ATE SURVEY 2022

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 2022 survey of ATE program grantees. EvaluATE, the evaluation hub for the ATE program, located 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 2021 calendar year (and, for budget-related questions, the 2021 fiscal year).

The 2022 survey was a census of ATE principal investigators (PIs) with active grants (*N*=396). Ninety-two percent of PIs (*n*=364) 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 the addition of several new questions to capture a wider range of activities supported by ATE grants. Readers are cautioned against comparing results of the 2022 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 atesurvey.evalu-ate.org/survey-resources/. Custom reports may be developed upon request. For more information, contact atesurvey@evalu-ate.org.

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 may gain insight about the types of data projects are already asked 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-eight percent of ATE grants were for projects (including a variety of subcategories of project types).** Among the 319 project grants, 75 were designated for institutions new to the ATE program, and five were coordination network grants. Of the 26 centers, 11 identified as national centers, eight as regional centers, and seven as support or resource centers.

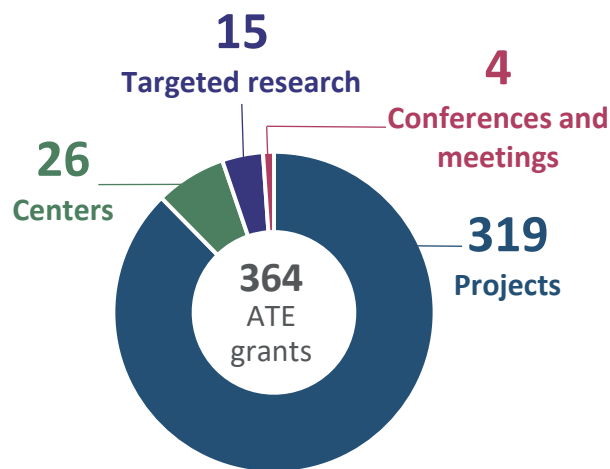The majority of ATE grants support **projects**.

Figure 1. Types of ATE grants awarded (*n*=364)

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

Figure 2. ATE grant recipient institutions (*n*=364)

The ATE program solicitation states that the "program focuses on IHEs that award two-year degrees in advanced technology fields and expects these IHEs and their faculty to have significant leadership roles on all projects" (NSF, 2021). Accordingly, most ATE grants are located at two-year colleges. The 272 grants awarded to two-year colleges supported 253 projects, 18 centers, and one conference and meeting grant. Most (80%) of the 15 targeted research projects 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**, **general advanced technological education**, and **information and securities 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.

21%
Advanced Manufacturing Technologies

20%
Information and Securities Technologies

10%
Bio and Chemical Technologies

20%
General Advanced Technological Education

17%
Engineering Technologies

9%
Agriculture and Environmental Technologies
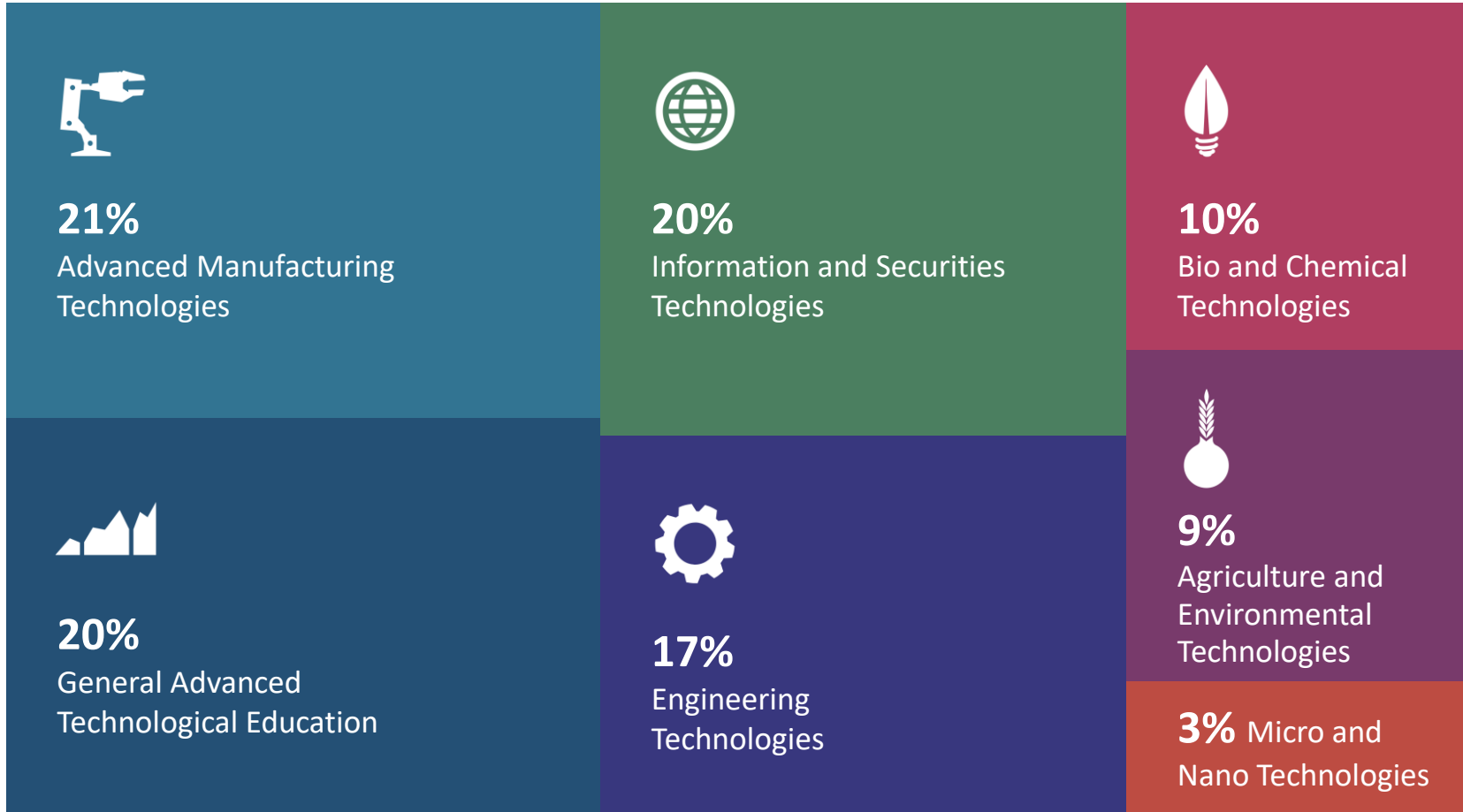
3% Micro and Nano Technologies

Figure 3. Disciplinary areas of ATE projects (*n*=364)

ATE PROJECT ACTIVITIES

ATE projects engaged in a variety of activities in 2021 to improve the education of science and engineering technicians.
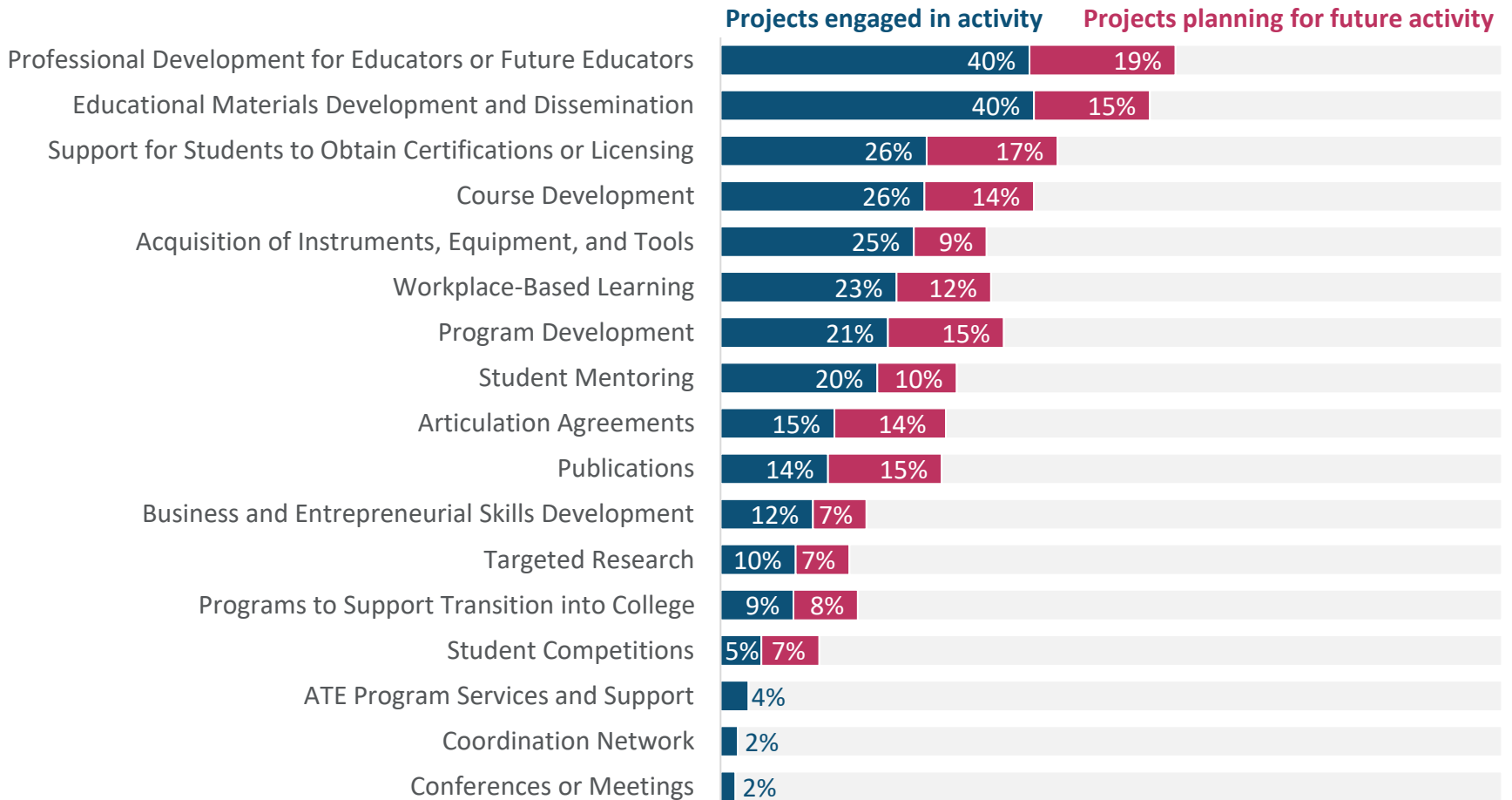
Activity	Projects engaged in activity	Projects planning for future activity
Professional Development for Educators or Future Educators	40%	19%
Educational Materials Development and Dissemination	40%	15%
Support for Students to Obtain Certifications or Licensing	26%	17%
Course Development	26%	14%
Acquisition of Instruments, Equipment, and Tools	25%	9%
Workplace-Based Learning	23%	12%
Program Development	21%	15%
Student Mentoring	20%	10%
Articulation Agreements	15%	14%
Publications	14%	15%
Business and Entrepreneurial Skills Development	12%	7%
Targeted Research	10%	7%
Programs to Support Transition into College	9%	8%
Student Competitions	5%	7%
ATE Program Services and Support	4%	
Coordination Network	2%	
Conferences or Meetings	2%	

Figure 4. Percentage of projects that reported engaging in activities in 2021 and planning activities for the future (n = 364)

ATE PROJECTS AT MINORITY-SERVING INSTITUTIONS

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

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

Sixty-two ATE projects (76%) 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. The designation is based on the percentage of minority students enrolled in the school. **Of the 332 projects at IHEs, 25% are at minority-serving institutions.** The majority of these IHEs are Hispanic-serving (76%). Asian American and Native American Pacific Islander–serving made up 13% of IHEs, followed by 7% Native Hawaiian-serving, 6% predominantly Black or historically Black colleges and universities, and 2% at Alaska Native-serving institutions. No projects were reported to be located at Tribal colleges or universities.
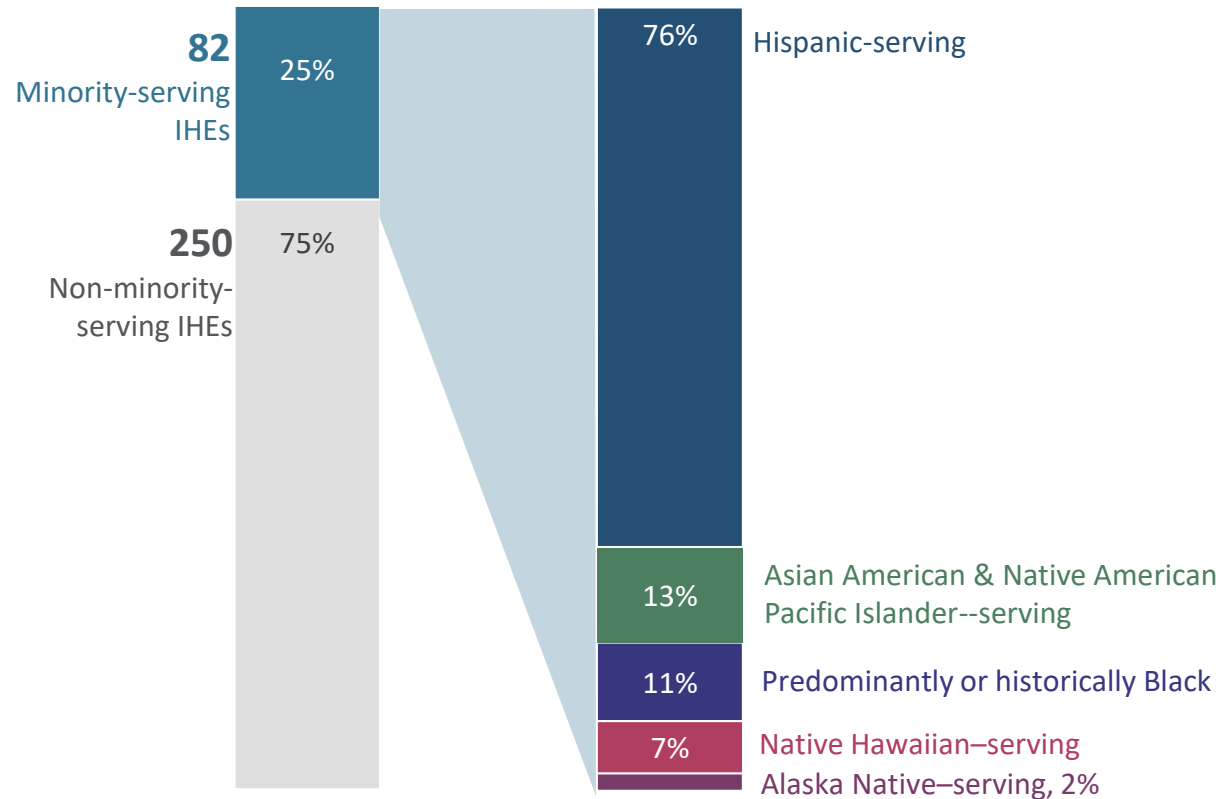
82 Minority-serving IHEs — 25%

250 Non-minority-serving IHEs — 75%

76% Hispanic-serving

13% Asian American & Native American Pacific Islander--serving

11% Predominantly or historically Black

7% Native Hawaiian–serving

Alaska Native–serving, 2%

Figure 5. ATE projects at minority-serving institutions (*n*=82)

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 toward increasing diversity among PIs. Females make up 51% of the U.S. population (U.S. Census Bureau). Comparatively, females are underrepresented as ATE PIs, since only 40% of ATE PIs in 2022 identified as female. Fifteen percent of ATE projects have PIs who are over the age of 65, while 35% of ATE projects have PIs who are between the ages of 55 and 64, 27% are 45–54, 21% are 35–44, and 2% are 25–34.

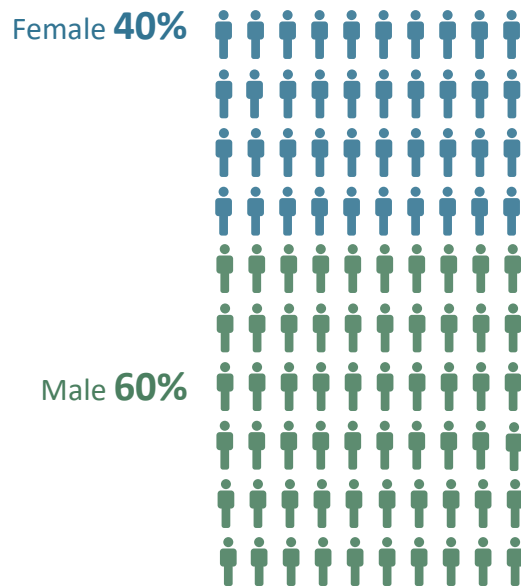Only 40% of ATE projects have a PI who identifies as **female**.

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.

Only 20% of ATE projects have a PI who identifies as a race or ethnicity other than **white**.
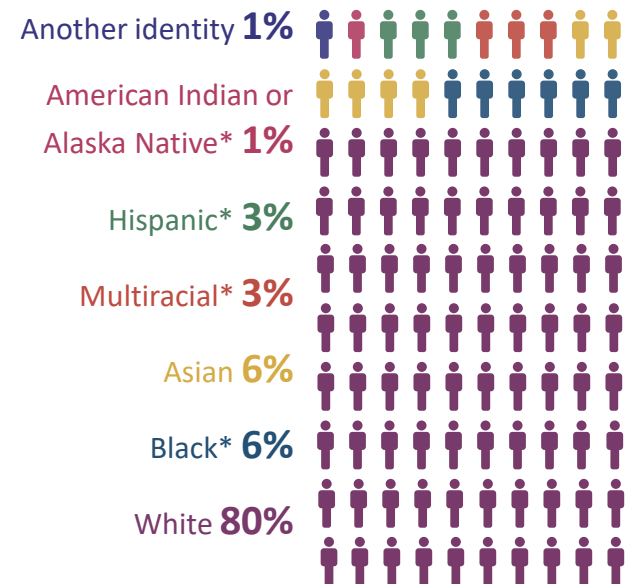
Female **40%**

Male **60%**

Figure 6. Gender identities of ATE PIs (*n*=361). Each icon represents 1%.

Another identity **1%**

American Indian or Alaska Native* **1%**

Hispanic* **3%**

Multiracial* **3%**

Asian **6%**

Black* **6%**

White **80%**

Figure 7. Racial and ethnic identities of ATE PIs (*n*=360). Each icon represents 1%. *Historically underrepresented racial and ethnic groups.

ACADEMIC PROGRAMS, COURSES, AND PATHWAYS

The ATE program supports the creation and improvement of academic 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-one 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 128 academic degree programs were developed or substantially modified by 78 ATE projects in 2021. **Most of these programs awarded certificates (48%) or associate degrees (46%).** Two programs awarded bachelor's degrees, and six programs provided other types of credentials (e.g., minors or micro-credentials). **Over 9,620 students attended at least one course in these academic programs**, with a total of 1,020 completing a program in 2021; 640 students completed an associate degree program, while 360 students completed a certificate program. Programs with students completing certifications or degrees in 2021 graduated an average of 25 students.

61 certificate programs served
3,380 students

59 associate degree programs served
4,610 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.

Sixty-four ATE projects out of the 78 that have developed academic degree programs emphasized recruitment of at least one of the following types of students.
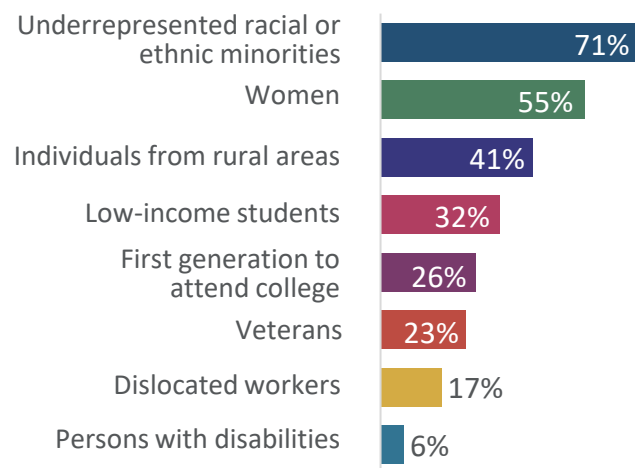

Group	Percentage
Underrepresented racial or ethnic minorities	71%
Women	55%
Individuals from rural areas	41%
Low-income students	32%
First generation to attend college	26%
Veterans	23%
Dislocated workers	17%
Persons with disabilities	6%

Figure 8. Percentage of projects that emphasized recruitment of students from specific demographic groups (*n*=64). Note that projects could choose more than one option.

STUDENTS SERVED BY ATE ACADEMIC PROGRAMS

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

Of the 126 academic programs that were developed or modified by ATE projects in 2021, 68 programs (54%) reported data on student gender, and 59 programs (47%) reported data on student race. Due to this low response rate, the numbers reported here do not represent the entire ATE program nor all 77 ATE projects that created or substantially modified academic programs in 2021.[i]

The gender breakdown in ATE-supported programs is similar to what is observed in STEM programs nationally. **Overall, 24% of ATE students are women, although the proportion of women varies by education level and discipline.** According to the U.S. Department of Education, 26% of students in technical programs at two-year colleges and 14% of students who received certificates below the associate level in the U.S. are women.[ii]

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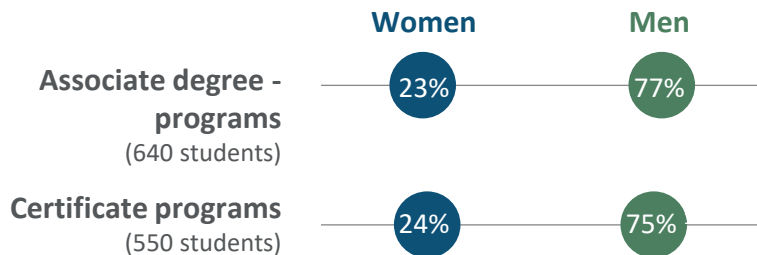

Figure 9. Percentage of women and men in ATE-supported academic programs by degree level (n=42). One percent of students in certificate programs identified as another gender.

Students who identify as Black/African American have slightly higher representation in ATE-supported programs than they do in the general population of students across 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.
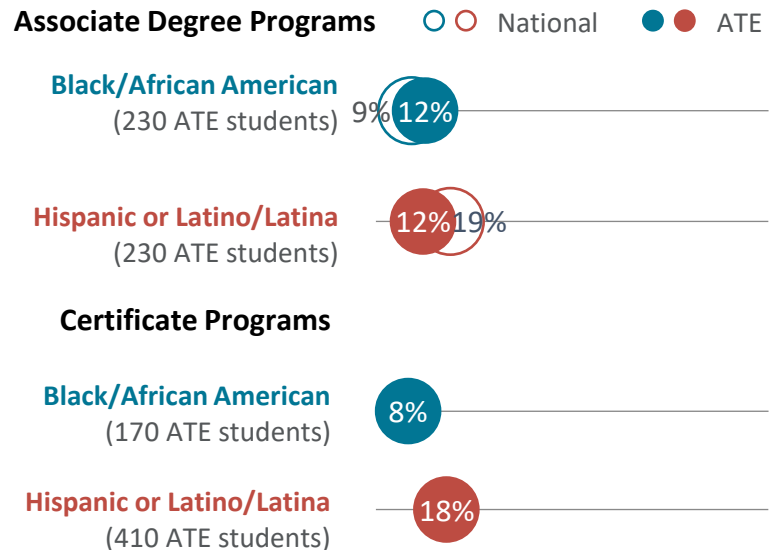

Figure 10. Percentage of students from underrepresented racial and ethnic minority groups in ATE-supported academic programs, compared with national rates (n=32).

COURSE DEVELOPMENT

Twenty-six 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 344 courses were developed by 95 projects in 2021. The majority of these courses (88%) were for **two-year college students**.

9
high school courses were developed by
7
ATE projects

304
two-year college courses were developed by
88
ATE projects

9
four-year college courses were developed by
4
ATE projects

Fifty-five percent of these 344 courses were offered in 2021.

4,110 students
completed an ATE-developed or -modified course in 2021

ATE PIs were asked about the primary delivery modes for each of the courses they developed or modified.

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

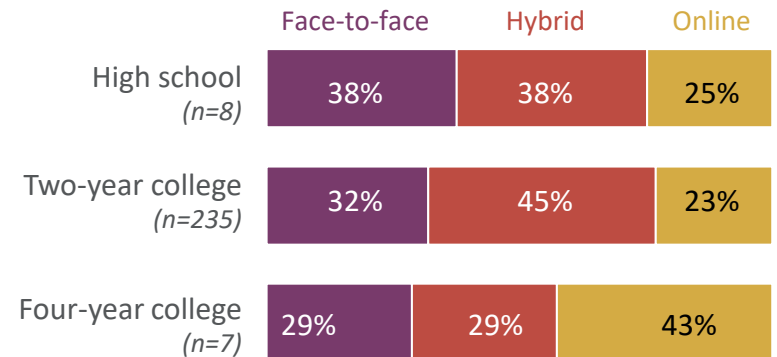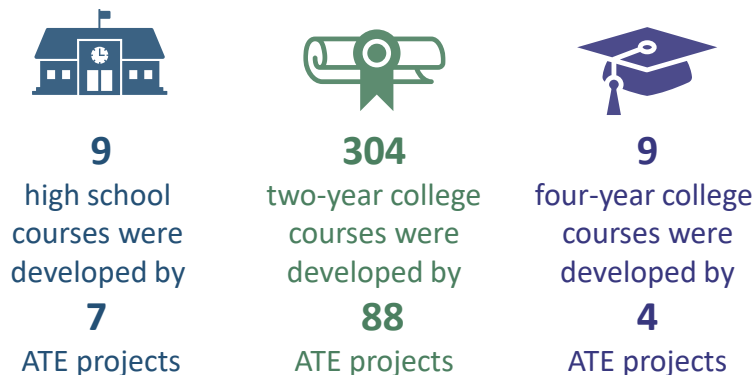|	Face-to-face	Hybrid	Online
High school (n=8)	38%	38%	25%
Two-year college (n=235)	32%	45%	23%
Four-year college (n=7)	29%	29%	43%

Figure 11. Percentage of courses designed by differing delivery mode, by education level. High school and two-year colleges add to 101% due to rounding.

INSTRUMENT ACQUISITION

Twenty-five 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 ATE projects acquired instrumentation or equipment in 2021. Examples of instruments purchased and utilized by projects might include 3D printers, computers, drones, virtual reality viewers, and laboratory equipment. Eighty-six projects reported the amounts they spent on instrumentation or equipment. **Projects spent between $10 and $388,594 on instrument acquisition in 2021.**

A majority of projects spent less than 25% of their grant funds on instrumentation in 2021.

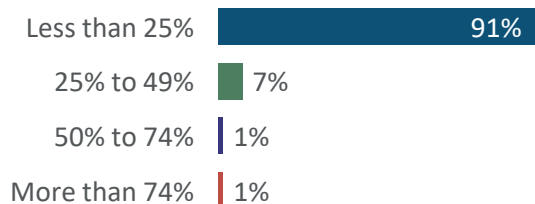|	
Less than 25%	91%
25% to 49%	7%
50% to 74%	1%
More than 74%	1%

Figure 12. Percentage of total grant amount spent on instrumentation or equipment in 2021 (*n*=86)

Projects that use 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 2021, 3,020 students used instruments and equipment.

A median of 16 students used the equipment or instrumentation acquired by each ATE project.

3,020 students
benefited from purchased equipment

330 educators
used the purchased equipment

220 courses
used the purchased equipment

Sixty-nine projects reported acquiring instrumentation, equipment, or tools to give students hands-on experience with instruments used in the field. Ten projects reported acquiring instruments to allow students to perform technical tasks in a simulated environment, and eleven projects noted other reasons, such as enabling students with disabilities to perform certain technical tasks and enhancing virtual instruction.

ARTICULATION AGREEMENTS

Fifteen 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, 2021).

Fifty-three projects developed or maintained articulation agreements in 2021.

Most articulation agreements created in 2021 were between **high schools and two-year colleges**, but more students matriculated between **two-year and four-year colleges**.
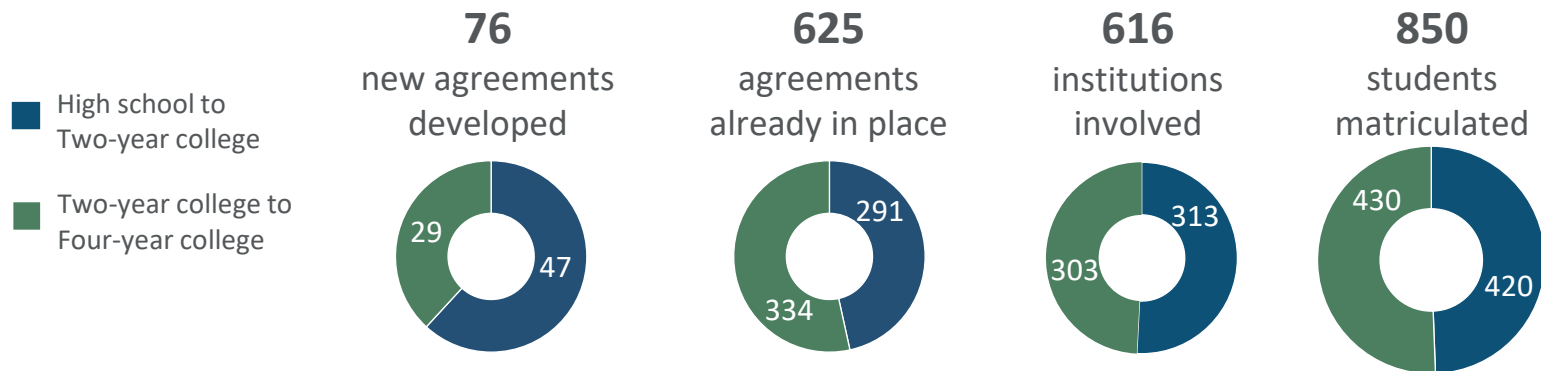

- ■ High school to Two-year college
- ■ Two-year college to Four-year college

76 new agreements developed — 29 / 47

625 agreements already in place — 291 / 334

616 institutions involved — 313 / 303

850 students matriculated — 430 / 420

Figure 13. Number of articulation agreements, institutions, and students (*n*=53)

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 materials in print and 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 percent of ATE projects created or substantially modified educational materials.

146 ATE projects developed or modified over 5,490 educational materials in 2021.

1,210
Modules or instructional units

1,210
Assessment activities or tests

760
Lab experiments

470
Lessons or lesson plans

310
Course curricula

290
Interactive simulations

Additional materials developed include 270 instructor guides, 180 case studies or problem sets, 120 program curricula, and 20 textbooks. One project developed 470 mini-lecture videos. ATE projects also developed 180 other types of materials.

Educational materials created in 2021 by ATE projects were primarily disseminated through the projects' websites (65%) and conference presentations or booths (64%). This was followed by workshops (50%), ATE Central (the ATE program's archiving platform; 47%), and commercial publication (6%).

One hundred twelve ATE projects disseminated educational materials that were created prior to 2021. These materials were primarily course curricula (53%), modules or instructional units (42%), and program curricula (36%). ATE projects also reported continued dissemination of lab experiments (34%), assessment activities or tests (33%), and lesson plans (31%) created in previous years.

Posting materials on a project's website (63%) was the most prominent avenue for disseminating materials created in previous years. Fifty-two percent of projects distributed materials at a conferences, and 47% of projects distributed materials that were developed in a previous year at workshops.

Thirty-six of the 135 projects that developed and/or disseminated educational materials kept track of which other institutions are using their program and/or course curricula.

390 institutions
Used program and/or course curricula created by 36 ATE projects

Note that one project was responsible for a 68% drop in the number of institutions that used curricula created by ATE projects between 2020 (1,220) and 2021 (390).

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

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

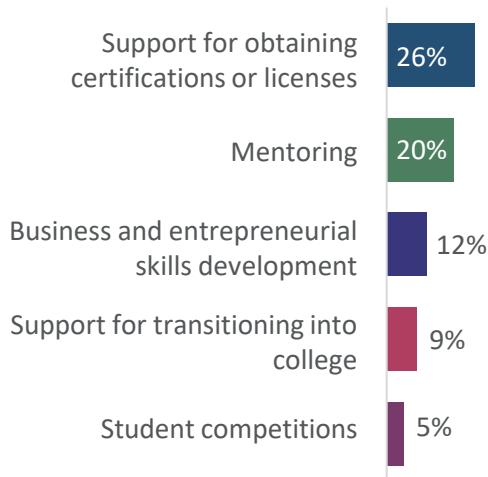162 ATE projects provided at least one type of student service or support.

Support for obtaining certifications or licenses — 26%
Mentoring — 20%
Business and entrepreneurial skills development — 12%
Support for transitioning into college — 9%
Student competitions — 5%

Figure 14. Percentage of projects that provided student services and support (*n*=364)

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 6,430 students received business and entrepreneurial skills development from 41 ATE projects in 2021.

ATE projects used a variety of strategies to develop students' business and entrepreneurial skills.

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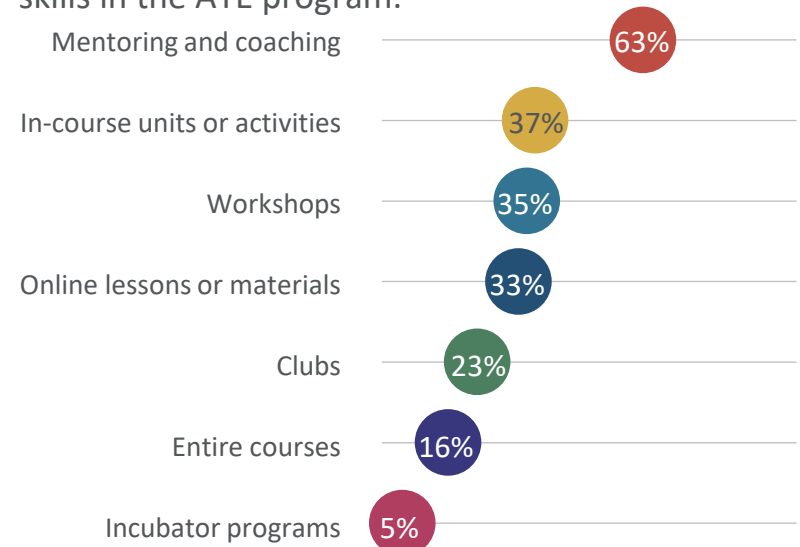

Mentoring and coaching — 63%
In-course units or activities — 37%
Workshops — 35%
Online lessons or materials — 33%
Clubs — 23%
Entire courses — 16%
Incubator programs — 5%

Figure 15. Percentage of skills development opportunities offered to students by ATE projects (*n*=43)

STUDENT SERVICE AND SUPPORT

Twenty percent of ATE projects provided students with mentoring or coaching, and 5% hosted or organized a student competition.

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).

Approximately **2,740** students received mentoring through ATE projects.

420
High school students

2,180
Two-year college students

30
Four-year college students

Mentoring was most often provided by educational faculty or staff (86%), followed by business and industry professionals (49%) and students or peers (37%). Twenty-six percent of projects that offered mentoring or coaching provided training to the mentors.

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., 2018).

3,920 students participated in one of the 64 ATE-hosted student competitions. The most common areas for competitions included:

40
information security competitions engaged
1,820
students

16
advanced manufacturing competitions engaged
510
students

4
general advanced technologies competitions engaged
1,320
students

Two other competitions engaged 270 additional students in ATE disciplines including engineering technologies and agriculture and environmental technologies.

STUDENT SERVICE AND SUPPORT

Nine 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.

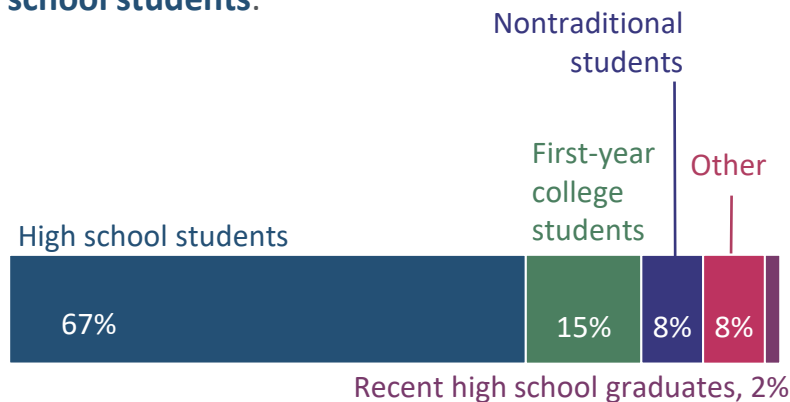The majority of transition programs are for **high school students**.

Figure 16. Primary audience for transition programs supported by ATE projects (*n*=48)

Over **4,240** students transitioning into college received support from ATE projects.

3,660
High school students

290
First-year college students

50
Nontraditional 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).

Ninety-seven ATE projects provided students with support for obtaining certifications or licenses in 2021. Eighty-five percent of those ATE projects reported supporting students through aligning existing courses with licensing or certification requirements. ATE projects also provided test preparation workshops or learning modules (64%) and served as testing centers (44%). 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 (61), followed by for-profit companies (33) and government agencies (18).

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 2021.

WORKPLACE-BASED LEARNING

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

In 2021, 2,330 students participated in workplace-based learning opportunities offered by 82 ATE projects. An additional 14 ATE projects reported offering field trips to business and industry sites. The 23% of projects that provided workplace-based learning in 2021 excludes the 14 projects that only reported offering field trips.

Most ATE projects offered workplace-based learning through **internships** and **apprenticeships**.
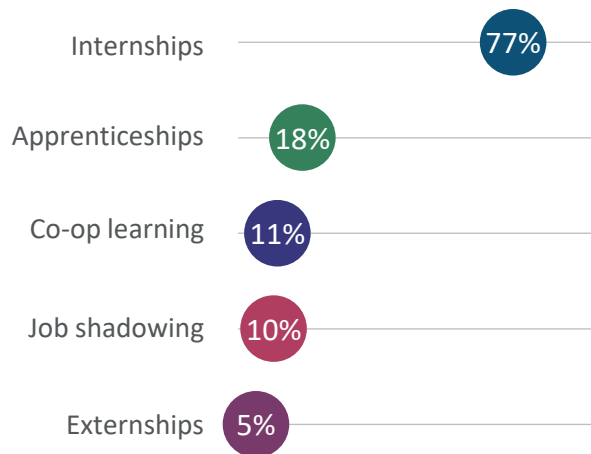
Figure 17. Percentage of ATE projects that offered each type of workplace-based learning (*n*=82)

The median number of weekly hours that students spent in a workplace-based learning activity ranged from 4 to 35, and the median number of weeks spent in an activity ranged from 2 (job shadowing) to 41 (apprenticeships).

Respondents discussed a variety of benefits to both students and employers. As one respondent noted:

> **Students are able to connect understanding of classroom concepts with their ability to perform as expected in the workplace; they get a good idea of the level of coursework they need to complete in order to reach their career goals; they gain a better idea of what direction they would like to head when they graduate."**

Survey respondents reported on the characteristics of the workplace-based learning their projects offered. The table shows variation both within and across activities.

	Internships (*n*=63)	Apprenticeships (*n*=15)	Co-op learning (*n*=9)
Required by program	51%	67%	33%
Academic credit	62%	73%	78%
Coupled with a course	46%	87%	33%
Received payment	75%	87%	67%

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

One-hundred forty-four ATE projects provided 960 training or professional development activities for educators in 2021. Over half of these activities were a day or less in length (52%), including webinars and one-day workshops. Twenty-three percent lasted from one to several weeks, including courses and summer institutes. Eighteen percent lasted more than one day but less than one week, including workshops and online modules. The remaining 7% were long-term and periodic and included internships and peer coaching.

Professional development activities focused on a range of skills and topic areas. Eighty-one percent focused on discipline- or industry-specific knowledge or skills, 49% on training on specific equipment, and 40% on pedagogy. Additional professional development topics reported by ATE projects included recruitment or retention of students (22%), addressing issues of equity, diversity, or inclusion (17%), and other professional skills, such as leadership (24%).

Due to a technical error in the data collection process, we are unable to report data on educators from 2021. At least 21,580 students were taught by educators who participated in ATE-sponsored professional development (most likely many more, due to underreporting and projects' inability to collect this data).

21,580 students
were taught by educators who participated in ATE-sponsored professional development (*n*=49)

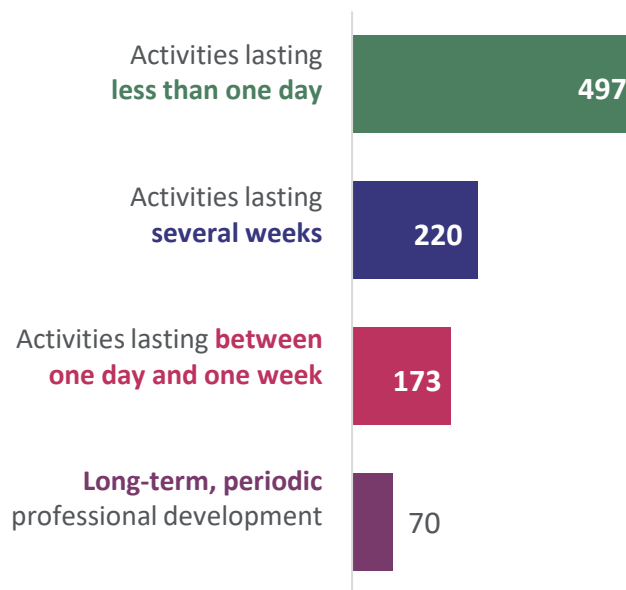ATE projects offered 960 professional development activities for educators in 2021.

Figure 18. Number of professional development activities for educators by length of time (*n*=144)

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
Two percent of ATE projects indicated coordination networks as a primary purpose of their grant.

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

- **Advanced Technological Education Coordination Network for Knowledge Sharing in Robotics/Automation and Cybersecurity** intends to facilitate the sharing of best practices about how to develop community college students' knowledge and skills in robotics/automation and cybersecurity.

- **Advanced Technological Education Network for Utilities and Energy Technical Education** facilitated relationships and resource sharing between educators, industry leaders, and workforce developers focused on closing the workforce gap in the energy industry.

- **Center for Systems Security and Information Assurance (CSSIA)** supported the development of successful cybersecurity certificate and degree programs across the country.

- **Collaboration of Midwest Professionals for Logistics Engineering Technology Education Project** facilitates the Ohio Supply Chain Academic Network (O-SCAN), a collaboration between the supply chain industry and higher education.

- **Implementation of an Industry-Recognized Credentialing System for Biotechnicians** brought together two-year colleges, high schools, administrators, industry, and policymakers to increase industry recognition of a credential.

- **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 ways to address the convergence of materials science and additive manufacturing in technician education resources.

- **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

Two percent of ATE projects engaged in organizing a conference or meeting for the purpose of professional exchange in 2021.

Four ATE projects were explicitly funded to coordinate conferences or meetings in 2021. Three additional projects indicated that hosting a conference was the main purpose of their grant. Of these seven projects, four were able to host conferences in 2021. These four projects hosted a total of nine conferences or meetings, with attendance that ranged from eight to 906 people. ATE PIs identified the purposes of these events as networking and professional development, disseminating best practices, and bringing together stakeholders from industry and education.

9 conferences and meetings
were organized by four ATE projects

1,110 people
attended conferences and meetings
organized by four ATE projects

Projects that organized conference or meeting events in 2021 included:

- **Center for Systems Security and Information Assurance (CSSIA)** hosted four events around the internet of things.

- **Conference to Explore the Impact of Future of Work Issues on Technician Education in Florida** hosted the second FLATE Future of Work caucus.

- **RoadMAPPs to Careers: A New Approach to Mobile Apps Education** hosted a mobile app development mini conference.

- **Strengthening and Supporting the Community College Leadership Role in Advancing STEM Technician Education** hosted the 2021 ATE conference and two meetings for the 2019–21 and 2021–23 MentorLinks cohorts.

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

Ten percent of ATE projects conducted some type of research, and 14% developed materials intended for publication.

TARGETED RESEARCH

Fifteen ATE projects were specifically funded to conduct targeted research in 2021. Between them, they reported 22 active studies. At the time of the survey, 27% of those studies were collecting data, 14% were analyzing data, 27% were writing up results, and 32% had findings published or submitted for publication.

In addition to these 15 targeted research projects, 20 other ATE projects indicated they conducted some sort of research in 2021. Together, these projects reported 52 research studies. Most of this research was descriptive (71%), followed by document reviews (19%) and correlational studies (17%). Only a few studies used experimental or quasi-experimental designs (8%) or meta-analysis methods (4%).

Research findings are frequently disseminated through **conference presentations** or **articles in peer-reviewed journals**.

Dissemination channel	Percentage
Conference presentation	75%
Article in peer-reviewed journal	58%
Blog or newsletter	40%
Report available for free online	38%
Article in a practitioner journal	31%
Other (e.g., webinar, project website)	15%
Article in a magazine	6%

Figure 19. Percentage of research activities shared via various dissemination channels (*n*=52)

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 ATE projects prepared a total of **137 publications**.

54 Manuscripts for academic journals

9 Manuscripts for practitioner journals

44 Reports

30 Magazine articles

PIs reported 60 other publication types, such as news posts, blogs, and newsletter articles.

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

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

- **AccessATE** supported ATE projects in making their materials and activities more accessible to all students and faculty, including those with disabilities.

- **ATE Central** served as the ATE program's information hub, dedicated to highlighting ATE projects' work and supporting them in various aspects of their work, such as archiving, outreach, and connecting with others in the ATE community.

- **ATE for 2 Year Colleges (ATE-2YC)** provided proposal writing workshops and a mentoring program for two-year college STEM faculty.

- **ATE Collaborative Outreach and Engagement** raised awareness of the ATE program, primarily through the publication of the *ATE Impacts* book.

- **BILT and Mentoring Academies** supported ATE projects in integrating the Business Industry Leadership Team model for productive partnerships with industry.

- **EvaluATE** strengthened the evaluation capacity of those involved with ATE projects through training, networking opportunities, and research, including administration of the ATE Survey.

- **Formative Assessment Systems for ATE (FAS4ATE)** provided workshops to improve the assessment of professional development activities by ATE projects.

- **HIS ATE Hub** supported Hispanic serving institutions to apply for ATE funding.

- **Mentor-Connect** served as a mentoring and leadership development program for two-year institutions of higher education new to the ATE program.

- **Mentor Links** served as a mentoring initiative that supports community colleges in developing new or strengthening existing STEM technician education programs.

- **Mentor Up** served as a mentoring initiative that supports teams in developing and submitting a successful ATE proposal.

- **Project Vision** encouraged presidents of colleges new to NSF funding to apply for grant programs in the NSF Division of Undergraduate Education.

- **Working Partner Workshops** provided training to ATE project teams on how to effectively and sustainably collaborate with industry partners.

Collectively, these 13 projects delivered 83 webinars that engaged an average of 67 people per webinar and provided over 640 people with one-on-one technical assistance.

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 7,410 other organizations and institutions.

In 2021, ATE projects collaborated with 2,740 business and industry partners, 1,850 colleges, 1,230 K–12 schools, 590 entities within their host institutions, 610 other ATE projects, 340 public agencies, and 60 other types of partners. ATE projects collaborated with a median of five business and industry groups, two K–12 schools, two colleges, and one other ATE project.

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

Business/industry	80%
Two- or four-year colleges	61%
K–12 schools or school systems	52%
Partners within host institution	43%
Other ATE projects	41%
Public agencies	33%
Other types of partners	4%
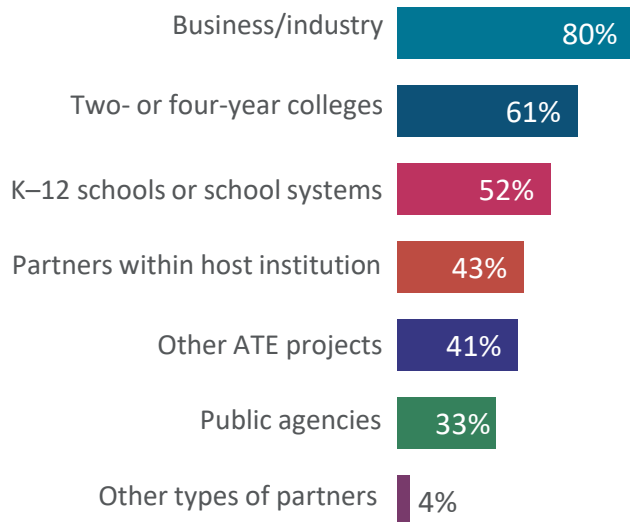
Figure 20. Percentage of ATE projects that collaborated with other groups, by type (*n*=319)

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

Collaborators provided over $10 million in monetary and in-kind support to 124 ATE projects.

$2,914,200 monetary support
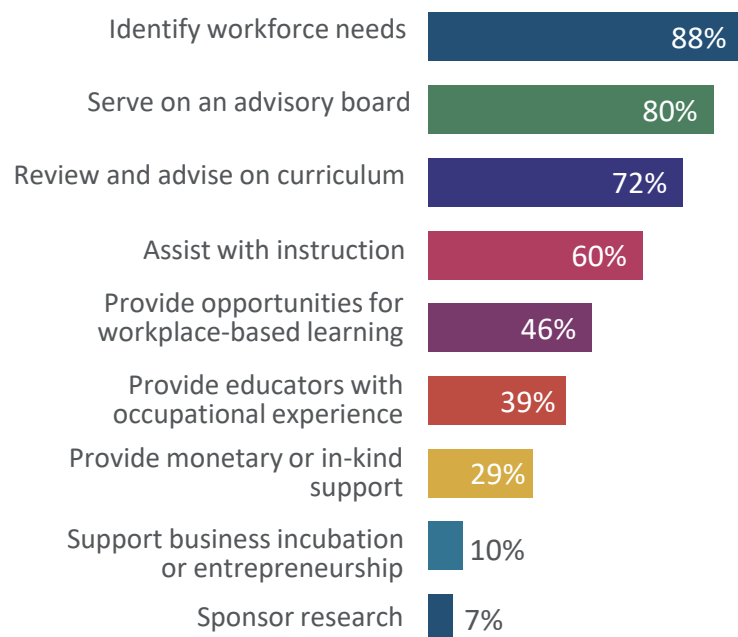
$8,077,080 in-kind support

Fourteen percent of projects reported receiving monetary support from collaborators, while 29% reported receiving in-kind support. The median contributions for monetary support and in-kind support across projects were $21,130 and $10,000, respectively. Two projects reported 59% of the total in-kind support received by ATE projects in 2021. Of the 104 projects that reported in-kind support, this primarily consisted of staff time (67%) and equipment (42%). Other types of in-kind support included access to facilities, materials, and supplies.

Participating with business and industry is important to the ATE community. The next page presents more information on how projects collaborated with these groups.

COLLABORATION WITH BUSINESS AND INDUSTRY

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

A total of 246 projects reported collaborating with business and industry groups. Most used these partners to **identify workforce needs**, **serve on an advisory board**, or **review and advise on curriculum**.

Identify workforce needs — 88%

Serve on an advisory board — 80%

Review and advise on curriculum — 72%

Assist with instruction — 60%

Provide opportunities for workplace-based learning — 46%

Provide educators with occupational experience — 39%

Provide monetary or in-kind support — 29%

Support business incubation or entrepreneurship — 10%

Sponsor research — 7%

Figure 21. Percentage of projects reporting contributions from business and industry partners (*n*=246)

Business and industry representatives serve on advisory boards for 197 projects. Most of these projects (25%) 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, PIs frequently pointed to the utility of the information that they received from them. For example, one PI noted, they provide

> **Continuous improvement from learning from others, benchmarking techniques and approaches, and accomplishing center objectives of helping to create infrastructure for the nation."**

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."

As a result of collaborating with industry partners, one respondent noted that their project was

> **Determining industry needs as it relates to curriculum development and sustainability. Also, the recruitment of students into the program. Lastly, to increase the job opportunities for current and future students."**

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
Ninety-one percent of ATE projects engaged an evaluator.

Three-hundred thirty-two ATE projects had evaluators in 2021. Of the 32 PIs who said they did not have evaluators, 11 were either in their first year of funding or a no-cost extension; six experienced delays due to the COVID pandemic; and three noted they were not required to have an evaluator for their grant. **Of the 332 projects with evaluators, 85% reported having an external evaluator, with 11% having both an internal and external evaluator and 5% having only an internal evaluator.**

Forty percent of PIs reported that they interacted with their evaluators *occasionally* (more often than quarterly), while 21% interacted with their evaluators *often* (two or three times a month) and 21% interacted *infrequently* (once a quarter or less). Eight percent interacted *continuously* (at least once a week) with their evaluator, and 6% interacted with their evaluator *rarely* (annually or semiannually).

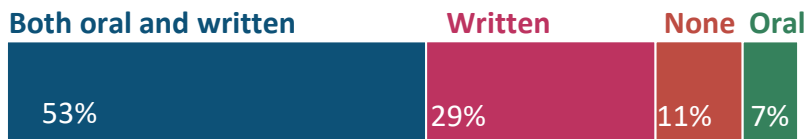Almost half of ATE projects received **both oral and written** evaluation reports.

Both oral and written	Written	None	Oral
53%	29%	11%	7%

Figure 22. Types of evaluation report received by ATE projects (*n*=332)

Of the 332 PIs who received evaluation reports, 71% indicated their project's evaluation caused them to make a change in implementing their project, and 41% indicated that 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**, **faculty or staff at their host institution**, and **executive administrators**.

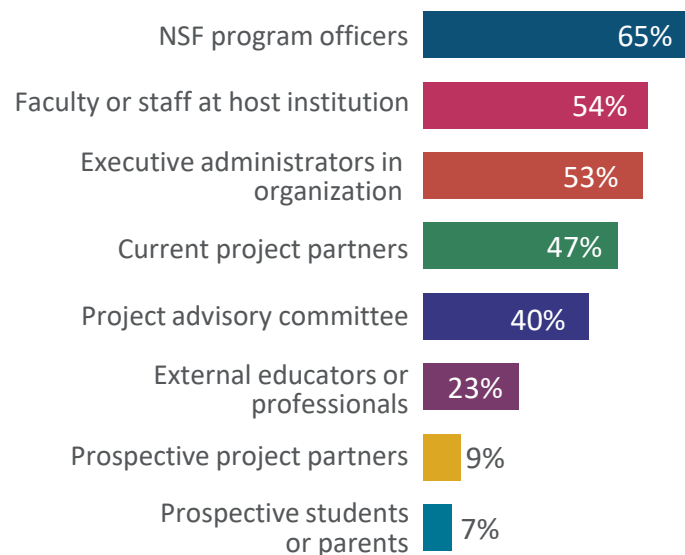|	
NSF program officers	65%
Faculty or staff at host institution	54%
Executive administrators in organization	53%
Current project partners	47%
Project advisory committee	40%
External educators or professionals	23%
Prospective project partners	9%
Prospective students or parents	7%

Figure 23. Percentage of projects that shared their evaluation results with various audiences (*n*=332)

ATE SURVEY
2022 HIGHLIGHTS

This summary of activities and achievements of the Advanced Technology Education (ATE) program is based on the 2022 ATE Survey. Principal investigators for 92% of ATE grants (*n*=364, out of a total of 396 active ATE grants) completed the survey. Respondents represented grants supporting 319 projects, 26 centers, four conferences, and 15 targeted research projects.

128 DEGREE PROGRAMS AND 344 COURSES
were developed by 95 ATE projects.

Almost half (48%) of all academic degree programs developed were certificate programs, and a majority (88%) of courses developed were at the associate degree level.

41 associate degree programs served 4,610 students

49 certificate programs served 1,770 students

960 PROFESSIONAL DEVELOPMENT
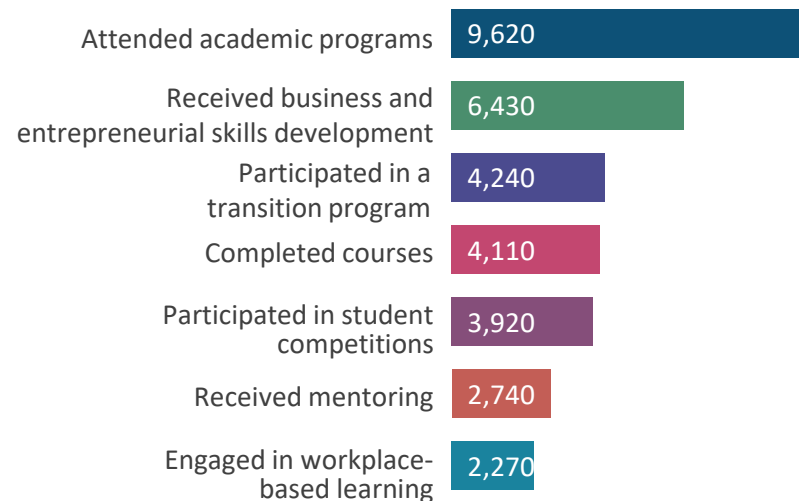### activities were offered by 144 ATE projects.

Half of professional development activities for educators were **less than one day**, with almost one-fourth lasting **several weeks**.

Less than one day	Several weeks	Less than one week	Long-term, periodic
52%	23%	18%	7%
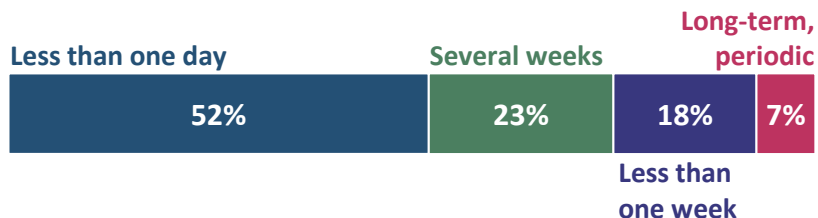
33,330+ STUDENTS
were served by ATE projects.

ATE projects served over 33,330 students through a variety of activities in 2021.* ATE projects served the most students through **developing or modifying academic programs**, followed by **developing business and entrepreneurial skills**.

Attended academic programs	9,620
Received business and entrepreneurial skills development	6,430
Participated in a transition program	4,240
Completed courses	4,110
Participated in student competitions	3,920
Received mentoring	2,740
Engaged in workplace-based learning	2,270

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

Sturgis, E., & Becho, L. W. (2022). ATE annual survey: 2022 highlights.

5,490 EDUCATIONAL MATERIALS

were developed by 146 ATE projects.

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

1,210
Modules or instructional units
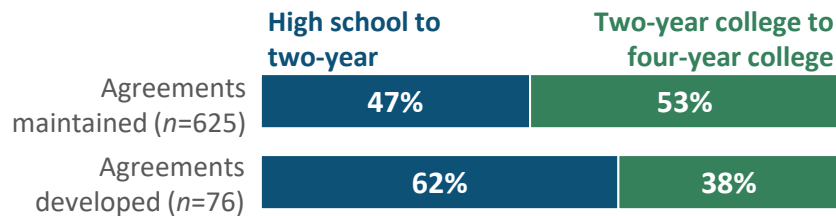
1,210
Assessment activities or tests

760
Lab experiments

## 635 ARTICULATION AGREEMENTS

were developed or maintained by 53 ATE projects.

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

	High school to two-year	Two-year college to four-year college
Agreements maintained (*n*=625)	47%	53%
Agreements developed (*n*=76)	62%	38%

7,410 COLLABORATORS

were engaged by ATE projects.

ATE projects most frequently collaborated with business and industry groups and other colleges and universities.
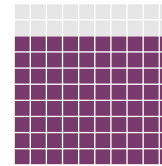
80% collaborated with **business and industry groups**
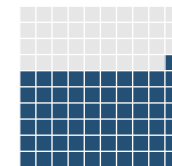
61% collaborated with **other two- and four-year colleges**

OTHER ACTIVITIES were conducted by ATE projects

in 2021 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 **10 coordination networks**

conducted **22 research studies**

hosted **5 conferences**

developed **140 publications**

Sturgis, E., & Becho, L. W. (2022). ATE annual survey: 2022 highlights.

TECHNICAL NOTES

i The 2021 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 demographic information on students who attended at least one course in an ATE-supported academic program. This, in addition to a lower than previous response rates, resulted in a decrease in student demographic data for the 2020–22 reports.

ii National data for two-year STEM programs and certificates are from the 2019–20 National Center for Education Statistics Digest of Education Statistics *Table 320.10* and *Table 321.10.* (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 2019–20 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.

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ATE Survey
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