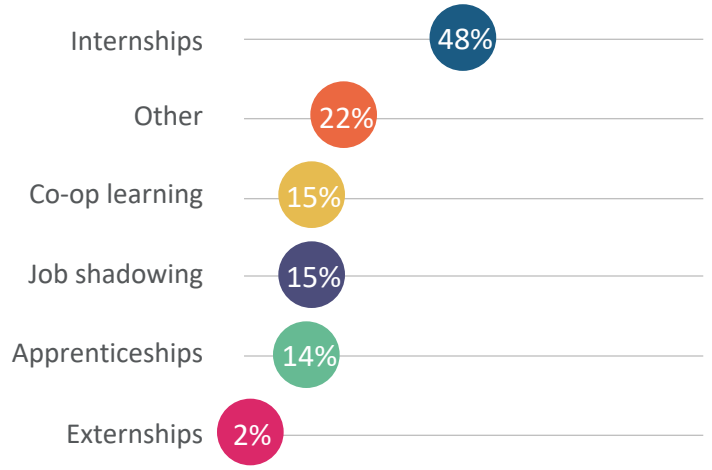


Figure 15. Percentage of ATE projects that offered each type of workplace-based learning (n=112)

Additionally, 60% of ATE PIs whose projects offered workplace-based learning identified field trips to business or industry sites as one of their opportunities. The 22% of respondents who selected *other* explained that they offered employment placement, industry/college partnership project, service learning, laboratory exercises, and work study experiences. (These examples may or may not meet a strict definition of workplace-based learning.)

PROFESSIONAL DEVELOPMENT FOR EDUCATORS

Community college faculty have diverse responsibilities. They not only design and deliver courses, but also 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

Forty-eight percent of ATE projects provided training or professional development to current or future educators.

One-hundred and thirty-five ATE projects provided a total of 1,080 training or professional development activities for educators in 2018. Most of these activities were a day or less in length (58%), including webinars and one-day workshops. Almost a third lasted more than one day but less than a week (30%) including in-person multi-day workshops and online modules. The remaining 12% of activities lasted one week or longer, including courses, summer institutes, internships, and peer coaching.

ATE projects offered 1,080 professional development activities for educators in 2018.

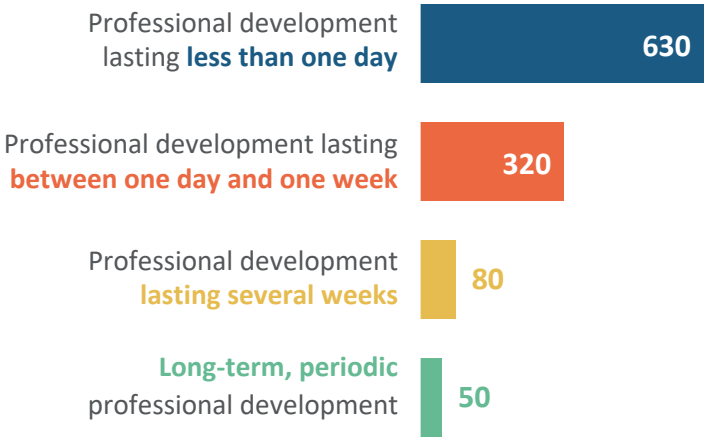


Figure 16. Number of professional development activities for educators by length of time (n=132)

Professional development activities primarily focused on discipline- or industry-specific knowledge or skills (77%), followed by training on specific equipment (37%) and teaching pedagogy (31%). A smaller percentage focused on recruitment or retention of students (23%) and other professional skills (17%), such as problem-solving, communication, project development and management, and inclusion practices.

19,330 educators
participated in ATE-sponsored professional development (n=132)

Forty-four percent of educators served by professional development activities were two-year college faculty, followed by high school teachers (33%) and other types of educators (19%). Four-year college faculty made up 3% of professional development participants, and preservice teachers made up 1%.

Thirty-nine projects reported tracking the number of students who were taught by the educators who participated in ATE-supported professional development. According to those projects:

44,050 students
were taught by educators who participated in ATE-sponsored professional development (n=39)

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 name and purpose of the events and number of attendees. Those engaged in network coordination were simply 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

Three ATE projects indicated that they were specifically funded to develop and facilitate coordination networks.

- **Consortium for Advanced Manufacturing of Cell and Tissue-Based Products** is focused on workforce development in manufacturing that constructs biological systems in combination with natural or synthetic materials using robotics, microfluidics, 3-D printing, computational modeling, and novel types of engineering.
- **Technician Education in Additive Manufacturing and Materials** is a coordination network focused on identifying the ways in which the convergence of materials science and additive manufacturing can be addressed in technician education resources.
- **Virtual Reality Coordination Network** brings together innovators in education, industry, and virtual and augmented reality development to create an end-to-end collaborative innovation ecosystem that will enhance learning through virtual and augmented reality-based technologies.

PIs for 58 other projects also said that coordinating a network was part of their funded activities. Their open-ended responses suggest that some of this work may not align exactly with NSF's definition of a coordination network. However, it is clear that several projects actively bring together diverse stakeholders to problem solve, advance common goals, and share knowledge.

CONFERENCES AND MEETINGS

Organizing conferences and meetings was the primary purpose of five ATE projects in 2018. These projects held a total of 10 conferences and meetings. Attendance at these meetings ranged from 20 to 900. ATE PIs identified the purpose of these events as networking and professional development, disseminating best practices, and bringing together stakeholders from industry and education.

10 conferences and meetings
were organized by ATE projects

2,310 people
attended conferences and meetings organized by ATE projects

One-hundred seventy-five other ATE projects indicated that they organized some type of conference, meeting, or similar event in 2018. However, the open-ended responses about the purposes and audiences of these events revealed that many PIs were reporting on conferences and meetings in which project personnel participated, rather than events organized by their projects. Many others reported on meetings that were held for the purpose of their projects' management and oversight. For these reasons, it is difficult to make conclusions about the nature, extent, and reach of professional exchange organized by ATE projects. However, whether organizing or attending, it is apparent that ATE project personnel are actively engaged within their professional communities.

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 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 events).

ATE TARGETED RESEARCH AND PUBLICATIONS

Fourteen percent of ATE projects conducted some type of research, and 22% developed materials intended for publication.

TARGETED RESEARCH

Fourteen ATE projects were specifically funded to conduct targeted research in 2018. At the time of the 2019 survey, 11% of these projects were in the planning phase, while 22% were collecting data, 33% were analyzing data, and 34% were writing up results.

Forty ATE projects indicated they conducted some sort of research in 2018. Examples included reviews of existing literature, informal research on best practices, and surveys of industry partners or participants for program improvement.

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

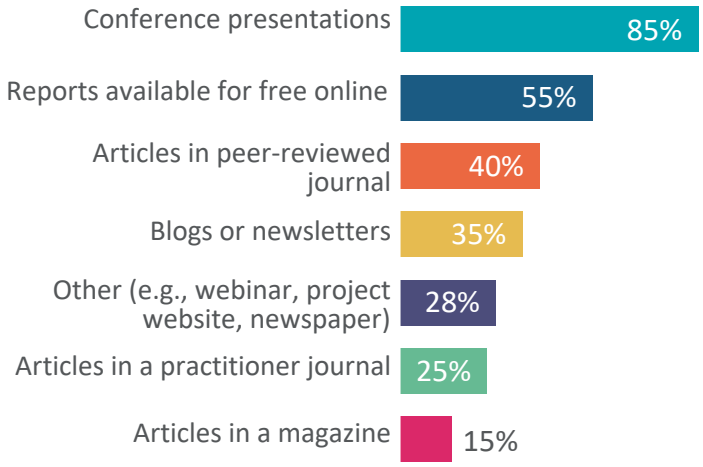


Figure 17. Dissemination channels for research findings (n=40)

PUBLICATIONS

While publication is an expectation for all projects engaged in targeted research, many ATE projects 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).

Sixty ATE projects prepared a total of 228 publications.

32 Manuscripts for academic journals

14 Manuscripts for practitioner journals

26 Reports

59 Magazine articles

PIs reported 97 other types of publications. According to their write-in responses, these included white papers, book chapters, blogs, online news articles, and video media.

ATE PROGRAM SERVICES

The primary purpose of a few ATE projects 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 a narrower area 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

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

Seven ATE projects are funded to provide services and support specifically for ATE grantseekers, grantees, and their affiliates. The projects with a specific focus on serving the ATE community include the following:

- **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 and dissemination.
- **ATE Collaborative Outreach and Engagement Project** 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 evaluation capacity for 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.
- **Promoting STEM Education at Two-Year Colleges** and **ATE Two-Year Colleges** provide proposal writing workshops and a mentoring program for two-year college STEM faculty.

Collectively, these seven projects report the following achievements:

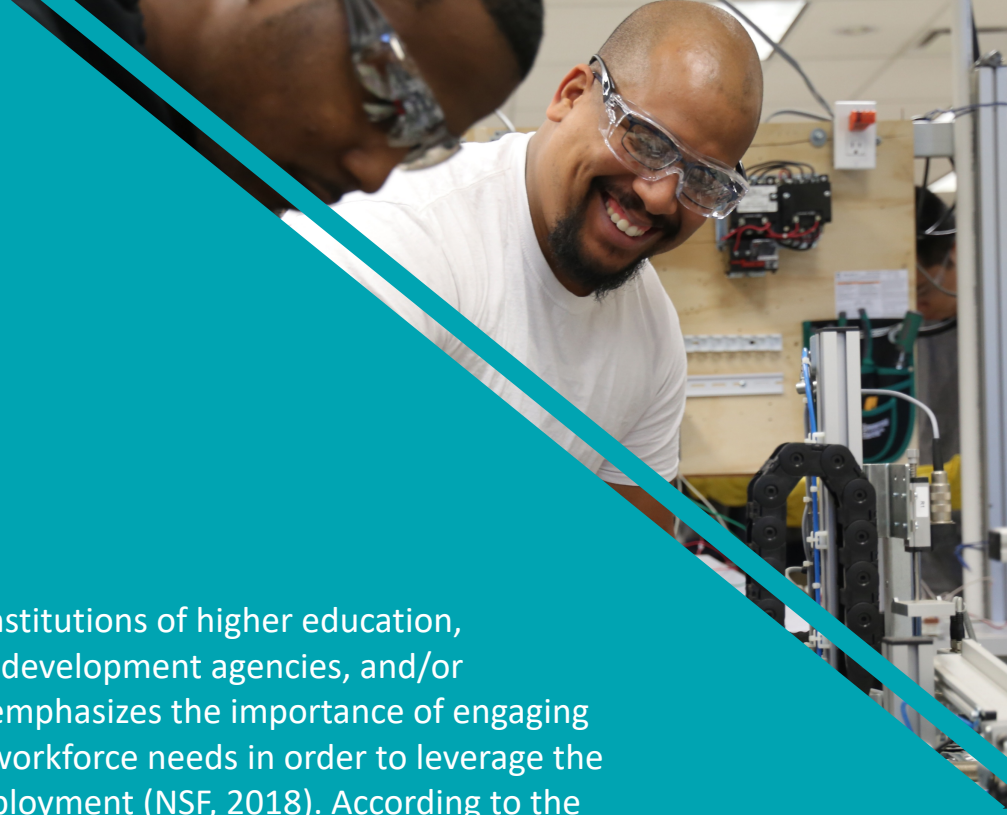
Delivered 5 workshops
that engaged an average of
50 people per workshop

Delivered 18 webinars
that engaged an average of
100 people per webinar

Provided over 290 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. Forty-seven additional projects identified ways that their projects served the ATE community.

23 projects developed and disseminated resource materials
17 projects held in-person workshops
10 projects offered webinars
6 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 in order to leverage the assets of industry in preparing students for their 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 almost 10,000 other organizations and institutions.

In total, ATE projects collaborated with 3,810 business and industry partners, 2,510 K-12 schools, 2,260 colleges, 550 entities within their host institution, 490 public agencies, and 90 other types of partners. ATE projects collaborated with a median of five business and industry partners, four K-12 schools, two colleges, and one other ATE project.

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

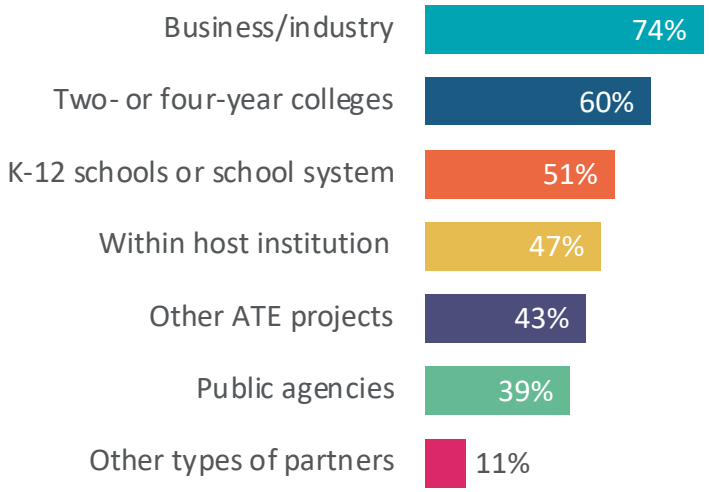


Figure 18. Percentage of ATE projects that collaborated with other groups, by type (n=279)

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

Collaborators provided over $15 million in monetary and in-kind support to 117 ATE projects.

$7,545,200 monetary support

$7,645,450 in-kind support

Eighteen percent of projects reported receiving monetary support from collaborators, while 35% reported receiving in-kind support. The median contributions for monetary support and in-kind support across projects were $29,000 and $10,000, respectively. Just a few projects accounted for a large proportion of the monetary and in-kind supported received from external collaborators. Specifically, three projects reported 43% of the total monetary support, while four other projects reported 42% of the total in-kind support received by ATE projects in 2018. Projects reported that in-kind support primarily consisted of staff time (35%) and equipment (17%). Other types of in-kind support included access to facilities, materials, supplies, and software.

COLLABORATION WITH BUSINESS AND INDUSTRY

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

A total of 207 projects reported collaborating with business and industry partners. Most used these partners to identify workforce needs, serve on advisory boards, or review and advise on curriculum.

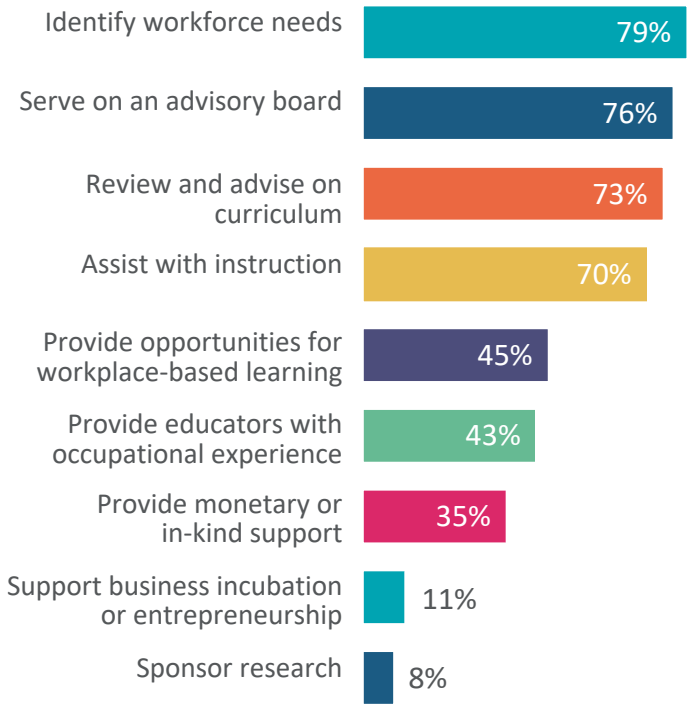


Figure 19. Percentage of projects reporting contributions from business and industry collaborators (n=207)

For the 157 projects that engaged business and industry partners to serve on their advisory boards, 13% reported partners committed one hour or less, 56% committed two to five hours, 25% committed one to two days, and 6% committed more than three days.

PIs whose projects collaborated with business and industry were asked to identify the most important benefits they derived from those collaborations. For example, one PI noted that engaging business and industry partners gave them

> **a greater understanding of industry needs and what needs to be taught in the classroom to ensure graduates are prepared for entry level positions."**

Collaborating with industry allowed projects to "maintain relevant instructional material" and provided "insight into course and curriculum development." Partnerships with industry also benefited students, creating a "sustainable network of work study employers" and "student internships."

One respondent noted that their project was

> **able to offer our students more opportunities for work experience, including internships, and also provide students an opportunity to develop their confidence and presentation skills in sharing information about their career path with others."**

EVALUATION

All ATE projects are required to have an evaluation component to assess their 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

Ninety percent of ATE projects engaged an evaluator.

Most ATE projects (90%) had an evaluator in 2018. Of the 27 PIs who responded they did not have an evaluator, 16 were in their first year of funding. Most projects with an evaluator identified having an external evaluator (88%), with 9% having both an internal and external evaluator and 3% having only an internal evaluator.

Thirty 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 29% did so infrequently or rarely (once a quarter or less).

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

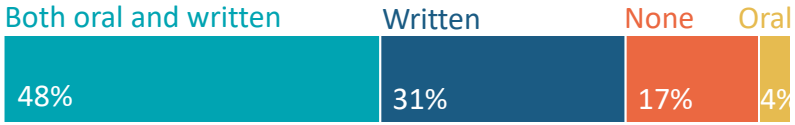


Figure 20. Percentages of projects that received oral and/or written reports (n=249)

Of the 207 PIs who received an evaluation report, 46% indicated their project's evaluation caused them to make a change in implementing their project and 10% 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 and executive administrators, faculty, or staff at their host institutions.

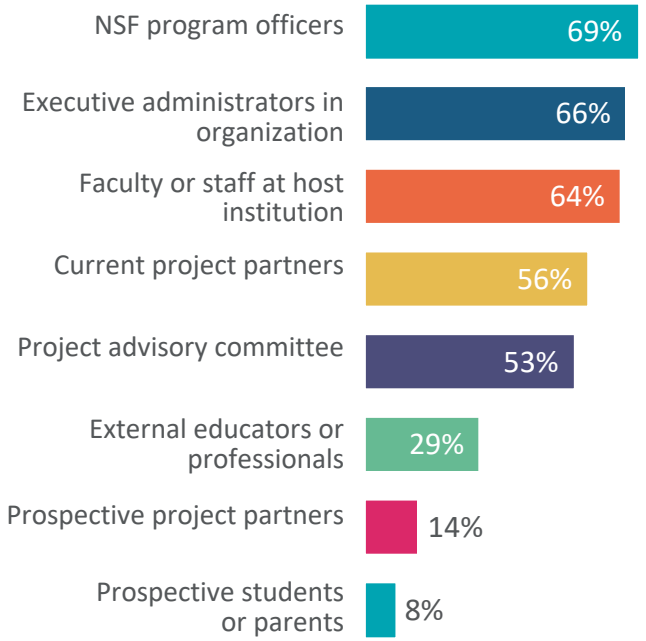


Figure 21. Percentage of projects that shared their evaluation results with various audiences (n=207)

ATE ANNUAL SURVEY
2019 HIGHLIGHTS

This summary of activities and achievements of the Advanced Technology Education (ATE) program is based on the 2019 ATE Annual Survey. Principal investigators for 92% (n=279) of ATE grants completed the survey, out of a total of 304 ATE grants. This included 229 projects, 32 centers, 4 conference grants, and 14 targeted research studies.

160 DEGREE PROGRAMS AND 423 COURSES
were developed by 99 ATE projects.

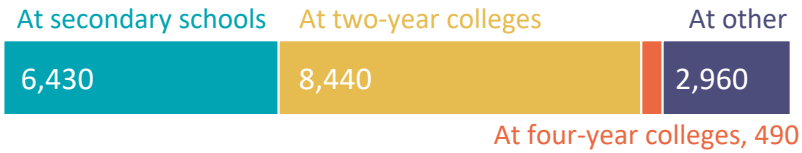
The majority of academic degree programs (51%) and courses (90%) developed were at the associate's degree level.

82
Associate's degree programs served 6,810 students

64
Certificate programs served 4,870 students

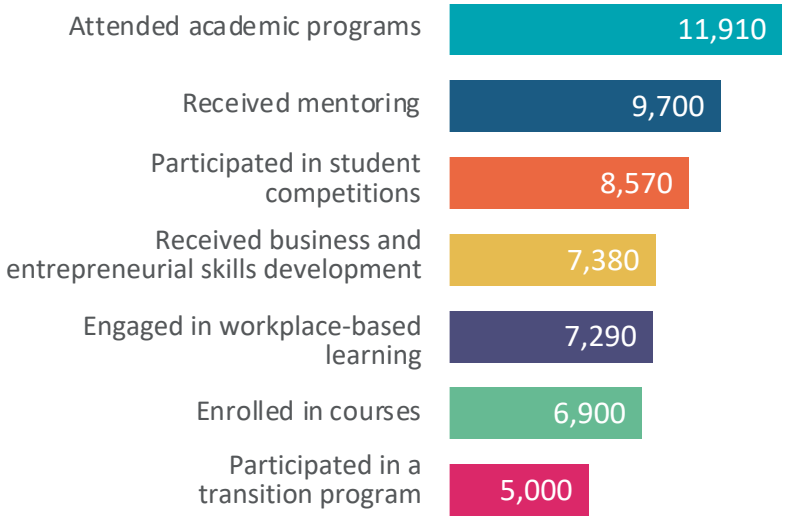
19,330 EDUCATORS
participated in 1,080 professional development activities.

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



50,000+ STUDENTS
were served by ATE projects.

ATE projects served over 50,000 students through a variety of activities.[1]



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

ATE ANNUAL SURVEY

2019 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

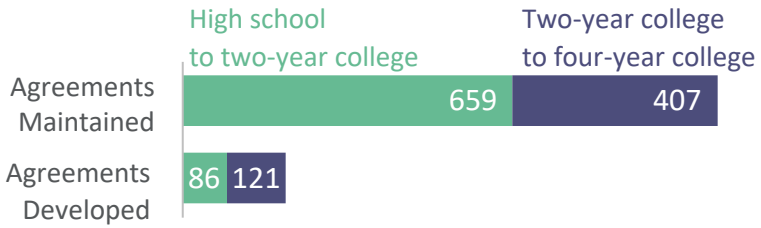
1,160
Modules or instructional units

1,010
Lessons or lesson plans

1,273 ARTICULATION AGREEMENTS

were developed or maintained by 48 ATE projects.

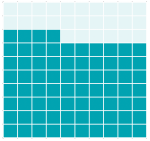
4,000 students matriculated to a higher-level education institution with the aid of an ATE-supported articulation agreement.



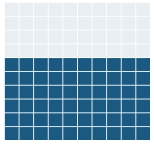
10,000 COLLABORATORS

were engaged by ATE projects.

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



74% collaborated with **business and industry partners**



60% collaborated with **other two- and four-year colleges**

OTHER ACTIVITIES were conducted by ATE projects in 2018 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 **3 coordination networks**

conducted **14 research studies**

hosted **10 conferences**

developed **228 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 2019 ATE Annual 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 for student characteristics by race, ethnicity, and gender in a single question. This approach differs from previous years, 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 2018. In previous years, 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 2019 report.

[ii] National data for two-year STEM programs are from the 2015-16 National Center for Education Statistics Digest of Education Statistics *Table 321.50.* (Retrieved from https://nces.ed.gov/programs/digest/2014menu_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 (NCES). 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 secondary school level reflects enrollment in public schools in 2017 and is from *Table 203.60.* The national percentage of underrepresented minority students at the two-year and four-year levels reflects STEM degrees conferred in 2016, derived from *Table 321.30* for two-year institutions and *Table 322.30* for four-year institutions. Selected fields of study are the same as those listed in note ii.

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ATE Annual Survey

2019 Report

January 2020

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