# Impacts of the National Science Foundation-funded Mentor-Connect Project on Two-Year Colleges

## Background

### The Mentor-Connect Intervention

The Mentor-Connect initiative, funded by a series of three National Science Foundation Advanced Technological Education (NSF-ATE) grants (#1204463, #1501183, and #1840856), was launched in 2012 to stimulate expansion and improvement of technician education programs offered by the nation's two-year technical and community colleges. The objective was to connect technician educators more effectively with the unique funding opportunity offered by the National Science Foundation through the Advanced Technological Education Program (NSF-ATE).

To accomplish this objective both a paradigm shift and capacity-building must occur. Generating proposals for external funding to advance specific academic programs, integral to the work of university professors and their graduate students, is not typical among two-year college faculty whose emphasis is on teaching. It is unusual for a faculty member to lead a grant-funded effort at a community or technical college. However, such faculty leadership is an expectation for NSF ATE grants. Mentor-Connect research shows that teaching two-year-college STEM faculty the skills and knowledge required to prepare competitive NSF ATE grant proposals expands their institution's capacity for generating external funding and develops leadership skills among these faculty.

The history of the NSF-ATE program was described in a previous ASEE paper as follows:

> With passage of the Scientific and Advanced Technology Act of 1992, Congress mandated the National Science Foundation (NSF) to develop a program to support the efforts of public associate-degree granting colleges — community colleges and technical colleges — to improve the preparation of technicians for advanced technology fields of importance to the nation's economic development and security. The Advanced Technological Education (ATE) program that NSF began in 1993 in response to this legislation expects two-year college educators to have leadership roles in funded initiatives. It also requires two-year college faculty members in science, technology, engineering, and math (STEM) to collaborate with other education sectors and employers in their efforts to create or improve certificate and degree programs. The multiple tracks of the NSF-ATE program provide support for faculty professional development and general STEM education improvement. The program provides support to test innovative ideas along the continuum from secondary schools through two-year colleges and universities and to develop career pathways for a wide range of STEM workplaces except healthcare. [1]

The need for NSF ATE Program funding opportunities that support advancement of technician education is clear. The previous ASEE paper about Mentor-Connect also documented an increasing workforce skills gap, along with the pressing need for highly skilled engineering and related technicians capable of working with advanced technologies that drive the American economy. In 2017, the widening of the workforce skills gap was described as persisting and was predicted to reach two million unfilled jobs by 2025. [2] [3] A new, September 2019 report issued by the National Science Board includes a prediction of an even greater shortage:

To grow our nation's science, technology, engineering, and mathematics (STEM) capacity and ensure that Americans nationwide can participate in a science and engineering (S& E) intensive economy, the United States must foster its Skilled Technical Workforce (STW) – individuals who use S & E skills in their jobs but do not have a bachelor's degree. Rapid changes in the nature of work, education, technology, workforce demographics, and international competition have led to the National Science Board (NSB, Board) to conclude that our competiveness, security, and research enterprise require this critical, but often overlooked segment of our STEM-capable workforce. Adding to the near-term urgency, a National Academies of Sciences, Engineering, and Medicine report predicts a shortfall of nearly 3.4 million skilled technical workers by 2022. [4]

The challenge lies in effectively connecting technician educators to NSF ATE funding opportunities to help them address the skilled technical workforce shortage. The following paper describes the progress that Mentor-Connect has made in engaging more two-year technical and community colleges in NSF-ATE-funded projects that address ever-changing technology and employers' needs for highly skilled technicians. Receiving grant funding to work on technician education, however, is just an interim outcome and step toward addressing the workforce need. What happens as a result of implementing these grants is the most important outcome. A new component of research for the project is harvesting outcomes once a first grant proposal has been funded and implemented.

The paper, therefore, is in two parts. The first part provides data on two-year college participation rates in Mentor-Connect. Also included are data on grant awards received among those submitting proposals.

The second part of the paper reports initial results from an exploration of longer-term impacts of NSF-ATE grant funding on institutions, faculty, and students as colleges that participated in Mentor-Connect complete their first NSF-ATE-funded projects.

Each year since 2012, Mentor-Connect has used an application process to select 20 to 24 two-year colleges to participate in its three-pronged approach to grant-writing assistance and STEM leadership development. Mentor-Connect offers mentoring, technical assistance, and digital resources to faculty-led teams from colleges that have not had an NSF-ATE grant in seven years. Most Mentor-Connect colleges have never had NSF grants. Primary objectives of Mentor-Connect are to help two-year college educators with the complexities of NSF-ATE proposal development and submission. Mentor-Connect also provides advice on implementation of grant-funded projects and recruits and prepares mentors to work with prospective grantees. Mentor-Connect explicitly encourages mentees to become STEM education leaders by weaving grant-related leadership skills development into the training process. They are also provided with encouragement and opportunities to interact with ATE Principal Investigators and their initiatives.

Each college team selected for Mentor-Connect participation includes two STEM faculty members. A grant writer and supportive administrator from the college are encouraged to participate with the faculty teams and most often do. During the nine months leading up to the

NSF-ATE application deadline, the selected teams receive training at two Mentor-Connect workshops that include in-person guidance on their grant proposal from a mentor. This is followed by periodic advice from a mentor via phone and email, on-going technical assistance via webinars, and online tutorials. Mentees (and the general public) also have access to the Mentor-Connect digital archive of materials that cover the many tasks involved in preparing a grant proposal for the NSF-ATE program. The workshops and technical assistance cover specific aspects of the ATE program, components of proposals, and strategies to improve the likelihood of funding. As participants apply the elements of this instruction, they are mentored by an experienced participant of the NSF-ATE program. Mentor-Connect Mentors have had years of success with multiple funded proposals and associated implementation of NSF-ATE grant awards directed toward the advancement of technician education. Additional details regarding this professional development intervention are described in a previous paper published by ASEE. [5]

**Participants**

Team members from participating colleges, Mentor-Connect Mentors, and Mentor Fellows are considered participants in the project. With the selection of an eighth cohort in fall 2019, the number of Mentee Colleges reached 164. Since the project's inception in 2012, 22 Mentors have been selected and prepared to work with cohort mentees. Sixteen people have served as Mentors multiple times; most Mentors guide two teams each year.

During 2020 five experienced NSF-ATE grantees also participated as Mentor Fellows. Mentor Fellows are Mentor-Connect mentors-in-training. This on-ramp to participating as a Mentor for Mentor-Connect was launched as a pilot in 2017. The following year, this became a funded activity of a new phase of the project. Mentor Fellows complete a nine-month internship that involves shadowing a current Mentor-Connect Mentor, working with Mentee teams, and participating in Mentor-Connect workshops and webinars. Successful completion of the Mentor Fellowship makes participants eligible to serve as a Mentor-Connect Mentor. Placement as a Mentor working with assigned teams in a Mentor-Connect cohort thereafter depends on the number of participating colleges and mentoring needs of the project in a particular grant cycle. From 2017 through 2019, nine Mentor Fellows completed internships. To date, seven Mentor Fellows have been assigned as Mentors.

**College Participant Data – Mentoring to Proposal Submission**

Since 2012, Mentor-Connect has been fine-tuned based on data from its formative evaluation and has been very successful in mentoring colleges to produce competitive New-to-ATE proposals, exceeding the 80% submission rate target for the project. Mentor-Connect has also made significant progress toward its objectives of involving geographically and demographically diverse two-year colleges in its initiative.  These project priorities align with NSF goals of increasing the participation of historically underrepresented populations in the STEM workforce.

Evidence of Mentor-Connect project success in terms of participation, proposal submission, and funding success is detailed below.

Note that availability of information is affected by cohort start dates and the NSF funding cycle. For example, Cohort 1 teams were selected in November 2012, received mentoring to prepare proposals over nine months in 2013, and submitted proposals to NSF in October 2013. NSF announced funding decisions on those proposals in 2014. Other cohorts followed this same pattern. Mentees in Cohort 7—the most recent cohort to complete Mentor-Connect mentoring— submitted proposals in October 2019, and were awaiting NSF notification of funding decisions when this paper was finalized in April 2020. Mentoring of Cohort 8 began in January 2020 to prepare proposals for submission in October 2020.

- In Cohorts 1 through 8, 164 of the 251 college teams that applied to Mentor-Connect to work on small, new-to-ATE project proposals were accepted. That is a Mentor-Connect project acceptance rate of 65%, or 2 out of 3 applicants have been accepted.

- 122 ATE proposals have been submitted from the 142 colleges that participated in Cohorts 1 through 7. That is an overall submission rate of 86%.

- Of the 122 ATE proposals, 115 were submitted in the Small Grants for Institutions New to ATE (New-to-ATE) funding track.

- Of the 97 New-to-ATE proposals submitted from Cohorts 1 through 6, 71 have been funded, for a funding rate of 73%. (At the time this paper was submitted in April 2020, NSF-ATE award decisions were pending for the 18 proposals submitted in fall 2019 by Cohort 7 Mentee college teams.)
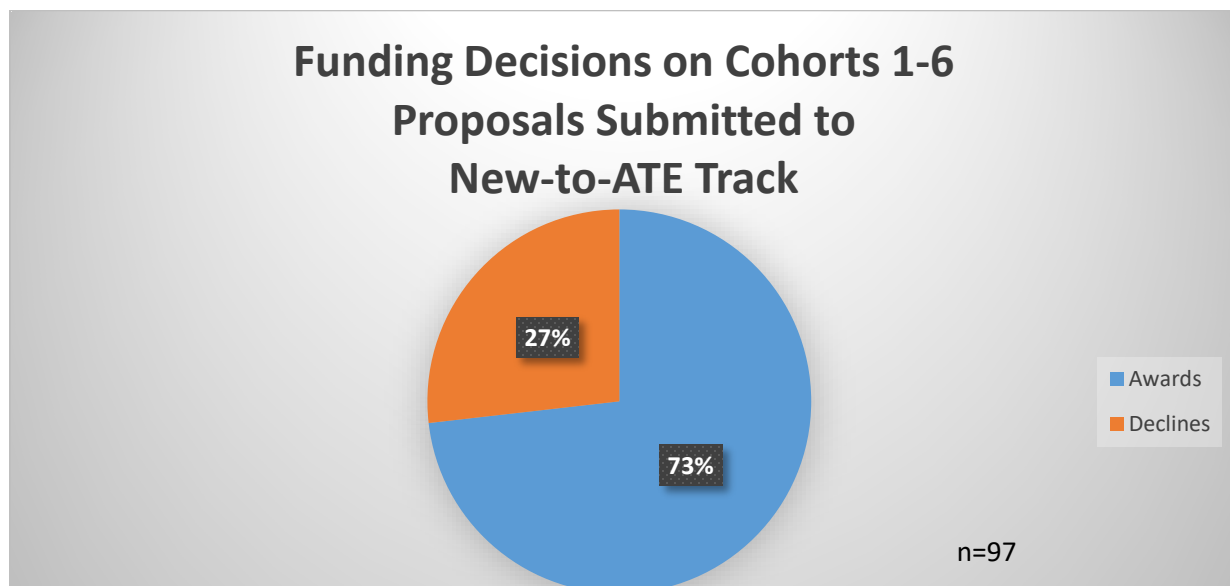


[6]

*Seventy-one of the 97 mentee colleges that submitted proposals to the New-to-ATE track were awarded funding by NSF.*

- Of the 26 colleges in Cohorts 1 through 6 that did not receive grants, six submitted a subsequent ATE proposal and received an ATE grant award.

- Mentor-Connect launched two new mentoring services for prospective grantees in 2019, "Moving-Up" and "Second Chance" mentoring, for which results are not yet available.

Success in terms of racial/ethnic and geographic diversity is evident by the wide dispersal of mentee college teams across the U.S. and two U.S. territories.

- In Cohorts 1 through 8, 39 states are represented as well as Puerto Rico and American Samoa, which are U.S. territories. All participating institutions have either never had a previous NSF ATE grant award or not had an NSF ATE grant in the past seven years.

U.S. States & Territories with Colleges that Have Participated in Mentor-Connect
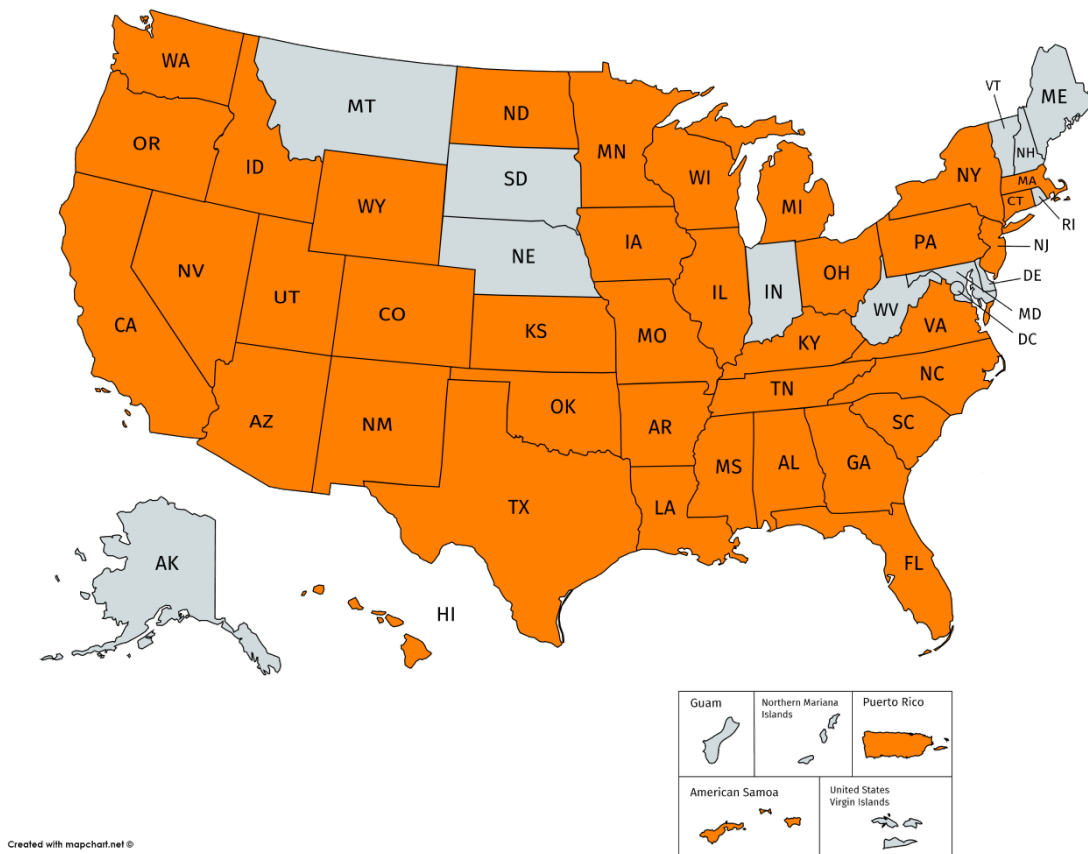


[7]

*Thirty-nine states and two U.S. territories are represented by the two-year colleges that have participated in Cohorts 1 through 8.*

Other indicators of Mentor-Connect project success in terms of racial/ethnic and geographic diversity include the following:

- 42 Hispanic-Serving Institutions (HSIs) participated in Cohorts 1 through 8.

- Among the 35 HSI participants in Cohorts 1 through 7, 27 submitted New-to-ATE proposals (77% submission rate).

- 16 of the 27 HSIs that submitted proposals were funded, a success rate of 70%. (The four proposals from HSIs submitted in October 2019 were awaiting NSF decisions in March 2020.)

- Five Historically Black Colleges have participated. (one in Cohort 6, two in Cohort 7, and two in Cohort 8). The two Historically Black Colleges in Cohorts 6 and 7 did not submit proposals.

Also notable is the extent to which Mentor-Connect involvement has provided the foundation for additional grant success by participant colleges:

- Of the Mentee colleges receiving New-to-ATE grant awards, eight have received subsequent, larger ATE project grants (three in Cohort 1, four in Cohort 2, and one in Cohort 3).

- One mentee college from Cohort 2 achieved the pinnacle of NSF-ATE funding in 2019 by receiving a $7.5M ATE Center grant.


**Research Methods**

**Data Collection**

The longevity of Mentor-Connect has given its leadership team the opportunity to study the longer-term impacts and outcomes experienced by Mentee colleges. As part of the external evaluation, site visits are made to the colleges of mentees who have received ATE awards. The evaluation process can best be described as "outcomes harvesting." At each site, the evaluator uses the same protocol of gathering qualitative data through participant narratives.
These visits involve individual interviews with the Principal Investigator, co-Principal Investigator(s), grant writer and/or grants manager, college administrators, industry representatives, and students using a prescribed interview protocol.

Each site report written by the Mentor-Connect evaluator summarizes interviews with key personnel at institutions that had received awards after participating in Mentor-Connect as part of Cohort 1 or Cohort 2. Interviews with teams from 11 institutions in Cohort 1 were conducted in late 2015 and 2016. Interviews with teams from seven institutions in Cohort 2 were conducted in late 2016 and 2017. The reports contained direct quotes and summarized statements from personnel who had been directly involved in Mentor-Connect at each institution. The findings presented in this paper are based on an in-depth, systematic analysis of the evaluator's detailed site reports from these two cohorts.

**Data Analysis**

Researchers at Oklahoma State University analyzed and synthesized the results of site-visit reports. A two-person data analysis team conducted a preliminary review of the site reports to generate a list of broad themes to guide a more in-depth analysis. Following analysis and discussion about a subset of site reports with the leadership team, a standardized approach was used to ensure inter-coder reliability. Next, half of the site reports from Cohort 1 were analyzed, and relevant content was deconstructed into broad themes. Then data were pulled into a shared coding sheet for comparison across all cases in Cohort 1. This process was repeated with the site reports for Cohort 2.

Combined data from Cohort 1 and Cohort 2, respectively, were assigned to a single coder for a third round of in-depth analysis to identify variation within each. Findings from each cohort were then compared and synthesized in a collaborative effort by both coders as a final step in the analysis.

## Findings

### Overview

The analyses of Cohorts 1 and 2 are arranged into four overarching sections: 1) a description of the conditions in which participating institutions operate, including discussion of local economies driving training needs as well as institutional contexts in terms of grant-related capacity; 2) successes and benefits at multiple levels extending from participation in Mentor-Connect and ATE grants; 3) challenges associated with participation in Mentor-Connect and Advanced Technological Education (ATE) grants; and 4) discussion of recommendations and suggestions from college representatives pertaining to Mentor-Connect. Feedback from Cohorts 1 and 2 generally coincided with the same broad themes, with grantees operating in comparable contexts and facing similar frustrations, successes, and organizational responses. The final section of the report highlights cross-cutting themes across both cohorts.

### Internal and External Conditions

*Context:* Many of the institutions within Cohort 1 that participated in Mentor-Connect operated in similar local economic and administrative contexts. For example, a majority of college representatives shared a general lack of experience preparing grant proposals and administering grants, and had limited resources for applying for grants. They also expressed the need for technical education to train and prepare students for various industry workforces. Many of the institutions in Cohort 2 operated in contexts that produced motivations, constraints, and incentives that mirrored those experienced by Cohort 1. Looking across the factors that college representatives referenced most frequently, themes coalesced around the local economy and the structural conditions within each organization.

Members of both Cohorts 1 and 2 operated in similar contexts with respect to local socioeconomic conditions and internal organizational dynamics. These institutions overwhelmingly sought to respond to challenging economies that struggled to grow due to a lack of skilled labor and shifting workforce demand. They served as critical supports to their

communities by providing local residents with the skills needed to keep up with employers' evolving needs, yet they had limited capacity to expand upon these activities. ATE grants offered a potential solution to these constraints, but participants needed the additional support provided by Mentor-Connect to pursue them.

Some of the colleges in Cohort 1 were characterized by a desire to cultivate a culture of grants even before their participation in Mentor-Connect, whereas most of the organizations in Cohort 2 had limited experience with grant funding. Yet among both groups, participants struggled with their ATE applications due to inexperience and limited support staff, highlighting the value that Mentor-Connect added by supporting them through the proposal writing and submission processes. Similarly, faculty in both cohorts had limited grant-writing experience and relied heavily on the coaching provided by their Mentor-Connect Mentors.

*Local economy:* Overwhelmingly, representatives from colleges in Cohort 1 indicated the need and desire to educate students for local and regional workforces ranging from the automotive industry to information technology and computer science, to chemical engineering, to name but a few examples. This was often a significant motivator for faculty and college leadership to apply for NSF-ATE grants. With respect to Cohort 2, interviewees at more than half of the colleges specifically discussed the needs of local industry or other economic drivers as primary reasons for the programmatic expansions pursued as a result of their involvement with the ATE program. The communities in which several of the institutions were located had experienced a shortage of skilled or specialized workers sought by regional employers. Programs were being developed or modified in direct response to shifting workforce demand and the needs of the local economy. They were thus poised to make a significant impact by empowering area residents with in-demand skills.

*Internal grant-writing conditions:* A majority of representatives from Cohort 1 shared that there is support for grants at the institutional or administrative levels of their respective colleges. In many cases, faculty members were encouraged to apply for ATE grants at the direction of deans or college presidents. While most colleges represented in Cohort 1 had received grants in the past, college representatives were quick to point out that these grants were not usually faculty-driven, nor did college faculty and staff members have much experience, if any, applying for NSF grants. Perhaps in part due to these conditions, most Cohort 1 institutions did not have a grant writer to assist with ATE proposal development. Many of the colleges had no infrastructure in place for grant-writing resources and support. Some interviewees attributed these internal conditions prior to participating in Mentor-Connect to the fact that two-year community college grants are typically administrator-driven, as opposed to four-year institutions that emphasize and encourage faculty-driven grants.

The grant-support infrastructure within the institutions was overwhelmingly similar across Mentor-Connect teams. In Cohort 2, the majority of colleges had small grants departments and limited support staff. While a handful had previously received grants or funding from other agencies, most had no culture of grants at the organizational level and limited capacity to manage them. In several cases, the college administration had encouraged the teams to pursue Mentor-Connect or ATE applications more generally, lending critical support. Three of the colleges had pursued mentoring after previous failed attempts at ATE proposals.

**Benefits and Successes**

Upon reflection of the successes associated with their involvement in Mentor-Connect, college representatives reported a number of benefits and improvements within their institutions and beyond. These are presented at three levels: 1) institutional-level benefits; 2) faculty-level benefits; and 3) student-level benefits. The final subsection presents areas of success with regard to the Mentor-Connect project, highlighting what worked well for Mentor-Connect participants. Similar to Cohort 1, the Cohort 2 teams' reflections on the successes resulting from their participation in Mentor-Connect focused on three groups of beneficiaries, including the institutions as a whole, faculty and staff, and students.

Among both Cohorts 1 and 2, the funded ATE grant proposals evidenced Mentor-Connect's value—particularly among organizations that had previously applied unsuccessfully. These grants produced a range of institutional-level benefits that include

- increasing the colleges' visibility to community partners, potential students, and local industry;
- encouraging a culture of grants;
- creating opportunities for partnerships with other educational institutions and industry contacts; and
- enhancing programmatic offerings.

Additionally, faculty teams in both cohorts reported that they had benefited directly from their involvement in Mentor-Connect and from their ATE-funded programs. These individuals viewed the coaching and grant-writing experience as important for developing skills that would continue to produce returns well into the future.

These resources and improvements ultimately benefited students by supporting enhancements to programs and providing new opportunities. Key among these were new connections to industry partners who were recruited from programs funded by ATE grants. These changes also promoted and, in several cases, helped broaden participation by populations that have been historically underrepresented in STEM disciplines.

***Institutional-level benefits:*** College representatives reported a number of benefits as a result of participation in ATE projects and Mentor-Connect. A majority reported new partnerships and strengthened connections with industry, other Mentor-Connect Mentees and other ATE applicants, departments on campus, and other nearby community colleges and high schools. Some also experienced increased visibility at program and college levels. Finally, participating in Mentor-Connect fostered a desire among many faculty and administrators to create or enhance a "culture of grants" at their institutions.

Increased visibility first pertains to students who may be interested in learning at these institutions. It also pertains to visibility among industries that have come to recognize Mentee colleges as sources of potential employees who have up-to-date knowledge and skills in relevant areas to fulfill STEM workforce needs. For some colleges, participation in an ATE grant

strengthened their legitimacy and reputation in specific advanced technology fields. ATE grants, with the support of Mentor-Connect, often created or enhanced programming in a way that was also beneficial to industry partners by addressing their specific employee-related education needs.

In many cases, Mentor-Connect support and ATE grant involvement prompted a shift in thinking among faculty and administrators about the need to create or enhance a "culture of grants," in which faculty and program leaders feel supported and inspired to pursue external funding. As mentioned earlier, a majority of colleges represented in Cohort 1 either did not have a grant writer or a grants office to support them in the construction and submission phases of the ATE grant and/or did not have experience with NSF grants. Because of this, nearly all of Cohort 1 college representatives indicated that they would not have been able to be involved in the grant proposal construction and submission process and/or receive an ATE grant without the support of Mentor-Connect.

In Cohort 2, interviewees overwhelmingly described their team's involvement in Mentor-Connect as being beneficial for their college as a whole. Successful ATE proposals were referenced as evidence of the program's effectiveness in helping institutions succeed in pursuing ATE funding. Several interviewees stated that the grant had enhanced their college's overall reputation, visibility, or connectedness within the regional educational landscape. Moreover, three interviewees stated that funded ATE projects had enabled their colleges to discover or access additional grants and partnerships.

The enhanced opportunities that the ATE grants provided had improved the quality of programs in ways that may not have been possible on the same scale or timeline without the resources that the grant had provided. Additionally, some of the collaborations that began with ATE projects had further enhanced access to resources such as equipment and technology. More than half of interviewees stated that participating in Mentor-Connect and seeing ATE projects come to fruition had helped their institutions develop a culture of grants with infrastructure to support grant proposal development and execution of awards.

*Faculty-level benefits:* For Cohort 1, involvement in Mentor-Connect and ATE grants led to a number of benefits for faculty at participating institutions. These benefits include a growth in internal faculty leadership, increased encouragement and support among faculty to pursue future grants, boosts in the confidence of faculty members in their ability to write and submit grant proposals, as well as general feelings of inspiration that have energized some faculty members to come up with new ideas for grant funding. These benefits have extended to include individuals who may not have been involved in Mentor-Connect or ATE grants.

Other beneficial outcomes include the recognition that some faculty members have received from college leaders and beyond as a result of their work associated with ATE grants. One specific example of faculty success is a Principal Investigator who received a Women of Achievement Award from the local Young Women's Christian Association (YWCA) in Education, which she directly credits to her participation in an ATE grant. Another example is a Principal Investigator whose program has been designated as exemplary by the state's education governing board. He credits his professional development through Mentor-Connect with the

expansion of his technical program and this statewide award. Other Mentor-Connect Mentees have been recognized internally within their institutions at departmental and college levels as a result of their involvement in the ATE grant, which many attributed to the knowledge and experience gained during their involvement in Mentor-Connect.

In Cohort 2, members of the grant-writing teams and faculty involved with programs that were expanded through ATE grants also derived direct professional benefits as a result of their institutions' participation in Mentor-Connect. Interviewees at three institutions specifically noted that faculty had been able to receive additional training or other professional development that enhanced their teaching capacity. For example, the grant enabled machine tool instructors at one college to receive training from a renowned program at Vincennes University to sharpen their expertise in the field.

Others explained that the process of writing the grant had positively affected their confidence or capacity to pursue similar activities in the future. Several interviewees described how the grant fostered faculty interest in grant writing and greater receptivity to pursuing grants in their department.

A few individuals stated that their professional networks had been expanded, either through direct connections to others within their Mentor-Connect cohort or through collaboration with others on ATE proposals. These networks were viewed as conduits to new opportunities and future partnerships. Additionally, a few representatives stated that the grant had increased collaboration on campus.

***Student-level benefits:*** At the student level, multiple benefits were associated with colleges' participation in Mentor-Connect, which primarily included indirect benefits as a result of successful ATE proposals. For instance, college representatives overwhelmingly noted increased employability among students upon graduation. More specifically, the availability of specific training programs originating from ATE funding allowed students the opportunity to gain experience and build skills specific to the needs of local and regional industries. In some instances, college representatives reported an increase in enrollment in ATE-supported programs. While enrollment remains an issue for some (as explained in the next section), multiple colleges attributed increases in enrollment to a surge in student interest associated with ATE-funded programming in various fields. Several colleges' ATE projects focused on increasing enrollment; in some cases these efforts increased recruitment of groups that have been underrepresented in STEM, such as women and ethnic and racial minority populations.

Interviewees from Cohort 2 also linked their participation in Mentor-Connect to positive student outcomes. Specifically, these indirect benefits were identified as the products of programmatic improvements that were eventually funded by successful ATE proposals. These included expanded training programs and increased enthusiasm about educational opportunities. A majority of teams stated that enrollment had increased as a result of the improvements funded by their ATE grants. Two interviewees credited their grants with helping to increase diversity among enrolled students. In fact, representatives from one of these institutions stated that their ATE project had helped to increase enrollment among women by 10 percent.

*Other benefits of Mentor-Connect involvement:* Overwhelmingly, faculty and personnel involved in Mentor-Connect Grant Writing Workshops reported positive outcomes and high levels of satisfaction. The workshops provided learning and networking opportunities, while also allowing for time and space to construct ATE grant proposals thoughtfully and to receive feedback. Nearly all institutions reported that this experience was invaluable to the development of successful proposals. Specifically, the mock panel review experience, reading others' grant proposals, and guidance around NSF proposal submission processes were commonly noted as components of the workshops that were especially beneficial to program participants. The workshop also helped applicants to refine, strengthen, and clarify project-related goals and objectives.

## Challenges

College representatives involved in Cohorts 1 and 2 of Mentor-Connect shared a number of barriers and constraints in applying for and implementing their respective ATE grants. These constraints are divided into five sections: 1) time commitment and faculty overload; 2) lack of familiarity with grant writing and administration; 3) developing collaboration; 4) student enrollment and retention; and 5) other reported challenges.

Members of both cohorts encountered challenges and constraints that impeded the grant-writing process or contributed to ongoing pressures that threatened funded projects. In the proposal stage, mentee teams struggled with limited institutional grant-support capacity and a lack of experience with the grant-writing process. These issues created frustrations with the time commitment required to construct competitive proposals and with the dearth of institutional mechanisms to support faculty and staff in these endeavors.

The cohorts diverged somewhat in articulating the barriers they had encountered once ATE projects had been funded. Whereas Cohort 1 emphasized struggles with navigating the post-award period (e.g., no-cost extensions, purchasing), Cohort 2 focused more heavily on difficulties engaging external partners and developing mutually beneficial arrangements. Members of both Cohorts 1 and 2 referenced these issues to some degree; however, how these issues played out among them varied.

*Time commitment and faculty overload:* Particularly in Cohort 1, college representatives reported a number of thematic and anecdotal challenges pertaining to ATE grant applications and administration. More than half of Mentor-Connect-participating institutions identified overload concerns among faculty directly involved in ATE grant writing and administration. For example, faculty members reported that they had a limited amount of time to dedicate to grant writing, due in part to a lack of familiarity with what the grant-writing process entails. A few faculty members reported working unpaid hours beyond their normal work week toward proposal development and submission.

Many faculty members felt stretched to dedicate time to ATE grant construction and grant-related programming with the usual demands of teaching. For some of them the necessity to hire additional instructors and obtain buy-in among colleagues presented additional barriers to the

success of their ATE grants. A few interviewees noted what they perceived to be as "tension" between teaching obligations and the attention needed to devote toward the grant. As some participants explained, faculty overload and time commitment issues were a direct reflection of the lack of familiarity and experience with the grant-writing process. A key issue for them was learning how to budget the appropriate amount of time to ensure the successful implementation of project components.

*Lack of familiarity with grant-writing and grant administration:* People interviewed at a majority of the 11 colleges in Cohort 1 expressed concerns and constraints relating to a lack of familiarity with grant writing and grant administration, including the need for more direction around grant budgeting, creating an appropriate project scope, as well as a general lack of awareness with the NSF grant process (e.g., navigating Fastlane, the online proposal submission system used by NSF). In expressing these challenges, interviewees offered additional specific examples of constraints pertaining to grant-writing and administration processes. These include, but are not limited to: difficulty purchasing materials and equipment, hiring student workers, constraints for community colleges in applying for grants in a community college environment, and difficulty pulling together grant applications. Interestingly, several interviewees noted they continued to need mentoring support after receiving their ATE grant award. The need for mentoring beyond the initial scope of Mentor-Connect is described in more detail in the discussion section of this report.

As described above, many of the colleges lacked a robust internal structure to help manage or support grant submissions. As an example of how this affected grant-writing teams, at least one person among those interviewed for five of the seven Cohort 2 institutions mentioned the time burden associated with their ATE application. Specifically, these institutions lacked a means of accommodating the significant time investment required to write an ATE proposal. Some institutions simply had no established procedures for assigning course releases or otherwise budgeting for the time that participants needed to spend on the grant proposal, which compounded staff and faculty workload. Others lacked an internal structure for processing grants. This left teams with the additional task of figuring out complex requirements and resource allocations with little internal guidance. Finally, lack of experience was cited by personnel at three institutions as a hindrance to the grant-writing process, and many leaned heavily on their mentors to narrow their focus and create a competitive submission.

*Developing collaborations:* Industry partnerships—while beneficial and improved for many colleges as a result of ATE grant participation—presented challenges. For example, in Cohort 2, collaboration with external partners was a key component of the teams' ATE proposals. However, a few teams struggled to obtain buy-in from potential partners, establish relationships with potential partners, or contend with differences in capacity once projects had been implemented. Other institutions experienced difficulty sustaining support from industry and communicating the programmatic roles of industry partners. One specific instance of wavering industry support was when an ATE grant recipient lost the involvement of two industry partners who had committed during the grant-writing phase.

As an example of the first issue, one interviewee described difficulties connecting with partners because faculty within the institutions they sought to engage tended to work in isolation. The

region lacked an infrastructure for collaboration. So, the team had to create a professional network from scratch, essentially beginning with "cold calls" to potential partners. One interviewee explained it this way:  "Saying to [unacquainted faculty from other colleges], 'Could we talk about where you are going?' was a big step for me." Others stated that partnerships and verbal commitments had come easily, but that it was difficult to get partners to actually sign letters of commitment.

In some cases, colleges participating in collaborative endeavors had unequal degrees of access to resources. For example, when one such collaboration began, only one of four partners had access to the equipment on which all sought to become certified. These disparities were challenging, but the partnership also afforded an opportunity to seek external support that eventually enabled all partners to acquire the necessary machines.

***Student enrollment and retention:*** Specific to Cohort 1, student enrollment and retention presented additional challenges for a few institutions. Administrative hurdles, a lack of—or unfocused—recruitment and outreach plans, and course scheduling, were viewed as contributing factors by faculty when they reviewed why certain programs struggled to involve and retain students. Course scheduling for some programs, such as those focused on training and recruiting high school students, posed challenges for faculty who had to schedule college courses in a way that did not overlap with high school schedules.

***Other challenges:*** In reflecting on the barriers and challenges they had faced, a few teams in Cohort 2 pointed to difficulties maintaining the degree of visibility needed to attract students, expand programs, or gain the attention of industry personnel. This was particularly significant for colleges serving rural areas with small populations. Additionally, representatives at one site in Cohort 2 described difficulties connecting with their mentor to obtain advice and then understanding the feedback they received. While the overall mentoring experience was described as acceptable, some representatives expressed a desire for greater involvement and accessibility on the part of their mentor.

Lastly, college representatives reported issues accessing NSF's Fastlane for three weeks during a government shutdown. During this time, they were unable to submit their proposals or ask logistical questions about submission. For many, this was a source of stress that made them feel as though they were pressed for time once they were able to access the Fastlane platform.

## Discussion

Interviews with representatives from Cohort 1 institutions provided a handful of recommendations for Mentor-Connect improvement. Important to note, however, is that many interviewees expressed positive sentiments toward the program without recommendations for improvement. Among those who shared suggestions, common themes included: post-award support, including information about requesting no-cost extensions, and continued emphasis on face-to-face support. Specific suggestions for post-award and "back-end" of project support included webinars and workshops about navigating the final phases of grants. Relevant to these suggestions, a number of interviewees specifically asked for assistance and information regarding no-cost extensions.

Also in Cohort 1, face-to-face support appeared to be a more valued mode of mentorship compared to virtual support (e.g., webinars, conference calls). One person noted that they were happy with "intrusive advising," explaining that it was helpful for them in producing a culture shift from faculty focusing solely on teaching to becoming more comfortable in a research space. Given the benefits of their involvement in the Grant Writing Workshop, some interviewees noted that it would be beneficial to put a mechanism in place for mentees to discuss future ideas for grant development. Finally, another suggestion from an ATE Principal Investigator was that Mentor-Connect should create and allow for space to share lessons learned among all Mentor-Connect participants, including challenges in administering grants (e.g., via quarterly meetings).

With respect to recommendations for how Mentor-Connect could be improved, the majority of representatives in Cohort 2 stated that the support their team had received was overwhelmingly useful and did not warrant adjustment. As an example, when asked about recommendations for what could be done differently, one participant stated, "It is hard to improve on a very good experience."

Regarding specific programmatic elements that they found most valuable, Cohort 2 representatives from two colleges stated that online resources such as the Mentor-Connect website and webinars had been informative and motivating. Two others specified that having face-to-face interactions via the Grant-Writing Workshop had enhanced their overall experience.

A few representatives from Cohort 2 did volunteer some specific recommendations. However, these emerged on an individual basis, precluding the development of cohesive themes on this topic. Instead, the recommendations are detailed individually:

- One respondent stated that he/she would like to share curriculum that his/her program had developed using ATE funds with other institutions. While not directly related to improvements in Mentor-Connect per se, the representative would have appreciated guidance on how to disseminate best practices once a successful ATE proposal had produced valuable lessons learned.
- Another emphasized the importance of providing candid feedback to mentees, stating that mentors should be "brutally honest" to help push them to the next level.
- Recalling the struggles that some encountered with the NSF's FastLane interactive website and portal for submitting proposals, one person stated that it would have been helpful to have more assistance with FastLane.
- A representative whose team had struggled with the grant proposal timeline suggested that mentees be informed of the time commitment required and encouraged to start writing early.

In sum, through the course of its work, Mentor-Connect has received extremely positive feedback from participants. The following comments from two mentees and a college system administrator are a sampling of the numerous endorsement statements that participants have provided with attribution.

Jonathan Beck, Principal Investigator of the National Center for Autonomous Technologies (NCAT), said that Mentor-Connect Mentor Mel Cossette facilitated connections to the leaders of other ATE centers and projects. "She was instrumental in helping to guide us based on where we were going, what we were trying to accomplish, who good contacts would be for some of the core areas that we were trying to shape and grow through our small project, our large project, and ultimately the center. And without that guidance of those key points of contact as we formed our network, I don't think we would have been successful on getting to where we are at with the ATE program. I think it is because of that constant mentoring, making sure our ideas were aligned to the program, and helping us identify those right resources that were already out there. That's what's allowed us to be so successful in such a short period of time," he said. [8]

Jay Olsen, director of Agriculture and Farm/Ranch Management at Snow College, said questions from MENTOR-CONNECT Mentor Osa Brand helped him and Michael P. Medley, the dean of Business and Applied Technologies, clarify their thinking about the Agriculture Systems curriculum. Brand has a PhD in geography, but does not have a background in agriculture. So her questions came from a "different perspective," which Olsen said led him and Medley to reconsider the needs of farm families in the six rural counties the college serves. The program Snow College has developed with its ATE grant blends agriculture mechanics and advanced technologies, and instruction about the region's hydrology for efficient use of irrigation water. Strong initial enrollment in the program has continued with a strategic recruitment effort funded by the grant. [9]

Christine Johnson, president of Spokane Community College system, wrote "our colleges' success rate with NSF have increased given participation and support by Mentor-Connect." [10] Spokane Community College (SCC) and Spokane Falls Community College (SFCC), which are part of the Spokane Community College System, participated in Cohort 1. Each college had two Mentee teams. All four teams submitted New-to-ATE proposals. The two proposals from Spokane Falls Community College (SFCC) were funded. In subsequent years, both colleges received funding for Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) from NSF.  In 2018 SCC received a New-to-ATE grant. In 2019 SFCC received another ATE grant. [11]

**Future Research**

Analysis of data from Cohort 1 and 2 site visits represents a relatively small sample of total participants in this eight-year project. Nevertheless, it is clear that Mentor-Connect is producing valuable outcomes for a majority of participants, particularly in terms of successful ATE grant proposals, greater understanding of grant preparation by faculty who also report higher confidence, and an increase in public awareness of STEM programs that prepare technicians at participating institutions.

Evaluator site visits are ongoing. As additional grantees who were Mentor-Connect Mentees reach the conclusion of their first NSF-ATE grant, this outcomes-harvesting activity will continue to capture participant impacts by college/location. Researcher synthesis and analysis of additional evaluator site-visit reports will seek to answer research questions about the overall impact of the body of work of Mentor-Connect in terms of community college participation,

STEM faculty leadership development, service to students and industry, and other elements of transformation and growth that have occurred that contribute to achievement of NSF and ATE program goals for the STEM workforce in the United States.

## **Conclusion**

As this paper demonstrates, there were a number of cross-cutting themes among Cohorts 1 and 2 categorized by internal and external conditions, successes and benefits, challenges and barriers, as well as recommendations and suggestions for Mentor-Connect. Each cohort shared difficulties navigating the NSF grant-writing and submission landscape. Additionally, partnerships and collaborations with external partners such as industry, local high schools, and other community colleges, while positive experiences for some, posed challenges for others. In particular, creating and maintaining industry connections before and after receiving ATE grants proved difficult for some institutions as they tried to articulate the role of industry with respect to ATE-related programming.

Overwhelmingly, however, participants in both Cohorts 1 and 2 reported positive experiences and outcomes associated with their participation in Mentor-Connect. Their participation in this program was often directly attributed to the success of ATE grant applications. While a majority of participants' experiences were positive, there were a few consistent recommendations across cohorts for how Mentor-Connect could be improved and/or sustained. Face-to-face mentorship and use of multimedia, such as webinars and conference calls, were important sources of support for Mentor-Connect participants throughout the grant-writing and submission process. In particular, Cohort 1 participants emphasized the importance of the grant-writing workshops in setting aside the space and time for meaningful proposal construction and in-depth mentorship. Although a suggestion for more information-sharing was made by one respondent in Cohort 2, a few Cohort 1 representatives made similar suggestions regarding how to share lessons learned, challenges, and new ideas with fellow and future Mentor-Connect and ATE grant participants.

The benefits of receiving grant funding from the NSF-ATE program are many. It is a unique funding source that is directed to two-year community and technical colleges. The Principal Investigators that lead funded centers and projects are a welcoming and supportive community for those seeking NSF-ATE funding. Faculty pursuing funding for the first time can dramatically increase the probability of success by taking advantage of support that the NSF-ATE program provides through grant-funded initiatives like Mentor-Connect.

The data shared in this paper provide evidence that the mentoring and technical assistance that Mentor-Connect provides helps those who are new to ATE learn grant-writing and related skills that foster success well beyond the first ATE grant. The technical resources that Mentor-Connect has developed and tested help faculty and the staff on grant-writing teams that are new to NSF or new to ATE write competitive proposals and avoid disqualifying technical mistakes.

The most important aspect of Mentor-Connect is the mentoring it provides. The project intentionally leverages the considerable expertise of two-year college faculty who have been engaged in ATE initiatives to help other educators acquire the resources to improve technician education programs at their colleges to benefit students and employers. The impact of Mentor-

Connect mentoring on the development of new STEM leaders at two-year colleges will be a key element of the project's future research.

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