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ARMY EDUCATIONAL OUTREACH PROGRAM

2022 Annual Program Evaluation Report
Summative Findings

July 2023

aeop
ARMY EDUCATIONAL OUTREACH PROGRAM

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Contents

Executive Summary

The Army Educational Outreach Program (AEOP) offers students and teachers science, technology, engineering and mathematics (STEM) programming that is designed to attract, develop, and mentor the next generation of the nation's diverse talent through United States (U.S.) Army educational outreach programs.

Education Development Center, Inc. (EDC), the external evaluation partner for AEOP, conducted a summative evaluation of the 2021-2022 program year. The FY22 evaluation sought to document and assess the benefits of participation, program strengths and challenges, and overall effectiveness in meeting AEOP and program objectives. The primary tools for data collection were student and mentor post-surveys[1]. It is important to recognize that survey results only reflect those individuals who completed surveys and cannot be applied across the Consortium and may not be generalizable within a specific program. The evaluation team focused on presenting aggregated results for the overall AEOP overall program; results for individual programs will be included in forthcoming program-level summaries.

Key findings from the evaluation are presented below.

Overview of Participants

In FY22, AEOP served a total of 18,579 participants – 95% were students and 5% were educators, advisors, mentors, Science & Engineering (S&E) volunteers, or other adults. A total of 3,540 organizations participated, and 80% of these organizations represented PK-12 schools and postsecondary institutions.

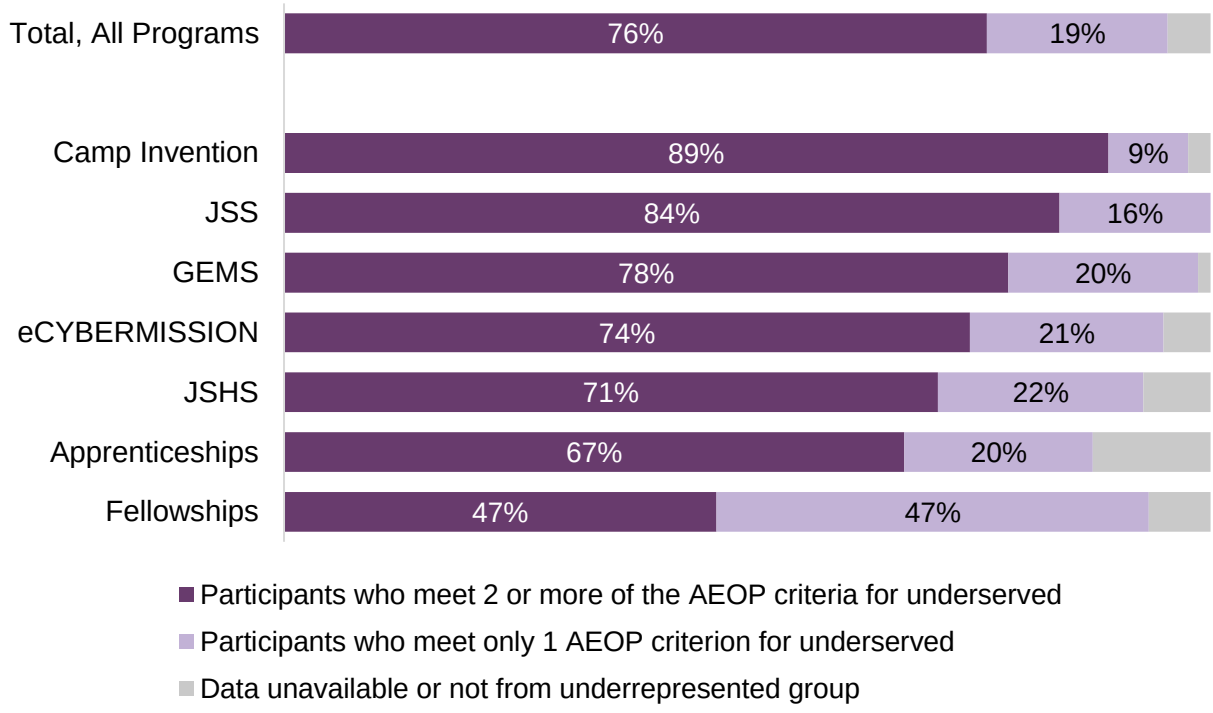
AEOP has a particular focus on reaching participants who have more limited access to STEM learning opportunities and/or who are from groups that are underrepresented in STEM education and careers. AEOP defines underserved and underrepresented participants as those who possess one or more of the following characteristics: attend a rural, urban, or frontier/tribal school; identify as female[2]; identify as racial/ethnic minority in STEM (i.e., Alaska Native, Native American, Black or African American, Hispanic, Native Hawaiian and other Pacific Islander, other); receive free or reduced meals price at school; speak English as a second language (ELL); first generation college student; students with disabilities; or a dependent of a military service member or veteran.

AEOP has identified a particular interest in reaching students who meet two or more of the underserved and underrepresented criteria described above (referred to hereafter as Underserved). As shown in Figure 1**.**, in FY22, more than three-fourths of all AEOP student

[1] Depending on the AEOP program, mentor surveys were administered to either mentors or team advisors. For reporting purposes, we simply refer to them throughout as "mentors."
[2] Two AEOP programs— Junior Science and Humanities Symposium (JSHS) and Apprenticeships—only females engaged in certain STEM fields (physical science, computer science, mathematics or engineering) are considered as underserved. For the purpose of this analysis, we have included all students who identified a female but not based on their STEM discipline, as those data were not available. This likely overestimates numbers for JSHS and Apprenticeships as well as the total for all programs.

participants (76%) meet two or more of the Underserved criteria. An additional one-fifth of student participants (19%) meet one of the AEOP Underserved criteria.

Figure 1. Percentage of FY22 Student Participants Meeting AEOP Criteria for Underserved*



FY22 Cvent data, confirmed by AEOP programs

*Unite provided aggregate demographic counts so it was not possible to determine how many criteria were met by individual participants

Participant Experience and Outcomes

AEOP exposed students to an array of STEM experiences. According to survey results from both students and mentors, the majority of students had experiences working in teams, conducting research, and solving real-world problems; at least 89% of students and 88% of mentors reported that students had these opportunities. A relatively smaller majority of students gained experiences working with STEM researchers; between 60% and 79% of students and between 72% and 81% of mentors reported some level of interaction between students and STEM researchers.

Students reported improved STEM skills such as: knowledge of STEM topics and STEM research; planning and carrying out an experiment; analyzing and interpreting data. Overall, between 75% and 95% of students reported improvements in a range of STEM skills.

Students noted gains in 21st Century skills such as: communication and collaboration; critical thinking and problem solving; and creativity and innovation. The majority of students (between

87% and 96%) indicated increased competencies in these areas. Students were less likely to report improvements in their skills related to media and technological literacy. Between 46% and 87% reported gains in this area.

Students' interest in STEM and STEM careers increased, including Army/DoD careers. Most students reported that they were more likely to engage in STEM activities after their participation in AEOP (ranging between 54% and 72%). They, along with their mentors, also indicated that AEOP had a positive influence on students' interest in earning a STEM degree (58% and 88%, respectively) as well as increased appreciation for Army/DoD research (roughly 90% on multiple items).

Mentors used a variety of strategies to engage with students. They reported using strategies to support the diverse needs of students, establish relevant learning activities, support students' development of collaboration and interpersonal skills, and support students' educational pathways. Across an array of items, mentors' responses fell between 50% and 97%.

Overall, both students and mentors reported generally positive experiences with AEOP. Students enjoyed learning new STEM skills, working in teams, and learning about community issues. Mentors enjoyed engaging with students in research, solving real-world problems, and providing students with opportunities for hands-on learning experiences.

Most suggestions for improvement were specific to individual programs, but respondents most frequently pointed to a need for improved communication, some also noted a desire for instructional and training resources.

Recommendations

This Summative Evaluation Report distills findings across the student participant and mentor surveys as they align with AEOP's overarching research questions. As stated in the report, data collected for this evaluation are not necessarily representative of the entire program; however, based on the results presented above, we offer the following recommendations:

Programmatic Considerations

- **Continue to offer hands-on, authentic, relevant research experiences.** Research shows these kinds of experiences are important to developing and sustaining students' interest in STEM education and career pathways.
- **In general, AEOP appears to be reaching historically marginalized populations; programming should center their interests and perspectives.** As the Consortium considers a revised Underserved definition, it should also ensure that programmatic strategies are aligned to meet the needs of AEOP's intended populations.
- **Consider ways to bring mentors together to exchange promising practices, successes, and lessons learned.** Mentors play an important role in AEOP. Most mentors shared that they are engaging in meaningful ways with student participants.

When asked about ways to improve AEOP, mentors frequently expressed a desire for instructional materials. Peer learning opportunities would allow them to share effective strategies, resources, and tools.

- **Explore ways to improve awareness of various AEOP resources, including printed materials, the website, and other social media.** Although students reported that in-person resources like invited speakers and career events were helpful, they were less likely to say the same about printed and online media. As AEOP considers developing pipelines across programs, print and online resources could be used to market programs more effectively.

Evaluation Considerations

- **Continue to examine ways to increase response rates.** As noted in this report, the variable response rates across programs make it difficult to generalize the findings across AEOP. The EDC evaluation team is working with IPAs to troubleshoot these issues and develop strategies to improve response rates.
- **Examine the relevance of surveys within and across programs.** Overall, AEOP participants reported strong results in many areas. Future surveys should explore to what extent participants may be reporting "topping out" in certain outcome areas and develop potential strategies to address these issues (e.g., retrospective survey items, more carefully constructed instruments, etc.).

1 Introduction

1.1 AEOP Priorities & Goals

The Army Educational Outreach Program (AEOP) mission is to provide an accessible pathway of science, technology, engineering, and mathematics (STEM) opportunities to attract, develop, and mentor the next generation of our nation's diverse talent through United States (U.S.) Army educational outreach programs.

AEOP has three priorities:

1. **STEM Literate Citizenry**. Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base (DIB).
2. **STEM Savvy Educators.** Support and empower educators with unique Army research and technology resources.
3. **Sustainable Infrastructure.** Develop and implement a cohesive coordinated, and sustainable STEM education outreach infrastructure across the Army.

1.2 Overview of 2022 Portfolio of Programs

AEOP offers a collaborative and cohesive portfolio of STEM programs that engage, inspire, and attract the next generation of STEM talent. These programs are led by multiple partners as shown in Table 1.

Table 1. AEOP Partners and Programs

Partner	Program	Description
National Science Teaching Association (NSTA)	eCYBERMISSION (eCM)	eCM is a web-based STEM competition for students in grades 6–9 that promotes self-discovery and empowers students to recognize the real-life applications of STEM.
	Gains in the Education of Mathematics and Science (GEMS) & Camp Invention (CI)	GEMS is an Army-sponsored summer STEM enrichment program for students in grades 5–12 held in the summer at participating Army Research Laboratories. CI is a week-long summer program that engages children to develop creativity, inventive thinking, and problem-solving skills through hands-on STEM content, while also providing professional development to teachers and high school leadership interns nation-wide.
	Junior Science and Humanities Symposium (JSHS)	The JSHS is a DoD-sponsored STEM program (U.S. Secretary of the Defense and the U.S. Departments of the Army, Navy, and Air Force) which promotes original research and experimentation in STEM at the high school level and publicly recognizes students for outstanding achievement.

Partner	Program	Description
Rochester Institute of Technology (RIT)	Apprenticeships & Fellowships	A career development initiative, AEOP Apprenticeships and Fellowships provides high school, college, and graduate students (Fellowships) with immersive STEM research opportunities in military and university laboratories across the United States and its territories.
Technology Student Association (TSA)	Junior Solar Sprint (JSS)	The JSS program is available for 5th-8th grade students and provides the opportunity for students to apply scientific understanding, creativity, experimentation, and teamwork to design, build, and race solar electric vehicles.
	Unite	Unite is a pre-collegiate, academic, summer program for rising 9th through rising 12th grade students from groups historically underrepresented and underserved in STEM areas.
Tennessee Tech University (TTA)	RESET	RESET is designed to provide high school and middle school educators with authentic summer research experience at participating Army Research Laboratories and Centers.

FY22 was still in the midst of the COVID-19 pandemic recovery, which had enduring effects on program delivery and participation. Some programs continued to offer virtual-only programming, while others offered hybrid activities or resumed in-person activities.

1.3 Overview of Participants

In FY22, AEOP served a total of 18,579 participants – 95% were students and 5% were educators, advisors, mentors, Science & Engineering (S&E) volunteers, or other adults (see Table 2). A total of 3,540 organizations also participated in FY22 AEOP programming. Eighty percent of organizations represented PK-12 schools and postsecondary institutions (see Table 3).

- 95% of student participants were in grades K-12 and 5% were post-secondary students.
- 28% of adult participants were teachers or educational professionals, 65% were mentors or team advisors, and 7% were volunteers or other unknown.

See Appendix A for more detailed information about participant counts.

Table 2. Total number of AEOP FY22 program participants, by program[3]

Program	Students	Adults (Educators, Advisors, Mentors, S&E Volunteers)	Total
Apprenticeships	354	114	468
Camp Invention	2,105	-	2,105
eCYBERMISSION	9,103	385	9,488
Fellowships	15	-	15

[3] AEOP programs have different means of tracking participant data. The majority (91%) of participant data is tracked using the online Cvent registration system and 9% is tracked by programs directly. This report relied on both data sources, and counts were vetted with AEOP program staff.

Program	Students	Adults (Educators, Advisors, Mentors, S&E Volunteers)	Total
GEMS	2,698	51	2,749
JSHS	2,755	-	2,755
JSS	135	28	163
RESET	-	73	73
Unite	463	300	763
Total, All Programs	**17,628**	**951**	**18,579**

* JSS participant counts for FY22 include Army sites only. In FY21, all sites were included. Going forward, we will report Army sites only.

Table 3. Total FY22 Participant Counts, by Organization Type

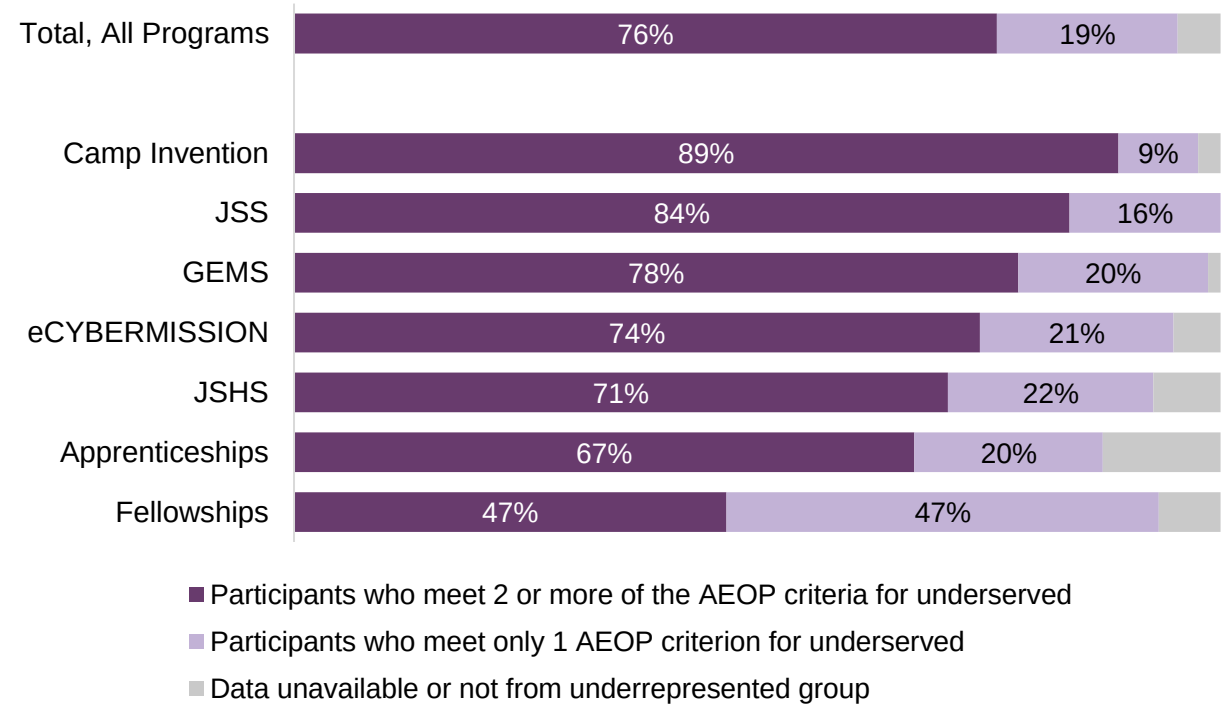
Program	Total Number of PK-12 Schools	Total Number of Colleges & Universities	DoD Labs, Facilities or Installations	**Other** (including government, research institutions, non-profit and for-profit organizations)	Total
Apprenticeships	34	68	17	17	119
Camp Invention	26	-	-	-	26
eCYBERMISSION	386	213	55	304	903
Fellowships	-	-	2	2	2
GEMS	1,481	44	16	16	1,541
JSHS	875	-	-	-	875
JSS	1		4	6	7
RESET	35	1	7	7	43
Unite	-	24	-	-	24
Total, All Programs	**2,838**	**350**	**101**	**352**	**3,540**

AEOP has a focus on reaching participants who have more limited access to STEM learning opportunities and/or who are from groups that are underrepresented in STEM education and careers. AEOP defines underserved and underrepresented participants as those who possess one or more of the following characteristics: attend a rural, urban, or frontier/tribal school; identify as female[4]; identify as racial/ethnic minority in STEM (i.e., Alaska Native, Native American, Black or African American, Hispanic, Native Hawaiian and other Pacific Islander, other); receive free or reduced meals price at school; speak English as a second language (ELL); first generation college student; students with disabilities; or a dependent of a military service member or veteran.

[4] Two AEOP programs—JSHS and Apprenticeships—only females engaged in certain STEM fields (physical science, computer science, mathematics or engineering) are considered as underserved. For the purpose of this analysis, we have included all students who identified a female but not based on their STEM discipline, as those data were not available. This likely overestimates numbers for JSHS and Apprenticeships as well as the total for all programs.

AEOP has identified a particular interest in reaching students who meet two or more of the underserved and underrepresented criteria described above (referred to hereafter as Underserved). As shown in Figure 2, in FY22, more than three-fourths of all AEOP student participants (76%) meet two or more of the Underserved criteria. An additional one-fifth of student participants (19%) meet one of the AEOP Underserved criteria. See Appendix A for full data tables and additional information.

Figure 2. Percentage of FY22 Student Participants Meeting AEOP Criteria for Underserved*



FY22 Cvent data, confirmed by AEOP programs

*Unite provided aggregate demographic counts so it was not possible to determine how many criteria were met by individual participants

2 Evaluation Approach

Education Development Center, Inc. (EDC) became the AEOP's external evaluation partner in fall 2021. The primary tools for data collection were student and mentor post-surveys[5], which were designed to evaluate the benefits of participation, program strengths and challenges, and overall effectiveness in meeting AEOP and program objectives. Some survey questions were asked of all participants across all AEOP programs, some questions were similar across programs but asked in slightly different ways depending on the program, and some questions were unique to a particular program. In most cases, AEOP program staff were responsible for distributing the online survey links to their student participants and mentors at the conclusion of program activities.

Table 4. Research Questions Addressed in This Report

AEOP Priority	Research Questions Regarding Participants
STEM Literate Citizenry: Broaden, deepen, and diversify the pool of STEM talent in support of our defense industry base.	*Participant Research Question #1* - To what extent do participants report growth in interest and engagement in STEM?
	Research Question #2a - To what extent do participants report increased STEM competencies, 21st Century/STEM skills, STEM knowledge, STEM abilities, and STEM confidence?
	Research Question #2b – To what extent do participants demonstrate use of and growth in 21st Century skills?
	Participant Research Question #3 - To what extent do participants and mentors report increased participant interest in STEM research and careers?
	Participant Research Question #4 - To what extent do participants and mentors report increased awareness of and interest in Army/DoD STEM research and careers?
	Research Question #5 - To what extent do participants report increased enrollment, achievement, and completion of STEM degree programs?
STEM Savvy Educators: Support and empower educators with unique Army research and technology resources.	*Research Question #6* - What is the impact of scientist and engineer (S&E) mentors on AEOP participants?
	Research Question #7 - To what extent do teacher participants report increased use of new approaches to teaching research concepts within STEM practices, and infusion of careers?
Sustainable Infrastructure: Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.	*Research Question #8* - To what extent do participants report growth in awareness of and/or interest in AEOP opportunities?

[5] Depending on the AEOP program, mentor surveys were administered to either mentors or team advisors. For reporting purposes, we simply refer to them throughout as "mentors."

2.1 Survey Respondents

This report describes participant data and results from student and mentor surveys. Table 5 shows the number of surveys by program.

Table 5. Participant and Mentor Survey Response Rates

	Participant Surveys		Mentor Surveys	
Program	**Count**	**Response Rate**	**Count**	**Response Rate**
Apprenticeships	84	23%	59	52%
eCYBERMISSION	1,367	15%	71	18%
GEMS	1,374	51%	43	25%
JSHS	414	15%	NA	NA
JSS	3	2%	6	17%
RESET	9	26%	NA	NA
Unite	377	81%	83	76%
Total, All Programs	**3,628**	**23%**	**262**	**32%**

2.2 Limitations

It is important to recognize that survey results only reflect those individuals who completed surveys and cannot be applied across the Consortium and may not be generalizable within a specific program. For example, the response rate among participants in Unite and JSHS was 81% and 15%, respectively. It is possible that these responses do not generalize well to the population of students that were involved in these programs. For this same reason, we do not include participant data for JSS since there were only three participants (2%) who responded to the JSS participant survey.

It is also important to consider the characteristics of survey respondents. For example, the majority of respondents had not yet completed high school at the time of the survey. In this instance, it is important to note that we cannot reasonably expect respondents to report postsecondary outcomes that are long-term goals of the AEOP program.

Finally, while we have presented participant and mentor findings together topically, these results should be interpreted with caution since the proportions of respondents for each group vary considerably by program. In addition, not all questions across the participant and mentor surveys are exactly aligned.

2.3 Report Organization

The evaluation team focused on presenting aggregated results for AEOP overall; results for individual programs will be included in forthcoming program-level summaries. Evaluation findings presented below are guided by the research questions and organized thematically by topic. Sections include the following:

- AEOP Activities
- Development of STEM Skills
- Development of 21st Century Skills
- Interest in STEM and STEM Careers
- Impact of S&E Mentors on AEOP Participants
- Overall Experience
- Recommendations

3 AEOP Activities

> *"[AEOP] is a great way for students to explore real-world problems and solutions. It takes STEM beyond the classroom and gives it meaning for students."*

AEOP gave students the opportunity to engage in a variety of STEM-related activities. According to survey results from both students and mentors, the majority of students had experiences working in teams, conducting research, and solving real-world problems;[6] at least 89% of students and 88% of mentors reported that students had these opportunities. A relatively smaller majority of students gained experiences working with STEM researchers; between 60% and 79% of students and between 72% and 81% of mentors reported some level of interaction with STEM researchers.

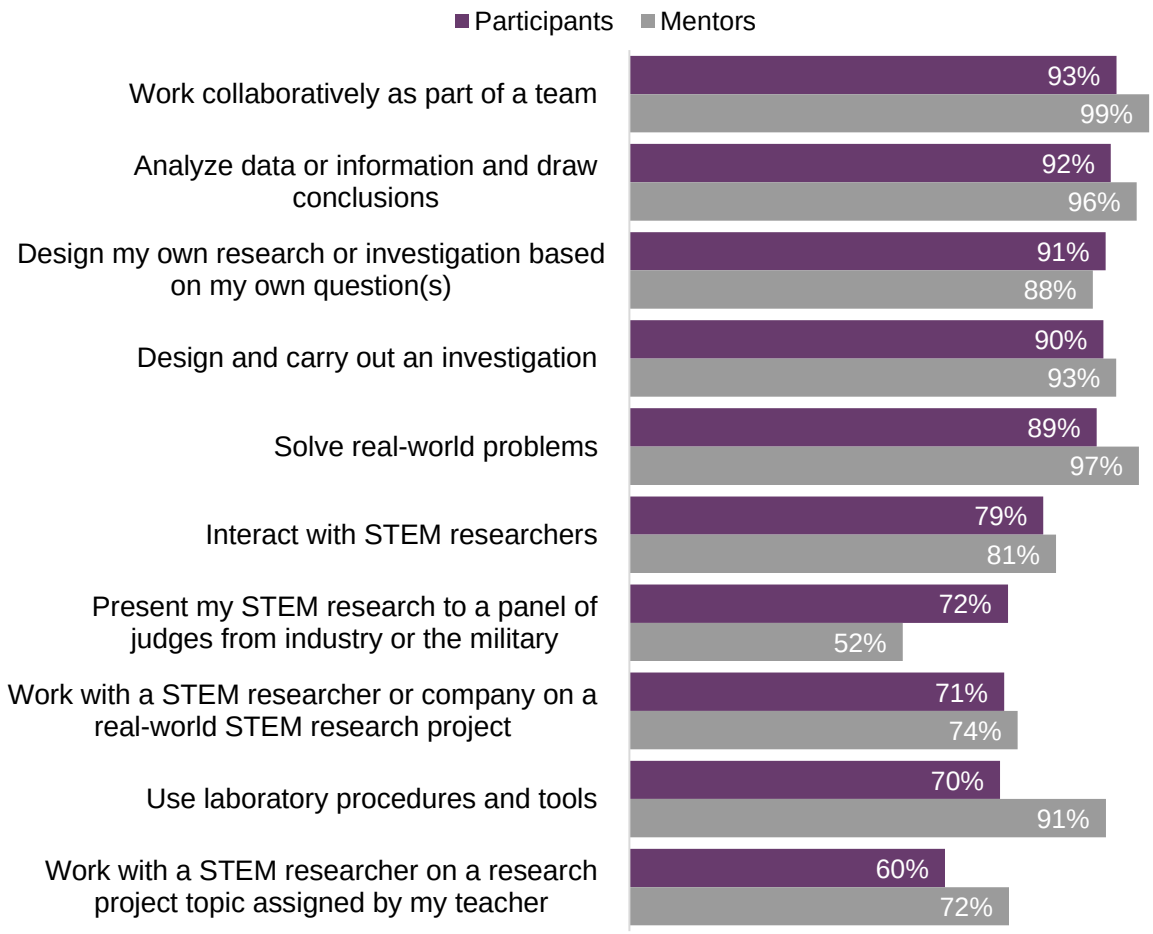
3.1 STEM Practices

AEOP participants had opportunities to engage in a variety of STEM activities. Most participants reported engaging in collaborative teamwork (93%), analyzing data and information (92%), independently designing their research studies (91%), and frequently solving real-world problems (89%). Results from mentor surveys were similar, with the vast majority of mentors reporting that their students engaged in each of these activities (Figure 3).

By comparison, fewer participants reported working directly with STEM researchers, and mentors' responses were generally consistent with participants. Nearly four-fifths of participants (79%) reported that they interacted with STEM researchers. Slightly smaller proportions of participants noted that they worked with a STEM researcher or company on a real-world STEM project (71%) or worked with a STEM researcher on a topic assigned by their teacher (60%).

[6] Participant responses include those who reported "at least once," "every day," and "most days." Mentor responses include those who reported "at least once, "every day," "a few times," and "most days."

Figure 3. AEOP participants had opportunities to engage in a variety of STEM activities



Participant Survey; All AEOP Programs combined (n = 3,427)
Mentor Survey (n = 256)
Participant responses include those who reported “at least once,” "every day,” and “most days.”
Mentor responses include those who reported “at least once, “every day,” “a few times,” and “most days.”

4 Development of STEM Skills

Participants reported gains in a number of STEM research skills as a result of their participation in AEOP. Students improved their knowledge of STEM topics, gained experience planning and carrying out experiments, and increased their ability to analyze and interpret data. Mentors were consistently more likely than students to report that they experienced gains as a result of their participation in AEOP.

In *open-ended comments*, students described learning new research and technical skills, increased knowledge about STEM content, engagement with STEM professionals, and hands-on STEM-related experiences.

- One GEMS participant shared that individuals were, *"learning what it takes to complete a 'real-life' research project."*
- Another student stated, *"The Apprenticeship Program expanded my view on scientific research, improved my confidence, and helped me form connections within the scientific community."*

4.1 STEM Skills

Survey results indicate that the majority of students increased their knowledge of STEM and various aspects of STEM research. Both students and mentors were asked about an array of STEM- and research-related skills. Students were asked to report to what extent they learned about a specific topic (from "did not learn" to "learned a lot"); mentors were asked to indicate to what degree their students experienced gains in the same areas (from "no gain" to "large gain"). As Table 6 shows, students and mentors consistently reported increases in all areas. Mentors were more likely than students to report that they experienced gains as a result of their participation in AEOP.

Table 6. Students increased their knowledge of STEM and various aspects of STEM research

Response	*Participant* / *Mentor*	Did not learn / No gain	Learned just a little / Small gain	Learned more than a little / Medium gain	Learned a lot / Large gain	Overall Learning or Gain
In-depth knowledge of a STEM topic(s)	Participant	5%	19%	36%	40%	**95%**
	Mentor	0%	10%	40%	50%	**100%**
Knowledge of research processes, ethics, and rules for conduct in STEM*	Participant	5%	18%	36%	41%	**95%**
	Mentor	2%	15%	37%	47%	**98%**
Knowledge of how scientists and engineers work on real problems in STEM	Participant	7%	24%	35%	34%	**93%**
	Mentor	1%	15%	29%	56%	**99%**
Knowledge of what everyday research work is like in STEM	Participant	8%	23%	32%	37%	**92%**
	Mentor	2%	14%	32%	53%	**98%**
Supporting an explanation with STEM knowledge	Participant	8%	25%	37%	31%	**92%**
	Mentor	4%	20%	32%	43%	**96%**
Making a model to show how something works	Participant	13%	26%	34%	28%	**87%**
	Mentor	9%	19%	34%	37%	**91%**

*This question was not asked of GEMS participants.

Participant Survey; All AEOP Programs combined (n = 3,388)
Mentor Survey (n = 260)

4.2 Planning and Carrying out Experiments

Most students improved skills associated with planning and carrying out investigations. Like the items above, both students and mentors were asked to report to what extent students learned or experienced gains in a number of areas related to conducting experiments. Mentors consistently were more likely than their students to report gains, though percentages were generally high across all areas (see Table 7).

Table 7. Students improved skills related to planning and carrying out investigations

Response	*Participant* / *Mentor*	Did not learn / No gain	Learned just a little / Small gain	Learned more than a little / Medium gain	Learned a lot / Large gain	Overall Learning or Gain
Designing procedures or steps for an experiment or designing a solution that works*	Participant	8%	26%	37%	29%	**92%**
	Mentor	6%	19%	38%	37%	**94%**
Creating a hypothesis or explanation that can be tested in an experiment/problem*	Participant	9%	27%	40%	24%	**91%**
	Mentor	2%	18%	44%	35%	**98%**
Carrying out an experiment and recording data accurately	Participant	10%	24%	34%	32%	**90%**
	Mentor	6%	15%	34%	46%	**94%**
Defining a problem that can be solved by developing a new or improved product or process*	Participant	10%	34%	38%	18%	**90%**
	Mentor	1%	24%	42%	33%	**99%**
Presenting an argument that uses data and/or findings from an experiment or investigation	Participant	12%	28%	33%	27%	**88%**
	Mentor	8%	20%	36%	36%	**92%**

*This question was not asked of GEMS participants.

Participant Survey; All AEOP Programs combined (n = 3,226)
Mentor Survey (n = 260)

4.3 Analyzing and Interpreting Data

Students developed skills in data analysis and interpretation. Students and mentors were also asked about to what degree students learned or gained experience with analyzing and interpreting data. Table 8 shows the full list of items related to analyzing and interpreting data. Students were least likely to report learning to create charts or graphs to display data; in fact, one-fourth of students said that they “did not learn” this in their AEOP program, which maybe be an indication that this was not a major component of their specific program.

Table 8. Students developed skills in data analysis and interpretation

Response	*Participant* / *Mentor*	Did not learn / No gain	Learned just a little / Small gain	Learned more than a little / Medium gain	Learned a lot / Large gain	Overall Learning or Gain
Considering multiple interpretations of data to decide if something works as intended*	Participant	8%	28%	37%	27%	**92%**
	Mentor	6%	23%	37%	35%	**94%**
Identifying the strengths and limitations of data or arguments presented in technical or STEM texts*	Participant	10%	28%	37%	25%	**90%**
	Mentor	8%	26%	34%	31%	**92%**
Identifying the limitations of the methods and tools used for collecting data	Participant	11%	28%	35%	26%	**89%**
	Mentor	5%	21%	38%	35%	**95%**
Creating charts or graphs to display data and find patterns	Participant	25%	28%	25%	22%	**75%**
	Mentor	8%	19%	34%	39%	**92%**

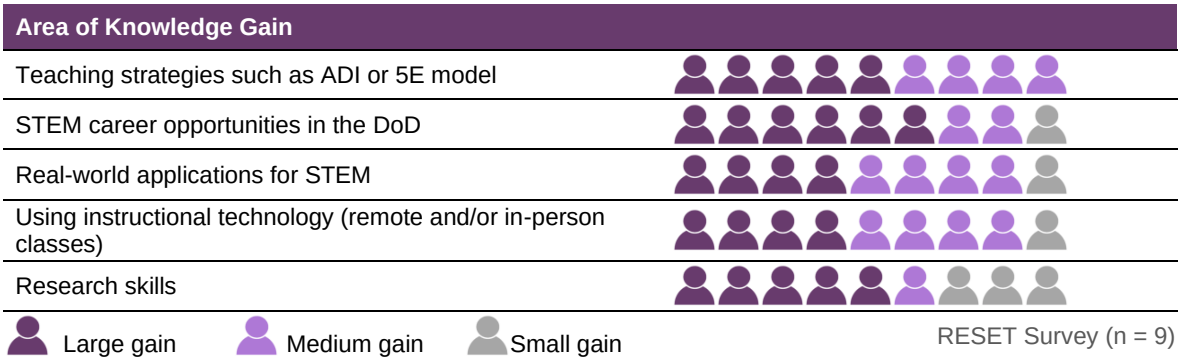
*This question was not asked of GEMS participants.

Participant Survey; All AEOP Programs combined (n = 3,226)
Mentor Survey (n = 260)

Although the majority of AEOP participants are students, educators have an opportunity to develop their STEM content knowledge and enhance their teaching practices through the Research Experiences for STEM Educators and Teachers (RESET) program. In FY22, 35 teachers participated in RESET and nine completed surveys. While these numbers are small and responses are not representative of all participants, a few key highlights are included below.

As **Figure 4** shows, the majority of participants reported gains in all areas covered in the program.

Figure 4. RESET teachers reported gains in all areas



When asked, *What are the three most important ways that the RESET program has helped you?,* themes included:

- Learning about a variety of careers in STEM fields that can be shared with students
- Practicing new skills and techniques before trying them with students
- Collaborating with others to create a lesson plan
- Strengthening content knowledge
- Networking and building connections with other teachers
- Making connections to STEM researchers

In response to the question, *What are three ways that the RESET program should be improved for future participants?,* the top responses included providing 1) additional supply funding for classrooms and 2) in-person research options.

5 Development of 21st Century Skills

In addition to reporting to what extent they experienced gains in STEM-related skills, students were also asked to indicate gains in 21st Century Skills. Students reported that increases in nearly all areas; they were less likely to indicate growth in their media and technological literacy skills, though this may be most likely due to programs not engaging in related activities.

The surveys asked about skills in five main areas:

1. Communication and Collaboration
2. Critical Thinking and Problem Solving
3. Creativity and Innovation
4. Initiative, Self-Direction, and Flexibility
5. Media and Technological Literacy

Results from each domain are below.

In *open-ended comments*, students stated that they saw improvements in their presentation, leadership, and communication skills. Others mentioned that their confidence, attitude, and motivation improved. While others remarked that the program has helped them to problem solve, be more responsible and they learned how to overcome conflicts within a team environment.

- One student remarked, *"eCYBERMISSION has helped me to become more confident in myself, it has helped me to learn to work with others, and taught me how to manage work."*
- Another Unite student from wrote, "*I learned how to work with a team, I learned how to solve everyday life situations, and how to present in a more formal way for my peers."*

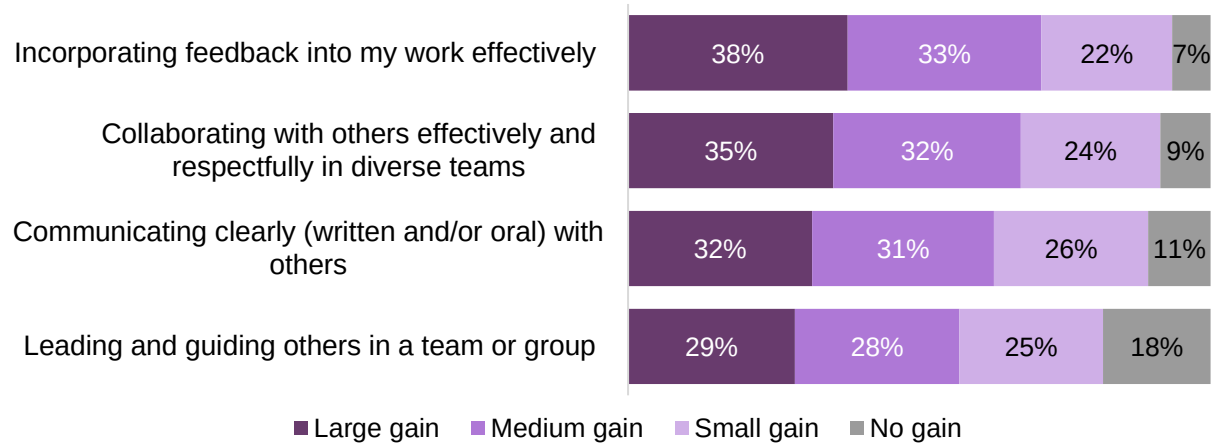
5.1 Communication and Collaboration

Overall, students reported gains in their communication and collaboration skills. They reported that they gained skills in incorporating feedback in to their work (93%), interacting with others in a respectful and professional manner (93%), collaborating with others effectively and respectfully in diverse teams (91%), and communicating clearly (written and/or oral) with others (89%).[7] Students were least likely to report gains in leading and guiding others in a team or group (82%), though this may not have been a central focus of all AEOP programs.

Figure 5 below shows responses to these items, including the full range of scaled responses (i.e., from "no gain" to "large gain").

[7] Responses include those who reported, "small gain," "medium gain," and "large gain."

Figure 5. Students improved their communication and collaboration skills, but were less likely to report improved skills leading within a team

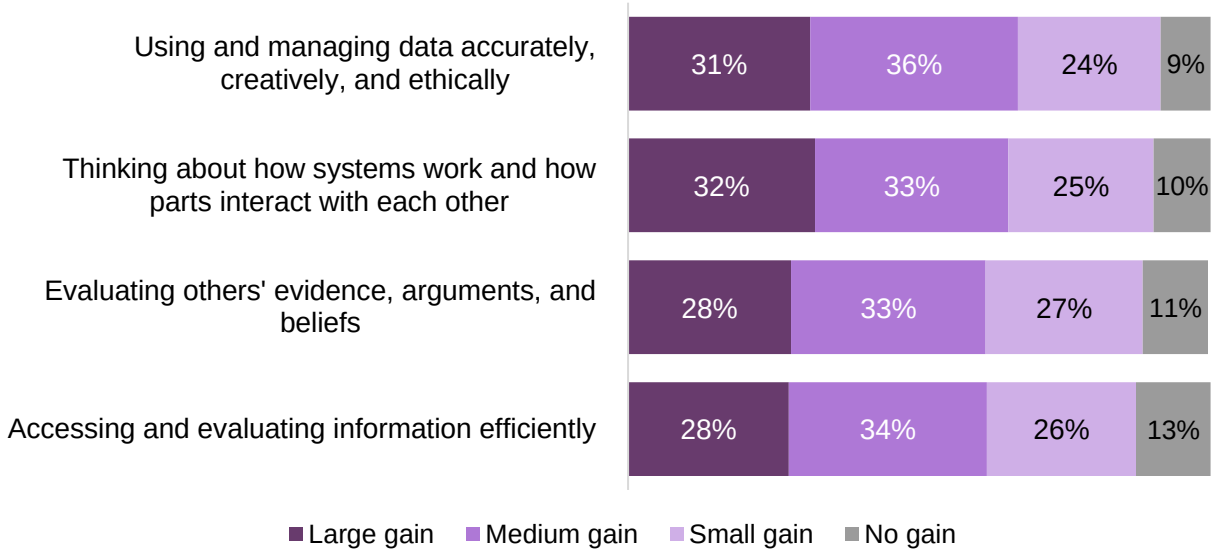


Participant Survey; All AEOP Programs combined (n = 3,163)

5.2 Critical Thinking and Problem Solving

Students indicated that they improved various critical thinking and problem solving skills. The majority of participants reported gains in their ability to use and manage data accurately, creatively, and ethically (91%); think about how systems work and how parts interact with each other (90%); evaluate others' evidence, arguments, and beliefs (89%); and access and evaluate information efficiently (87%). See Figure 6 below for the full range of responses to these items.

Figure 6. Students improved various critical thinking and problem solving skills

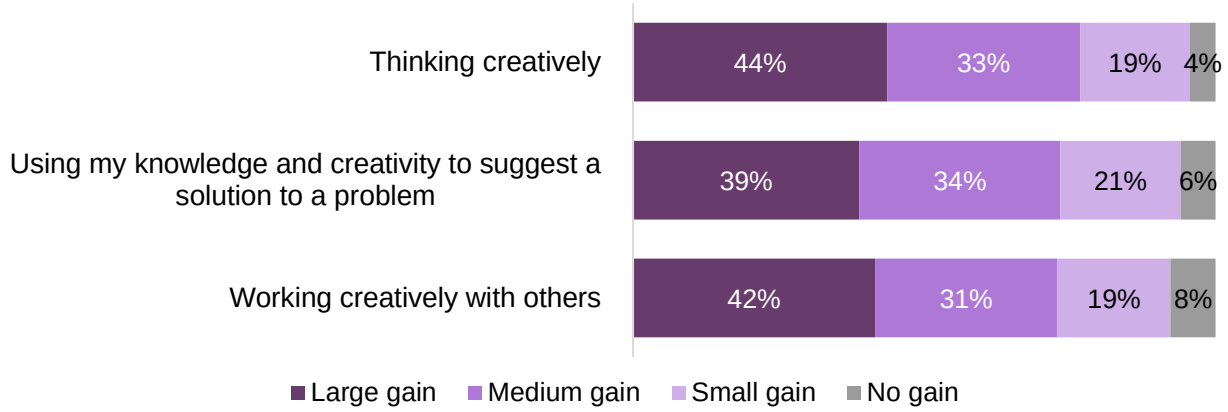


Participant Survey; All AEOP Programs combined (n = 3,168)

5.3 Creativity and Innovation

Students increased their innovation skills and ability to use creative approaches to address problems. As Figure 7 shows, most students reported that they increased their skills at thinking creatively (96%), using knowledge and creativity to suggest a solution to a problem (94%), and working creatively with others (92%).

Figure 7. Students increased their ability to work more flexibly and creatively.



Participant Survey; All AEOP Programs combined (n = 3,176)

5.4 Initiative, Self-Direction, and Flexibility

The majority of students reported gains in work habits related to taking initiative, self-direction, and flexibility. On a list of several items, setting goals and utilizing time wisely and working independently and completing tasks on time were at the top of the list, with 94% of all students reporting gains in each area. By contrast, a slightly smaller proportion of students (89%) reported improvement in taking initiative and doing work without being told to. In addition, this item had the highest proportion of students who reported “no gain” (11%) or “a small gain” (26%). See Figure 8 for the full list of items and range of responses.

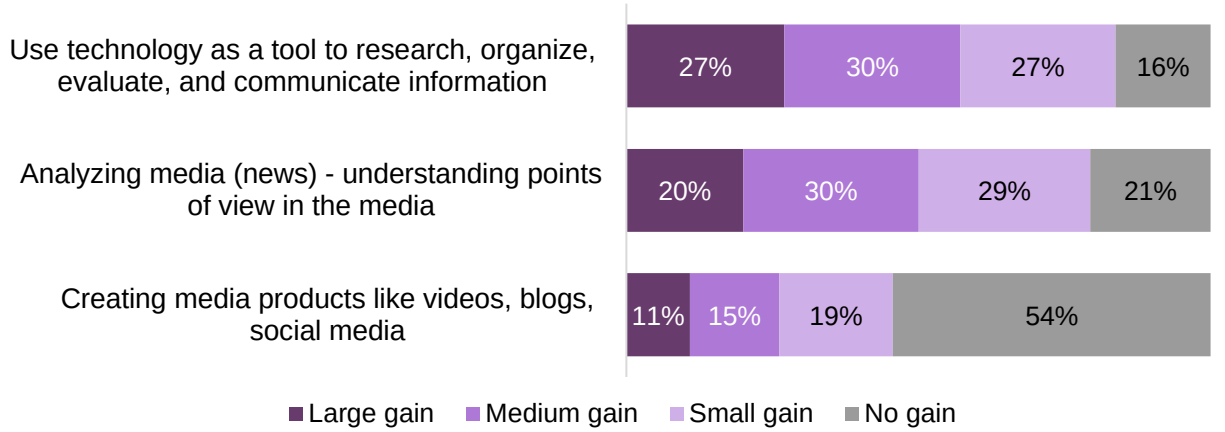
Figure 8. Students increased work habits related to taking initiative, self-direction, and flexibility

Participant Survey; All AEOP Programs combined (n = 3,133)
*This question was not asked of GEMS and eCYBERMISSION participants

5.5 Media and Technological Literacy

Among the 21st century skills assessed on the survey, students were least likely to report gains in media and technological literacy. Overall, between 46% and 84% of students reported gains in this area (see Figure 9). These relatively lower percentages are most likely due to programs not engaging in related activities.

Figure 9. Students were less likely to report gains in media and technological literacy



Participant Survey; All AEOP Programs combined (n = 3,142)

6 Interest in STEM and STEM Careers

The survey results show that participating in AEOP positively influenced students' inclination toward STEM education, interest and exploration, and community service projects, as well as mentoring or teaching other students. The program also increased students' interest in pursuing a STEM career and Army or DoD research, and many students learned about Army, or DoD careers through AEOP.

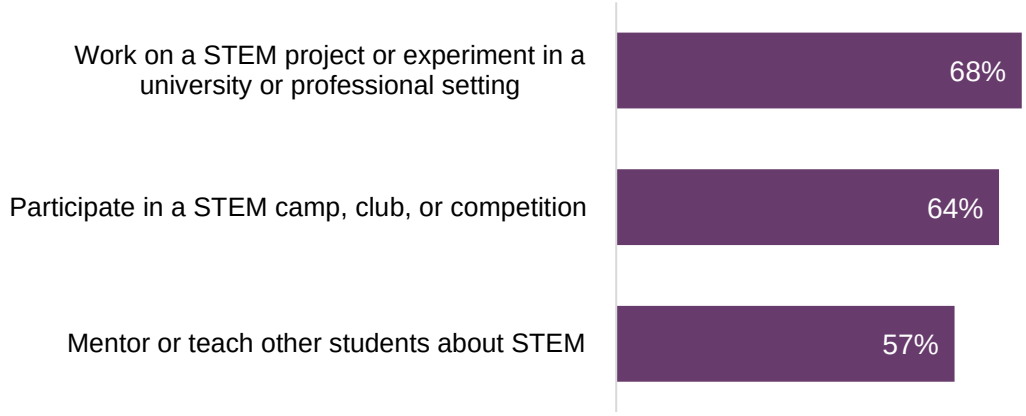
Students learned about STEM careers and increased their interest in a STEM career. Some participants learned about careers that they did not know existed. Students also mentioned that they were provided the opportunity to learn with and from STEM professionals, which included scientists. In an open-ended comment, one participant wrote:

"JSHS has broadened my view of what it means to have a career in the armed forces. JSHS also motivated me to conduct and present my own research. Finally, most importantly, JSHS was a major factor in deepening my interest in a research career for STEM by showing me how fun and valuable discovery is."

6.1 Interest in STEM

Most students reported that they were more likely to engage in other STEM activities after their participation in AEOP. More than one-half of all students reported a higher inclination to engage in STEM education and training opportunities such as working on a STEM project or experiment (68%) or participating in a STEM camp, club, or competition (64%) after participating in AEOP (Figure 10).

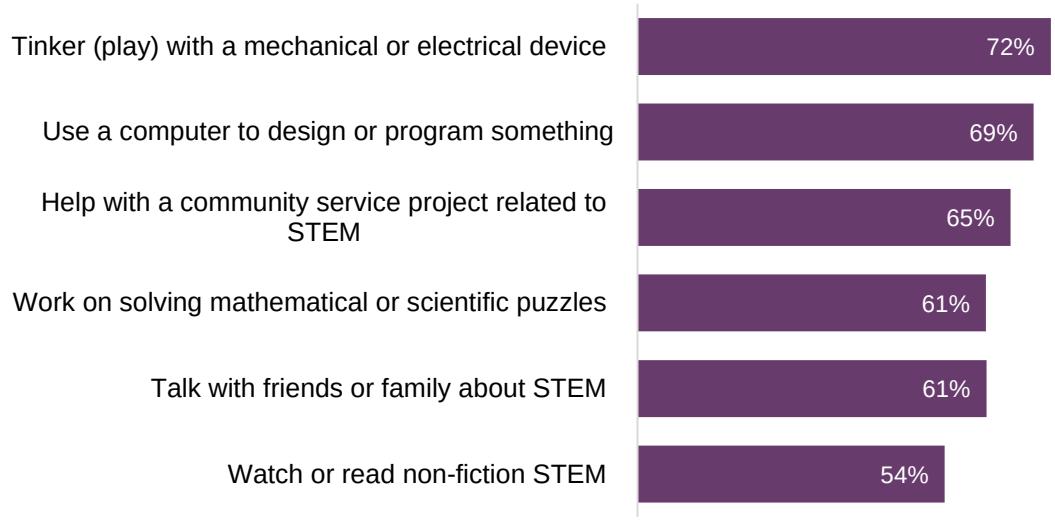
Figure 10. Most students reported an increase in their interest in participating in other kinds of STEM-related activities



Participant Survey; All AEOP Programs combined (n = 3,028)
Responses include those who reported "more likely" and "much more likely."

As Figure 11 shows, a notable proportion of students were also more interested in exploring other activities like tinkering with mechanical or electrical devices (72%), using a computer to design or program something (69%), working on STEM puzzles (61%), and discussing STEM topic with others (61%).

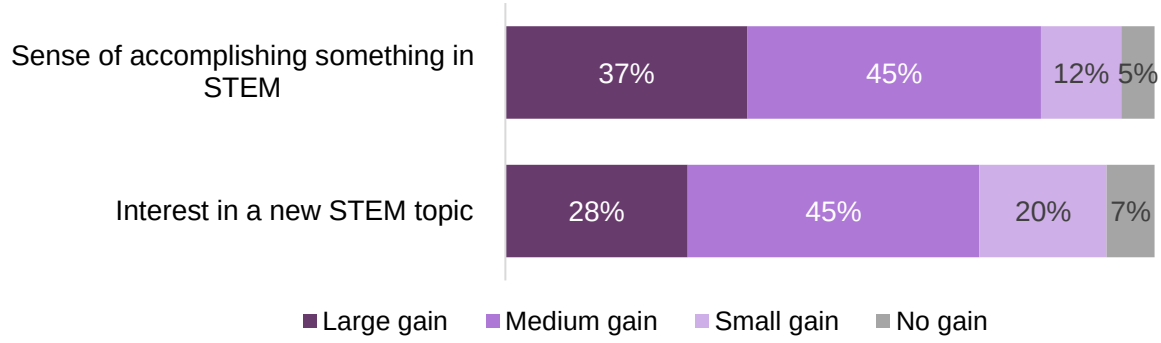
Figure 11. More than half of students reported an increase in their interest in STEM information and exploration



Participant Survey; All AEOP Programs combined (n = 3,028)
Responses include those who reported, "more likely" and "much more likely."

Most students indicated they gained an interest in a new STEM topic (93%) and a sense of accomplishing something in STEM (95%) due to participating in AEOP (Figure 12).

Figure 12. Most students said AEOP increased their STEM Confidence

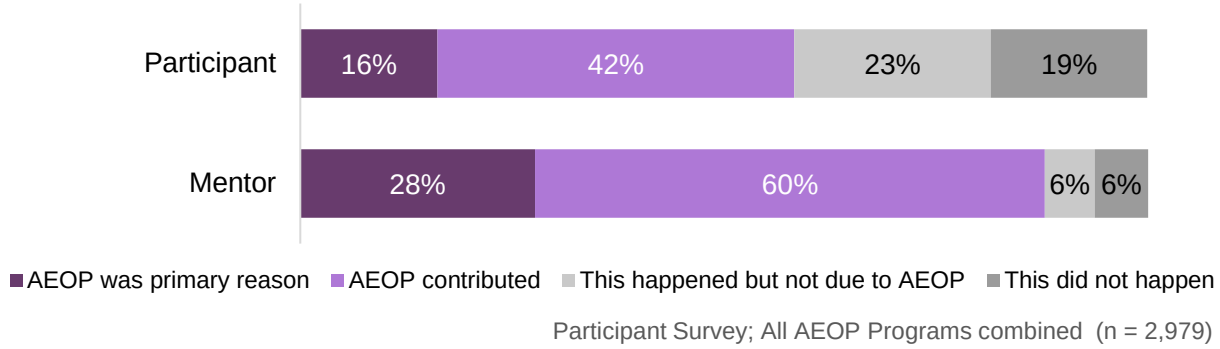


Participant Survey; All AEOP Programs combined (n = 3,109)

6.2 Interest in Pursuing STEM Education and Careers

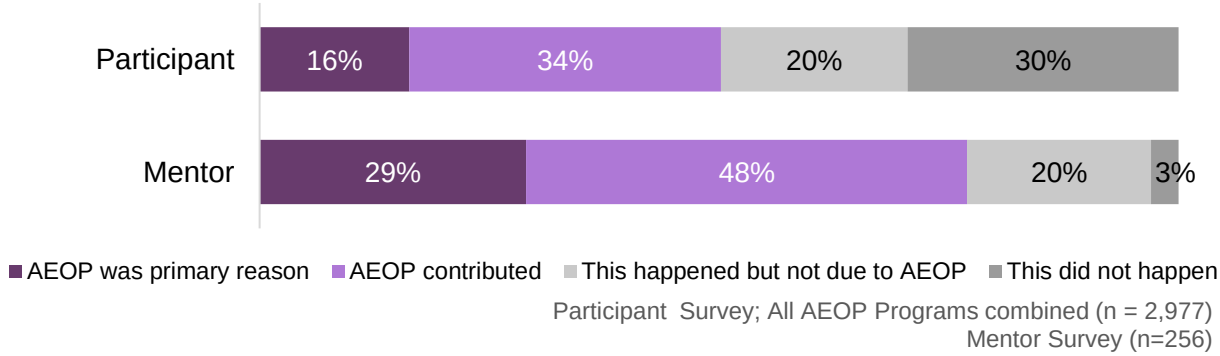
AEOP had a positive influence on students' interests in STEM education and careers. The surveys asked both students and mentors about students' interests in earning a STEM degree and pursuing a STEM career (see Figure 13 and Figure 14). Overall, both groups reported students had increased interest, although a higher proportion of mentors than students reported that AEOP contributed to students' interest. As Figure 13 shows, 58% of students and 88% of mentors reported that the program had influenced students' interest in *pursuing a STEM degree*. When asked about their interest in *pursuing a STEM career*, 50% of students and 77% of mentors indicated that AEOP had an influence (Figure 13).[8]

Figure 13. AEOP had a positive influence on students' interest in earning a STEM degree



Participant Survey; All AEOP Programs combined (n = 2,979)

Figure 14. AEOP contributed to increasing students' interests in pursuing a STEM career



Participant Survey; All AEOP Programs combined (n = 2,977)
Mentor Survey (n=256)

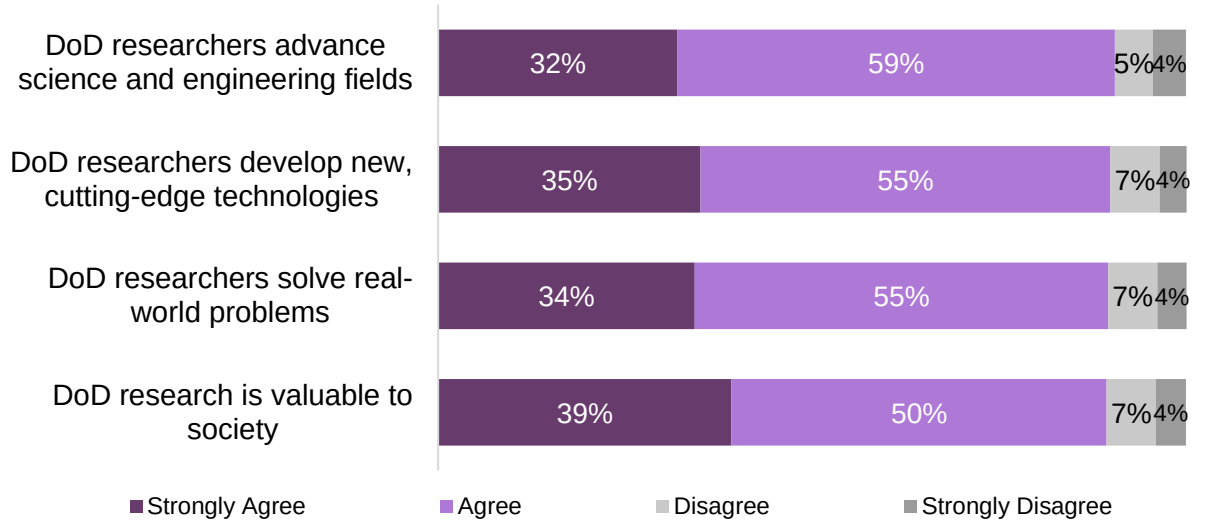
6.3 Interest in Army/DoD STEM Research and Careers

Students gained a greater appreciation of and interest in Army/DoD STEM research and careers through their participation in AEOP. AEOP has an explicit connection to the Army and DoD. Overall, 44% of students learned about at least one Army/DoD career as a result of their AEOP experience. Students also agreed that DoD research is important (Figure 15). Roughly 90% of all students agreed or strongly agreed that DoD researchers advance science

[8] Responses include those who indicated, "AEOP contributed" and "AEOP was the primary reason."

and engineering fields; that DoD researchers develop new, cutting-edge technologies; that DoD researchers solve real-world problems; and that DoD research is valuable to society.

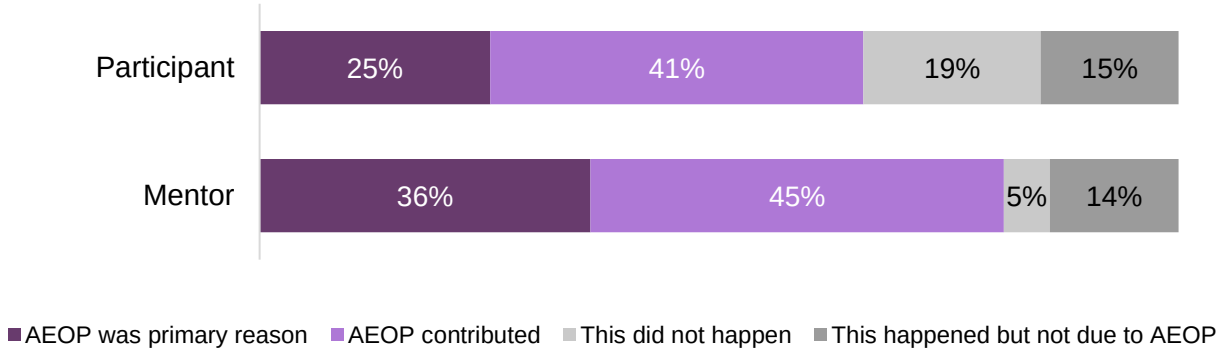
Figure 15. Students understand that DoD research is important



Participant Survey; All AEOP Programs combined (n = 3,015)

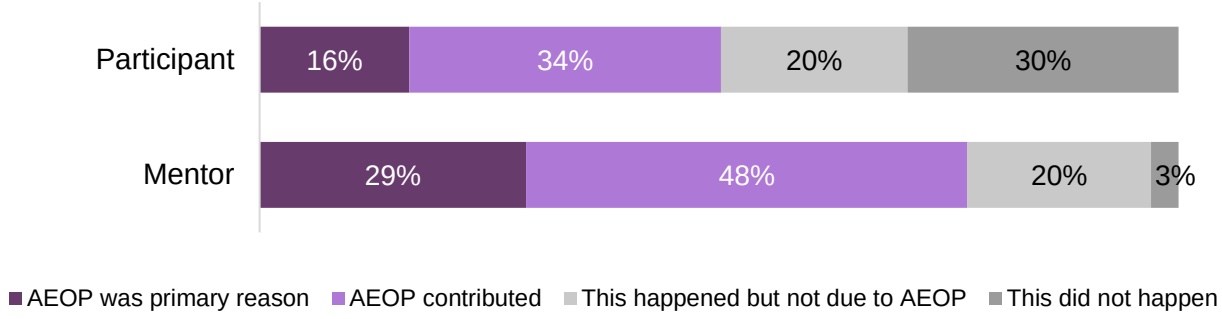
The majority of students (66%) and mentors (81%) agreed that AEOP contributed to students' appreciation of Army/DoD research (Figure 16). In addition, 50% of students and 77% of mentors reported that students' interests in an Army or DoD career increased as result of AEOP (Figure 17).

Figure 16. AEOP contributed to increasing students' appreciation for Army/DoD research



Participant Survey; All AEOP Programs combined (n = 2,998)
Mentor Survey (n = 194)

Figure 17. AEOP contributed to increasing students' interest in Army/DoD STEM Careers



Participant Survey; All AEOP Programs combined (n = 2,977)
Mentor Survey (n = 256)

7 Impact of S&E Mentors on AEOP participants

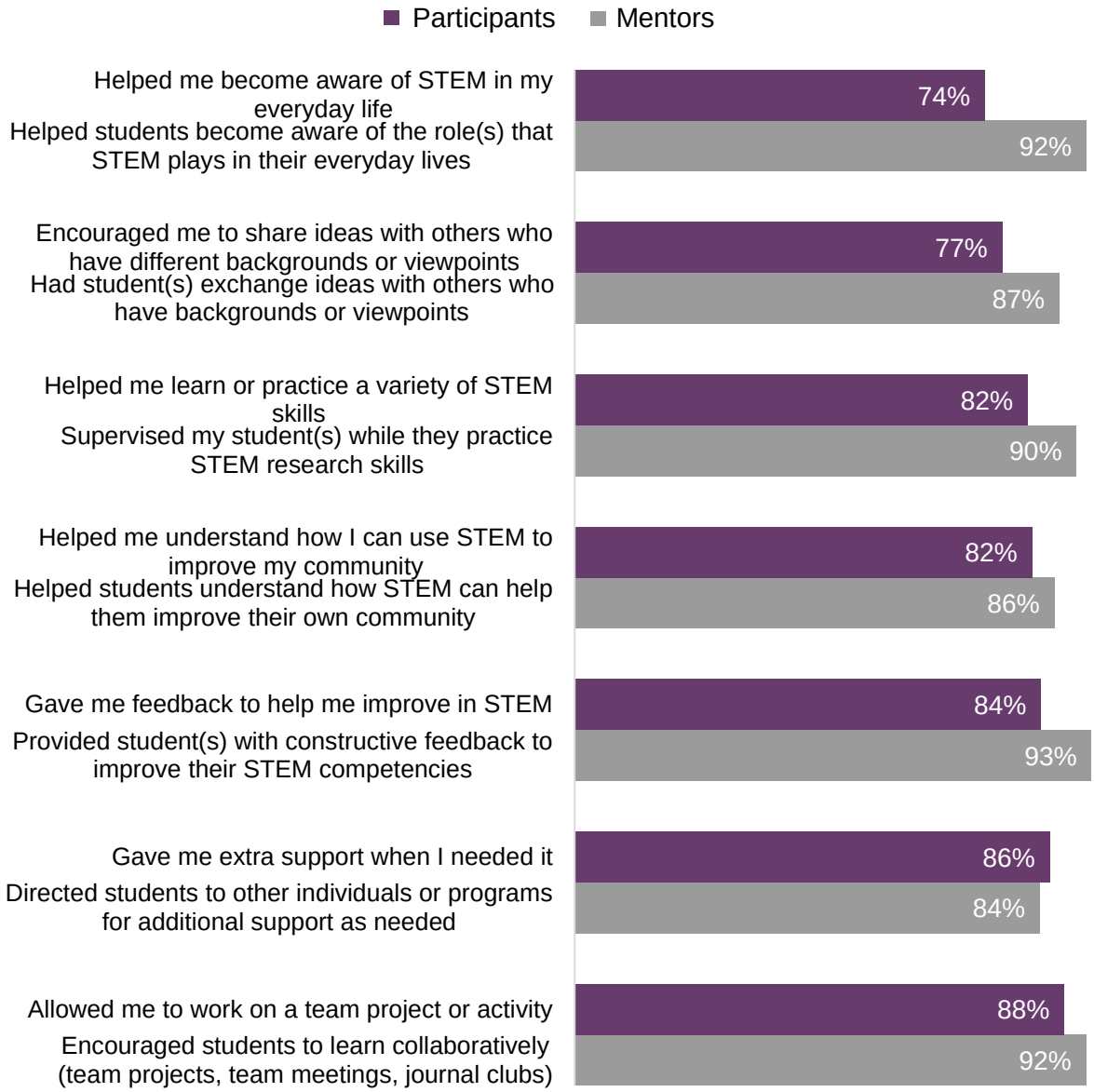
Mentors play an important role in AEOP. Although their roles may vary across the different programs, students reported positive experiences working with their mentors and the survey results suggest mentors had a strong impact on AEOP participants.

Many mentors noted that the mentorship component of AEOP is a strength of the program. They noted that AEOP provides an opportunity for students to connect with STEM researchers and is vehicle for STEM career exploration. As one mentor wrote,

"Being a mentor gave me immense pleasure and satisfaction to help the younger generation cultivate an interest/ hunger to learn about the research and development of practical technologies in STEM-related fields."

Students and mentors reported a high use of common strategies across programs to achieve AEOP goals. The survey asked both students and mentors about a range of mentor strategies employed in AEOP (see Figure 17). For example, about three-quarters of students (74%) reported that mentors helped them become aware of STEM in everyday life, while 84% of students indicated that mentors gave them feedback to help them improve in STEM. Mentors on the whole tended to report more frequent use of these strategies. For example, 92% of mentors reported they helped students become aware of the role that STEM plays in their everyday lives, and 93% of mentors said they provided students with constructive feedback to improve their STEM competencies.

Figure 18. Participants and mentors reported common strategies used across AEOP



Participant Survey; All AEOP Programs combined (n = 1,759)
Mentor Survey (n = 256)
Note: These questions were not asked of GEMS participants.

In addition to the methods mentioned above, the surveys asked about mentor strategies in four main areas:

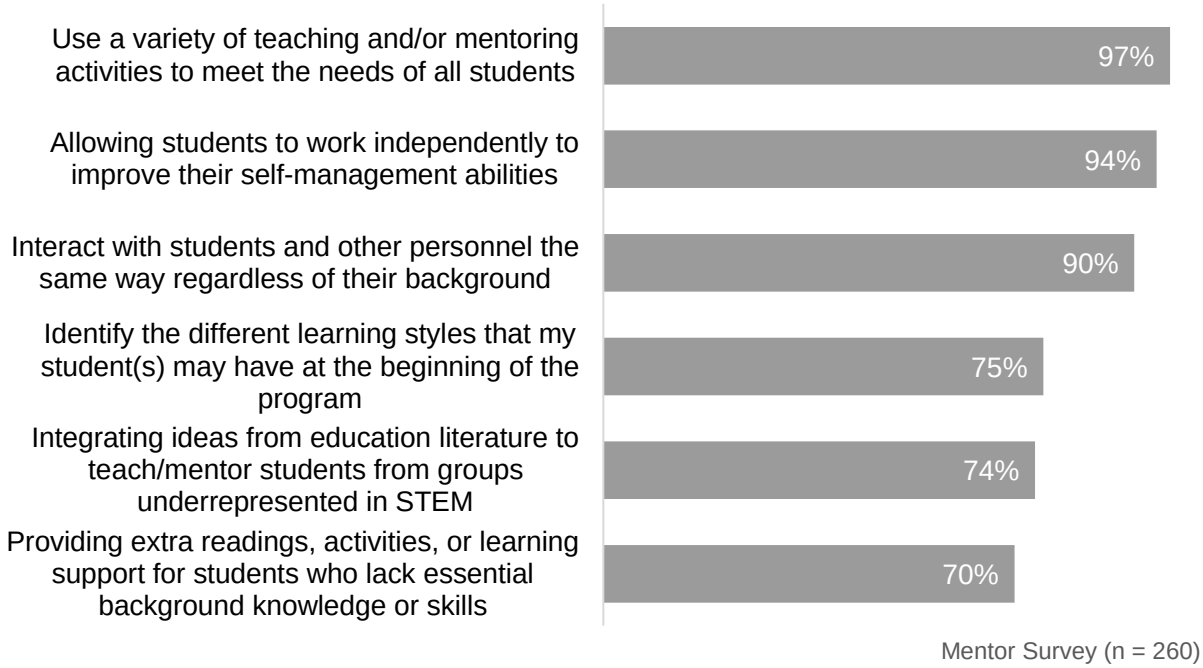
1. Supporting the Diverse Needs of Students as Learners
2. Establishing the Relevance of Learning Activities
3. Supporting Student Development of Collaboration and Interpersonal Skills
4. Supporting Student STEM Activities and Educational Pathways

Findings from each of these core areas are below.

7.1 Supporting the Diverse Needs of Students as Learners

Mentors used multiple strategies to meet students' diverse needs. For example, as shown in Figure 18, mentors reported that they used of variety of teaching and/or mentoring activities to meet the needs of students (97%). Mentors noted that they allowed students to work independently (94%) and interacted with students and personnel the same way regardless of their background (90%). Even the lowest reported teaching strategies—identifying different learning styles (75%), integrating ideas from education literature to teach students from underrepresented groups (74%), and providing for students who lack essential background (70%)—were reported as being used by the majority of mentors.

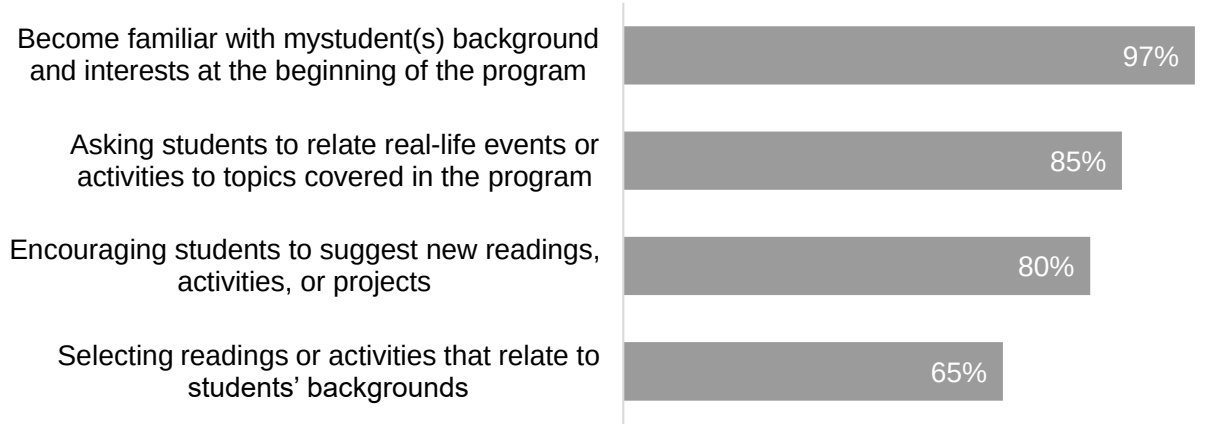
Figure 19. Mentors used multiple strategies to meet students' diverse needs



7.2 Establishing the Relevance of Learning Activities

Mentors used different teaching strategies to enhance the relevance of learning activities. Additional strategies mentors used to positively impact AEOP participants included becoming familiar with student background and interests at the beginning of the program (97%), asking students to relate real-life events or activities to topics covered in the program (85%), and encouraging students to suggest new readings, activities or project (80%) (Figure 19). Only one strategy was reportedly used by fewer than two-thirds of mentors: selecting readings or activities that relate to student backgrounds (65%).

Figure 20. Mentors used different teaching strategies to enhance the relevance of learning activities

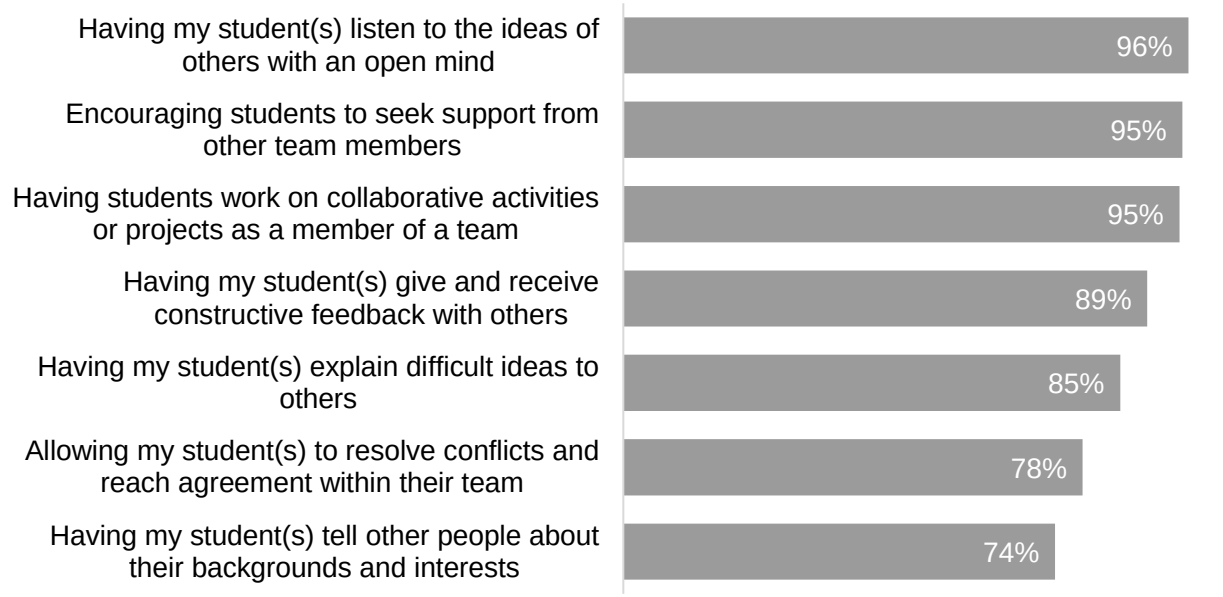


Mentor Survey (n = 258)

7.3 Supporting Student Development of Collaboration and Interpersonal Skills

Mentors frequently fostered communication and interpersonal skills. Almost all mentors (96%) reported having students listen to the ideas of others with an open mind. Most (89%) reported having students give and receive constructive feedback. The least reported strategies were having students tell other people about their backgrounds and interest (74%) and allowing students to resolve conflicts when working with a team (78%). See Figure 21 for the full list of responses.

Figure 21. Mentors frequently fostered communication and interpersonal skills

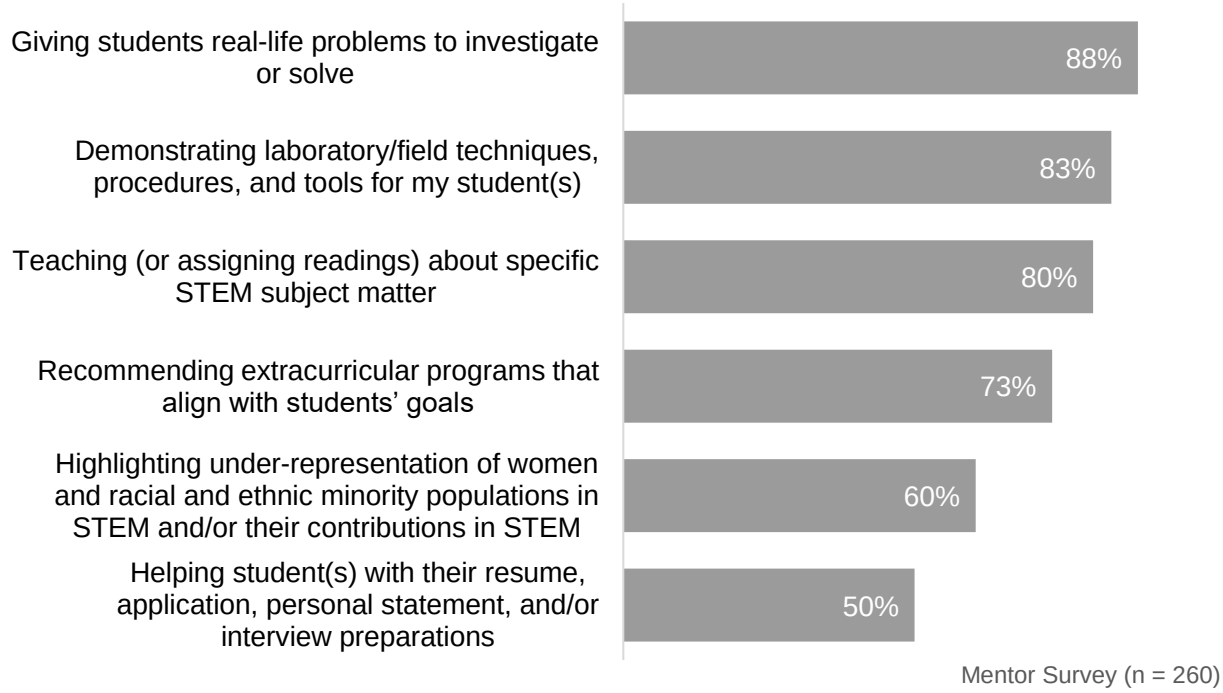


Mentor Survey (n = 260)

7.4 Supporting Student STEM Activities and Educational Pathways

Mentors reported using different strategies to support student engagement in STEM, with hands-on research strategies being the most common strategy. The majority of mentors AEOP (88%) reported giving students real-life problems to investigate or solve, demonstrating laboratory and field techniques to students (83%), and teaching or assigning readings about specific STEM topics (80%). Slightly fewer mentors reported recommending extracurricular programs aligned with student goals (73%). Far fewer mentors reported highlighting under-representation of women and racial and ethnic minorities contributions in STEM (60%) or helping students with their resumes, applications, personal statements and interview preparation (50%).

Figure 22. Mentors reported using different strategies to support student engagement in STEM, with hands-on research strategies being the most common strategy



8 Overall experience

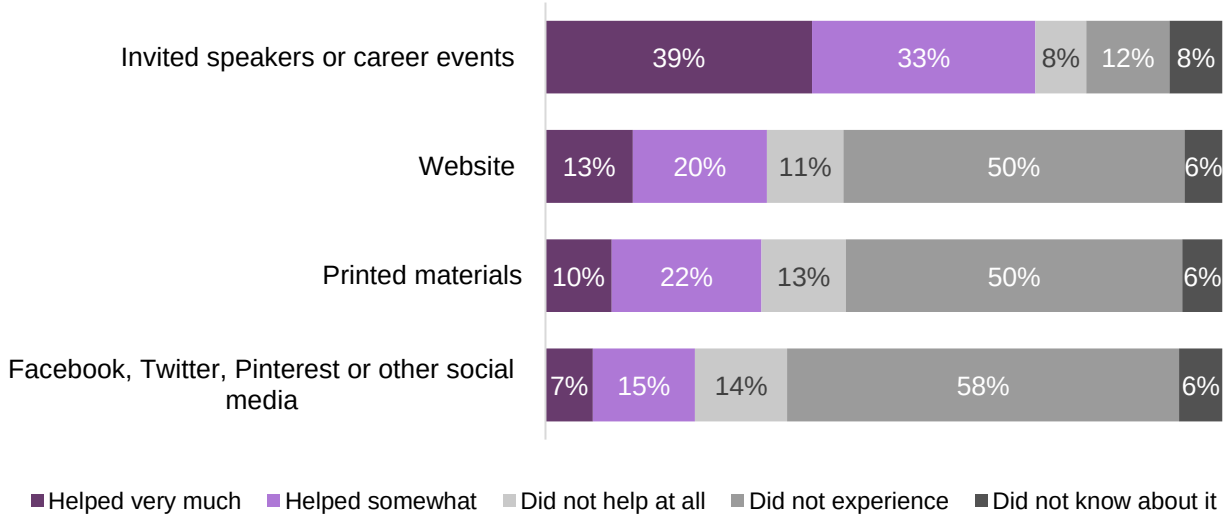
> *"I was very satisfied; the experience is always fun and exciting. I, too, learn with the students as I help in this program. I feel good with how I felt I was able to reach the students.*

In general, students and mentors reported positive experiences with AEOP. Students found the invited speakers and career events helpful. In addition, both students and mentors indicated that they largely were satisfied with the program. Students enjoyed learning new STEM skills, working in teams, and learning about community issues. Mentors enjoyed engaging with students in research, solving real-world problems, and providing students with opportunities for hands-on learning experiences. Suggestions for improvement from students were focused on better communication, organization, and planning information (e.g., dates or schedules and details about activities). Mentors also mentioned the need for improved communication; they also expressed a desire for more instructional resources and increased funding.

8.1 Perceived Value of AEOP Resources

Overall, students said that invited speakers and career events were by far the most helpful AEOP resources to them, while printed and online media were considered less helpful. Students rated the program website, printed materials, and social media as relatively less useful than more personal methods such as invited speakers or career events (Figure 23). More than one-half students said they did not use or were not aware of print or online media AEOP resources, whereas 80% of students reported experiencing invited speakers or career events (and 72% of students said the invited speakers/career events were helpful).

Figure 23. Students reported invited speakers and career events were the most helpful AEOP resources, while social media was the least effective resource



Participant Survey; All AEOP programs (n = 1,846)

8.2 Program Satisfaction

To assess overall satisfaction, the surveys asked both students and mentors an open-response question, *please tell us about your overall satisfaction with your [AEOP program] experience*.[9] Although many responses were particular to specific programs, several high-level themes stood out.

8.2.1 Student Program Satisfaction

Most students were satisfied with the programs. Program participants mentioned a variety of reasons which included learning new skills in STEM, working in teams, learning more about community problems and needs. Others stated that participating in AEOP gave them the opportunity to be involved in a program that focuses on STEM and that the program improved their critical thinking and curiosity in science. Other participants stated that the program was fun, interesting, informative, and that they enjoyed it overall.

Table 9. Reasons students gave for their satisfaction with AEOP

Theme	Quote
Gained confidence and learned skills	*This experience [Apprenticeships] taught me to be punctual, professional, and overall, a great communicator which are the skills to better prepare me for the real world and a career. I became a much more confident and mature individual who is enthusiastic to continue research in the future and never stop learning.*
Had the opportunity to work on real-life community problems	*I was very satisfied with it [eCYBERMISSION] and how well it has helped me, and my group help solve major problems in the world*
Had fun while doing STEM	*I loved the JSHS experience. It was not only so fun, but it allowed me to experience independence while doing something I love. I felt like I had a purpose to be there, and I made so many new friends that are like-minded in terms of STEM.*
Engaged in hands-on, STEM research	*I was very satisfied with my Unite experience. I got to work with amazing mentors who taught me so much about research and thoroughly answered all of my questions. I really enjoyed collaborating with a group and designing and executing my own research project. Unite gave me the experience in research I needed to affirm that this is the career path for me. This experience was truly impactful for me*
Overall positive experience	*I do not think I know a way for you guys to make GEMS better.*

8.2.2 Mentor Program Satisfaction

[9] Surveys were customized to include the names of specific programs (e.g., Apprenticeship, eCYBERMISSION, GEMS, JSHS, and Unite).

Most of the mentors were satisfied with their program. The mentors mentioned a variety of reasons why they were satisfied with their respective program, which included encouraging students to consider STEM careers, engaging students in conducting research, and engaging students in solving real-life problems that pertained to their own community.

Table 10. Reasons mentors gave for their satisfaction with AEOP

Theme	Quote
Encourages students to consider STEM careers	*We are very satisfied by the UNITE program. The UNITE program provides our students from the school system to gain hands-on experience in a STEM area. As result of this program, we have seen many students who pursue BS degree programs in the STEM area.*
Provides hands-on research experiences	*I am very pleased with the eCYBERMISSION program. It is my 3rd year participating with my colleague and we are so happy our students have gotten the opportunity to complete these STEM investigations and research. We are trying to bring more teachers on board so more students can get these experiences as well.* *The GEMS program exposes students early on, to STEM-related topics. It is very important to recruit talents and have these talents know early on what type of problems or challenges are still to be solved and addressed by society. I'm very satisfied with my experience with the GEMS program.*
Contributes to societal goals	*Being a mentor [in the Apprenticeship Program] gave me immense pleasure and satisfaction to help the younger generation cultivate an interest/hunger to learn about the research and development of practical technologies in STEM-related fields. This does not only help DoD but also society.*

8.3 Suggestions for Improvement

In addition to asking students and mentors about their overall satisfaction, the survey also asked them to identify areas for improvement. Both students and mentors were asked, *What are the three ways [AEOP PROGRAM] should be improved for future participants?* Mentors were also asked, *What are the three ways [AEOP PROGRAM] should be improved for mentors/team advisors?*[10] A high-level summary of key themes is included below.

8.3.1 Students' Suggestions for Improvements

Across the five programs surveyed, communication was the predominate suggestion for improvement. Respondents stated that they wanted better communication, organization, and planning information. This included having more information and greater clarity concerning due dates and presentation schedules, details about program activities, requirements from

[10] Surveys were customized to include the names of specific programs (e.g., Apprenticeship, eCYBERMISSION, GEMS, JSHS, and Unite).

participants, and even information about last-minute changes to room assignments. As one participant remarked, "*Activity schedules are not shared with students or parents and in our case the chaperone could not make it and a …chaperone was added last minute, who did not provide any details on the activities three weeks before the event."*

Instructional and training resources was also mentioned but less frequently across all programs. Respondents suggested improvements such as clearer guidelines on data collection tools, and clearer instructions on required forms. While many respondents acknowledged that hands-on activities are a strength of the program some also said that they would like to see even more interactive and hands-on learning, including more lab exposure.

8.3.2 Mentors' Suggestions for Improvement

On the mentor survey, the three most common suggestions for improvement were related to instructional and training resources, communication and planning, and funding. Mentors wanted more instructional resources, such as curriculum and teacher guides, program overviews, and a description of outcomes and topics to be covered in their programs. In one program, a small proportion of mentors (fewer than 10%) also indicated that more training would be beneficial for newer mentors, suggesting resources like webinars and access to more course materials.

Regarding communication and planning, respondents stated that there should be better and clearer communications, such as making deadlines clearer. For example, one mentor shared that, *"Communication about program final requirements (ex: deadlines) received by students did not always seem to be shared with mentors. It would be good to know those requirements on day one so we could plan internal deadlines to help the students complete them on time."* Others suggested that communication could be improved by providing revised documents that are easier to understand, giving regular updates especially during peak times, and even suggested that programs provide a "cheat sheet" with specific dates and how each resource should be used.

Related to funding, mentors suggested more resources would be helpful. As noted by one mentor, "*There needs to be indirect costs and supply money for mentors, along with a stipend for the grad student mentor."*

9 Recommendations

This Summative Evaluation Report distills findings across the student participant and mentor surveys as they align with AEOP's overarching research questions. As stated in the limitations, data collected for this evaluation are not necessarily representative of the entire program; however, based on the results presented above, we offer the following recommendations:

9.1 Programmatic Considerations

- **Continue to offer hands-on, authentic, relevant research experiences.** Research shows these kinds of experiences are important to developing and sustaining students' interest in STEM education and career pathways.
- **In general, AEOP appears to be reaching historically marginalized populations; programming should center their interests and perspectives.** As the Consortium considers a revised Underserved definition, it should also ensure that programmatic strategies are aligned to meet the needs of AEOP's intended populations.
- **Consider ways to bring mentors together to exchange promising practices, successes, and lessons learned.** Mentors play an important role in AEOP. Most mentors shared that they are engaging in meaningful ways with student participants. When asked about ways to improve AEOP, mentors frequently expressed a desire for instructional materials. Peer learning opportunities would allow them to share effective strategies, resources, and tools.
- **Explore ways to improve awareness of various AEOP resources, including printed materials, the website, and other social media.** Although students reported that in-person resources like invited speakers and career events were helpful, they were less likely to say the same about printed and online media. As AEOP considers developing pipelines across programs, print and online resources could be used to market programs more effectively.

9.2 Evaluation Considerations

- **Continue to examine ways to increase response rates.** As noted above, the variable response rates across programs make it difficult to generalize the findings across AEOP. The EDC evaluation team is working with IPAs to troubleshoot these issues and develop strategies to improve response rates.
- **Examine the relevance of surveys within and across programs.** Overall, AEOP participants reported strong results in many areas. Future surveys should explore to what extent participants may be reporting "topping out" in certain outcome areas and develop potential strategies to address these issues (e.g., retrospective survey items, more carefully constructed instruments, etc.).