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ARMY EDUCATIONAL OUTREACH PROGRAM

2022 eCYBERMISSION Evaluation Report
Summative Findings

July 2023

aeop
ARMY EDUCATIONAL OUTREACH PROGRAM

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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. eCYBERMISSION directly supports the AEOP mission by offering 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.

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/Team Advisor post-surveys. We also conducted a site visit during the national competition, during which we gathered data and information via focus groups with student participants. It is important to recognize that these results only reflect those individuals who participate in evaluation activities and may not be generalizable for the eCYBERMISSION program.

Key findings from the evaluation are presented below.

Overview of Participants

In FY22, eCYBERMISSION served a total of 9,488 participants – 96% (9,103) were students and 4% were (385) educators, advisors, mentors, Science & Engineering (S&E) volunteers, or other adults.

Approximately three-fourths of all eCYBERMISSION student participants met two or more of the Underserved criteria. An additional 20% of students met one of the AEOP Underserved criteria.

Participant Experience and Outcomes

eCYBERMISSION gave students the opportunity to engage in STEM-related activities and increase their STEM knowledge. According to survey results from both participants and Team Advisors, most students had experience working collaboratively as a team, designing and conducting their own research, and analyzing data. At least 86% of participants and 97% of Team Advisors reported that students had these opportunities. The majority of participants and Team Advisors also reported that participants gained experience solving real world problems (87% of participants and 100% of Team Advisors).

Students reported improved STEM skills such as: knowledge of STEM topics and STEM research; making models and supporting explanations with STEM knowledge, analyzing and interpreting data, and planning and carrying out experiments. Overall, between 85% and 91% of students reported improvements in a range of STEM skills.

Students noted gains in 21st Century skills such as: communication and collaboration; critical thinking, using data, problem solving; and using creativity and innovation. The majority of students (between 83% and 93%) indicated increased competencies in these areas. Students were less likely to report gains in thinking about how systems work and interact with each other (83%) and leading and guiding others in a team or group (89%), though these percentages are still relatively high.

Students reported increased interest in STEM, STEM careers, and knowledge of Army/DoD careers. Many students reported that they were more likely to engage in STEM activities after their participation in eCYBERMISSION (ranging between 39% and 47%). More than two-thirds of students reported more interest in tinkering with a mechanical or electrical device (69%) or using a computer to design or program something (66%). The majority of all students indicated they gained a sense of accomplishing something in STEM (73%) and an interest in a new STEM topic (55%) due to participating in eCYBERMISSION. Additionally, over one-third of students (41%) agreed that eCYBERMISSION contributed to their appreciation of Army/DoD research.

Team Advisors used a variety of strategies to engage with students. Team Advisors reported using various strategies with participants; they helped students to see how STEM skills could be applied in their everyday lives and supported their development of interpersonal and communication skills. Team Advisors also supported students in collaborating and learning from different viewpoints; they used hands-on research strategies to enhance the relevance of learning activities, and they supported students' educational pathways. Across an array of items, Team Advisors' responses fell between 31% and 100%.

Overall, both students and Team Advisors reported having positive experiences with AEOP. Students learned while doing hands-on STEM projects, and they learned how to solve problems in their communities. They also enjoyed working collaboratively in teams, gaining problem-solving skills, and learning from professionals in the field. Team Advisors enjoyed working with students, receiving feedback from STEM professionals, helping students to develop their problem-solving skills, and providing students with opportunities for hands-on learning experiences.

Participants offered some suggestions for improvement. Respondents most frequently pointed to improved communication of project requirements deadlines, a more user-friendly website (for login and mission folder requirements), and a desire for more hands-on, authentic, and relevant experiences for students. Some also requested a revision of research questions, and more information on STEM-related careers and engagement with professionals.

Recommendations

This report distills findings across the student participant and Team Advisor 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: presented above, we offer the following recommendations:

Programmatic Considerations

Continue to provide hands-on, relevant experiences with real-world applications. Student participants enjoyed doing research that was meaningful to them, hands-on, and working in teams to solve problems that connected to their communities.

Consider multiple modalities for communicating requirements and deadlines. Team Advisors indicated that they wanted better communication during peak times, including having resources that were easier to understand. One suggestion was to develop visual infographics or a quick reference two-pager that could be accessed easily or downloaded from the website with links to more detailed descriptions for individuals who need it.

Consider improving the website to be more user-friendly. Both students and Team Advisors indicated that improvements were needed regarding login and easier website navigation. More specifically, students wanted easier access and use of mission folder online and a simpler login process.

Help teachers develop strategies to support students who are required to participate in eCYBERMISSION but experience challenges. Responses from students indicate that some students attending schools where eCYBERMISSION was embedded in their science curriculum wanted more choice in their projects. Others struggled to manage all of the mandatory requirements while balancing school specific responsibilities. Team Advisors additionally indicated that some students struggled with community engagement outside of their school day, as eCYBERMISSION projects were different from traditional science projects.

Consider pairing new Team Advisors with more experienced ones for increased knowledge-sharing. Team Advisors indicated that there was a learning curve for newer Team Advisors who were not clear on all program requirements. Connecting newer Team Advisors with seasoned ones, can open up an opportunity for shared resources, and newer Team Advisors will feel better equipped to meet the needs of students.

Evaluation Considerations

Continue to examine ways to increase response rates. As noted above, the relatively low response rates for both participants and Team Advisors (15% and 18%, respectively), make it difficult to generalize the findings across the eCYBERMISSION program. The EDC evaluation team is working with IPAs to troubleshoot these issues and develop strategies to improve response rates.

1 Introduction

1.1 AEOP Priorities & Goals

The Army Educational Outreach Program (AEOP) mission 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.

eCYBERMISSION directly supports the AEOP mission and priorities by offering 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.

1.2 Overview of Participants

In FY22, eCYBERMISSION served a total of 9,488 participants – 96% (9,103) were students and 4% were (385) educators, advisors, mentors, Science & Engineering (S&E) volunteers, or other adults.

In FY22, 74% (1,348) of all eCYBERMISSION student participants met two or more of the Underserved criteria. An additional 20% (1,902) of student participants met one of the AEOP Underserved criteria. 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 has identified an interest in reaching students who meet two or more of the underserved and underrepresented criteria (referred to hereafter as Underserved). AEOP defines Underserved participants as those who possess one or more of the following characteristics: attend a rural, urban, or frontier/tribal school; identify as female; 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.

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/Team Advisor post-surveys, 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/Team Advisors at the conclusion of program activities.

In addition to the surveys, we conducted site visits for eCYBERMISSION and a selection of other programs to further understand and document the implementation, experience, and the impact of the individual programs. The findings presented in this report are from the four student focus groups (with approximately 40 students) conducted at the eCYBERMISSION National Judging & Educational Event (NJ&EE). It is important to recognize that these findings only reflect a subset of individuals who competed at the national event and cannot be generalized across the entire program.

Table 1. 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?

2.1 Survey Respondents

This report describes participant data and results from student and mentor/Team Advisor surveys. Table 2 shows the number of surveys by program.

Table 2. Participant and Team Advisor Survey Response Rates

	Participant Surveys		Team Advisor Surveys	
	Count	Response Rate	Count	Response Rate
eCYBERMISSION	1,367	15%	71	18%

2.2 Limitations

It is important to recognize that survey results only reflect those individuals who completed surveys and due to the relatively low response rates for both participants and Team Advisors (15% and 18%, respectively), it is possible that these responses do not generalize well to the populations that were involved in the program.

In addition, as noted above, the site visit results shared in this report only reflect a subset of students who competed at NJ&EE and cannot be generalized across the entire program. The focus group topics narrowed in on a few areas of interest and were meant to supplement data gathered through surveys. As a result, while these findings offer some insights into the eCYBERMISSION program, this report does not provide a complete or representative account of outcomes from the program.

2.3 Report Organization

The evaluation team focused on presenting aggregated results for AEOP overall. Evaluation findings presented below are guided by the research questions and organized thematically by topic. Sections include the following:

- Overall Experience
- Program Activities
- Development of STEM Skills
- Development of 21st Century Skills
- Interest in STEM and STEM Careers
- Impact of Team Advisors on AEOP Participants
- Recommendations

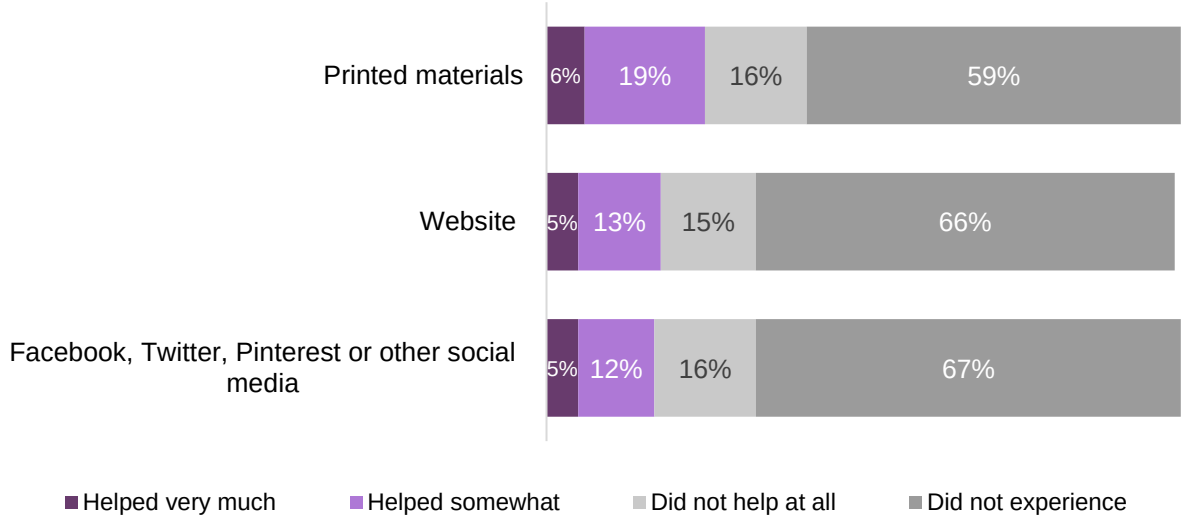
3 Overall experience

Overall, eCYBERMISSION students reported positive experiences. They enjoyed learning new STEM skills, working in teams, and networking with STEM researchers. Team Advisors similarly reported that they enjoyed engaging with students, provided students with opportunities to participate in hands-on learning experiences, and gave students opportunities to work with others. Suggestions for improvement generally focused on improved communication. There were also specific comments regarding a desire for a more user-friendly website (for login and mission folder requirements). Some students requested more information on STEM-related careers and engagement with professionals.

3.1 Perceived Value of AEOP Resources

In general, most students reported that AEOP-wide resources were of limited value. The participant survey asked students about a few different AEOP resources. Of the list of resources, printed materials were reported to be helpful to students; 25% said that printed resources helped them somewhat or very much (Figure 1). Social media was least helpful, with 17% of students saying that this helped them somewhat or very much.

Figure 1. Most students were not aware of AEOP-wide resources



Participant Survey (n = 1,096)

These survey findings are supported by what we learned in the focus groups with students. Participants shared that they had learned of eCYBERMISSION primarily through word of mouth, either through a family member or through their schools. If one family member (e.g., sibling) participated in the program, they shared their experiences which sparked an interest. For several participants, their schools embedded eCYBERMISSION into their curriculum as a project-based learning component or they offered it as an afterschool club. One participant shared, “our school offered it, but personally I didn't hear about it until one of my friends was

doing it. And so, I heard about it from them and then I kind of reached out to my friends too. And yeah. Some of our grades, it is a required thing, but for our grades, it was an optional thing." For others, a teacher or adult in their school building suggested the program to students in their class and asked if they wanted to join.

3.2 Program Satisfaction

To assess overall satisfaction, the survey asked both students and Team Advisors an open-response question, *please tell us about your overall satisfaction with your [AEOP program] experience*. A number of high-level themes stood out in the findings.

3.2.1 Student Program Satisfaction

Nearly three-quarters of students reported that they were satisfied with eCYBERMISSION. The most common reasons that participants cited for their satisfaction included being able to learn while doing STEM experiments, having an opportunity to work collaboratively in teams, learning about problems in their communities, and having a fun experience. Those who were not satisfied mentioned that eCYBERMISSION was a mandatory school requirement and not a choice of their own, it was very stressful, or that it was difficult to juggle the program with their other school obligations.

Table 3. Reasons students gave for their satisfaction with AEOP

Theme	Quote
Increased their knowledge	*I think this was a really fun and interesting experience, I liked that I got to work with people in my school and I got to learn from the STEM experience.*
Teamwork to improve the community	*It was fun to work together with my friends to improve the community.*
Fun program	*It was very well and great. I had fun doing the experiment for eCYBERMISSION.*
Mandatory with no student choice	*Honestly, it was a very stressful experience with the whole project. I believe it was a good idea but forcefully making students make a project with no choice other than to do it, isn't the greatest idea. I don't think the whole thing should be mandatory and instead be an optional thing, although if it was optional, I would still join.*
One of many responsibilities	*I wasn't so satisfied with my experience. eCYBERMISSION was one of the biggest projects out of the school year and I had to figure out a way to finish it whilst dealing with all my other honors classes.*

In the focus groups at the national competition, students shared that they enjoyed different aspects of their overall program experience, such as developing their projects, problem-solving, engaging with peers, and learning about career paths related to STEM. Prior to the competition, they enjoyed the "hard work" and learning about and then finding solutions to solve problems in their communities. One participant discussed the benefit of being able to test their assumptions and engage with labs, "*It was probably all the experiments I got to do... just the activities in the lab, being able to test different things that was really fun for me*." Several students said it was a fun way to engage with science that was different than what they were used to in a classroom setting. Related to their time in the actual competition, students shared that making new friends and meeting new people, especially individuals with similar interests created a positive experience for them. One participant explained, "*meeting new people, seeing about problems other people were like targeting…it was just a cool experience.*"

Students also enjoyed engaging in different activities and workshops, and discussions with individuals from the Army. For example, one participant explained, "*I thought the workshops were really fun…because you got to see what these different scientists did. And I've never really seen anything like that before the DoD workshop. So, I thought it was a new experience.*" There were several focus group participants who said that they would be interested in more STEM-related programs in the future. Some also shared that although they had some prior knowledge and eCYBERMISSION helped to deepen their interest in STEM careers. One student shared, "*I really didn't realize how many jobs the army actually had.... you think [about] the soldiers who are actually doing the fighting, but there's so much behind that. And then that those people actually who are doing those jobs are still part of the army and that was kind of cool to realize.*"

3.2.2 Team Advisor Program Satisfaction

The majority of Team Advisors (nearly 90%) were satisfied with eCYBERMISSION. Fifteen percent of Team Advisors stated that they appreciated that the program allows students to learn and explore research and science. Many respondents also stated that the program provided students with hands-on and real-life experiences. Those who expressed some level of dissatisfaction mentioned that they were not aware of deadlines or were overwhelmed with the amount of information that they were given. Some suggested that an introduction to the program would have been helpful. Other reasons provided as to why Team Advisors were not satisfied was that it was challenging to incorporate the eCYBERMISSION project into schoolwork, as students were not interested in reaching out to professionals outside of their school hours.

Table 4. Reasons Team Advisors gave for their satisfaction with AEOP

Theme	Quote
Students gain problem-solving skills and receive feedback from professionals	*Students grow in independent thinking, problem solving and evaluating, knowledge of real-world issues and other people. eCYBERMISSION gives students the opportunity for interaction and feedback with professionals outside of our school. I enjoy the challenge and experience with my 6th & 7th grade students every year. It 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.*
Application to real-life problems	*eCYBERMISSION promotes the application of engineering design principles and scientific inquiry practices to a real-world problem. Students thrive in an environment where they choose their own topic, explore, research, experiment and build. I offer my students 20% of their science time to work on their selected project.*
Increases students' research skills & increase knowledge of engineering	*This is my third year as a team advisor. I have found eCYBERMISSION to be an incredibly beneficial experience for each of the teams that I have advised. The opportunity to research and create a project that stretches across several months has allowed my students to greatly expand their understanding of the engineering process and dig deeply into topics that interest them.*
Better program acclimation and knowledge of deadlines	*Make times for deadlines a little more clear as EST probably could be abbreviated AND spelled out so those of us on PST don't get screwed up.*
Community focused project was challenging for students	*We did the project during school time allocating time for learners to work on their projects weekly thrice. Learners were not interested in reaching out to professionals outside school and started working on it like a science project. It took effort for them to understand the difference between a school science project versus community benefit project.*

3.3 Suggestions for Improvement

In addition to asking students and Team Advisors about their overall satisfaction, the survey also asked them to identify areas for improvement. Both students and Team Advisors were asked, *What are the three ways [AEOP PROGRAM] should be improved for future participants?*

Team Advisors were also asked, *What are the three ways [AEOP PROGRAM] should be improved for mentors/team advisors?*[1] A high-level summary of key themes is included below.

3.3.1 Students' Suggestions for Improvements

Student participants shared various ways that the eCYBERMISSION could be improved including both technical and programmatic components. About one-fifth of students indicated that they wanted a more user-friendly website. For example, one participant suggested, *"you could make a way to insert more file types into the Mission Folder; you could make the eCYBERMISSION website easier to navigate."* Another suggestion was to make the login process "simpler" and easier to navigate. Some participants stated that the experiment questions were difficult to answer and would like the questions to be revised. Additionally, about 5% indicated that they would like more information on STEM-related careers, and more engagement from STEM experts. One participant shared, *"eCYBERMISSION could be improved by having more opportunities for feedback, more resources when it comes to examples of STEM projects, and more information available for STEM careers connected to your work."*

When discussing areas of improvement at the national competition, participants expressed a desire for overall shorter days during the competition, more unstructured downtime and more time to socialize which included wanting to learn from others who had similar projects. One participant shared, "*it's a very, very tight schedule. Lots of stuff to do. Not enough time to go back to your room, wind down and stuff. Yeah. I feel like it adds a lot of stress to everything, and it makes people, at least me more like upset all the time.*" During focus group discussions, a theme that several participants shared was their benefit of getting to know new people through their program experience. However, with presentations, workshops, judging, and long-days, this was challenging given their schedules. Additionally, participants suggested having focus group interviews on a day that was not so packed for them. Others reported that they wanted a change in food choices due to health concerns (e.g., food allergies) and asked for more clarity on the judging process.

3.3.2 Team Advisors' Suggestions for Improvement

About four-tenths of Team Advisors suggested improvements to the website and student folders. Many Team Advisors suggested that it would be good for the folders to autosave instead of having the students hit "save section" so that they don't lose the work; this would allow students to be able to type and save information at one time. A couple of Team Advisors suggested that the mission folder should be copied to Google docs so that students always have a copy of their work. One participant shared, *"My team lost a long, complex answer from the mission folder when the page was accidentally swiped away from the page. Auto-save would be very helpful. It was great to have the Google doc, but the numbers didn't align perfectly."*

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

Approximately one-fifth of Team Advisors suggested improving instructions that are given to the students and Team Advisors. Specific suggestions included clearer guidelines on data collection tools, and more guidance on which forms are required. Another suggestion provided was to provide more content-specific exemplars so students understand the parts of the project better. One Team Advisors responded, *"I would still like more videos and the like about engineering…Direct upload of content to the corresponding mission folder question - not just the section…Ability to submit Mission Folder question answers to a mentor for review before the submission deadline."*

Other program improvements that were mentioned included sending out the mini grants earlier, having student funds arrive earlier, hosting eCYBERMISSION chats during the day so that students are able to access them at a more convenient time, and improving the registration process.

Roughly one-fourth of respondents provided suggestions related to being a facilitator for student projects. This includes, allowing Team Advisors to sort teams into groups, allowing students more than 30 minutes to work on their mission folder, providing more materials and readings for students, offering models of great, good and poor entries, and changing the rules to allow for mixed grade-level teams. Another 20% of respondents indicated that they wanted better communications, such as making the times of deadlines clearer, having easier to understand documentation, allowing for better communication during peak times, and providing a "cheat sheet" that includes specific dates and how each resource should be used. One participant shared, *"The scaffolding for each task is lacking; it is often difficult knowing how to complete a task (does the research need to be formatted as an official research paper, for example? and how do we do that when it is written jointly by 3-4 people?)...Regular updates on where we should be in the project would help my mental timeline."* Other suggestions for improvement included having cyber chats during school hours, offering more live sessions during non-school hours, making the website easier to navigate, and allowing advisors to meet virtually within their region.

4 Program Activities

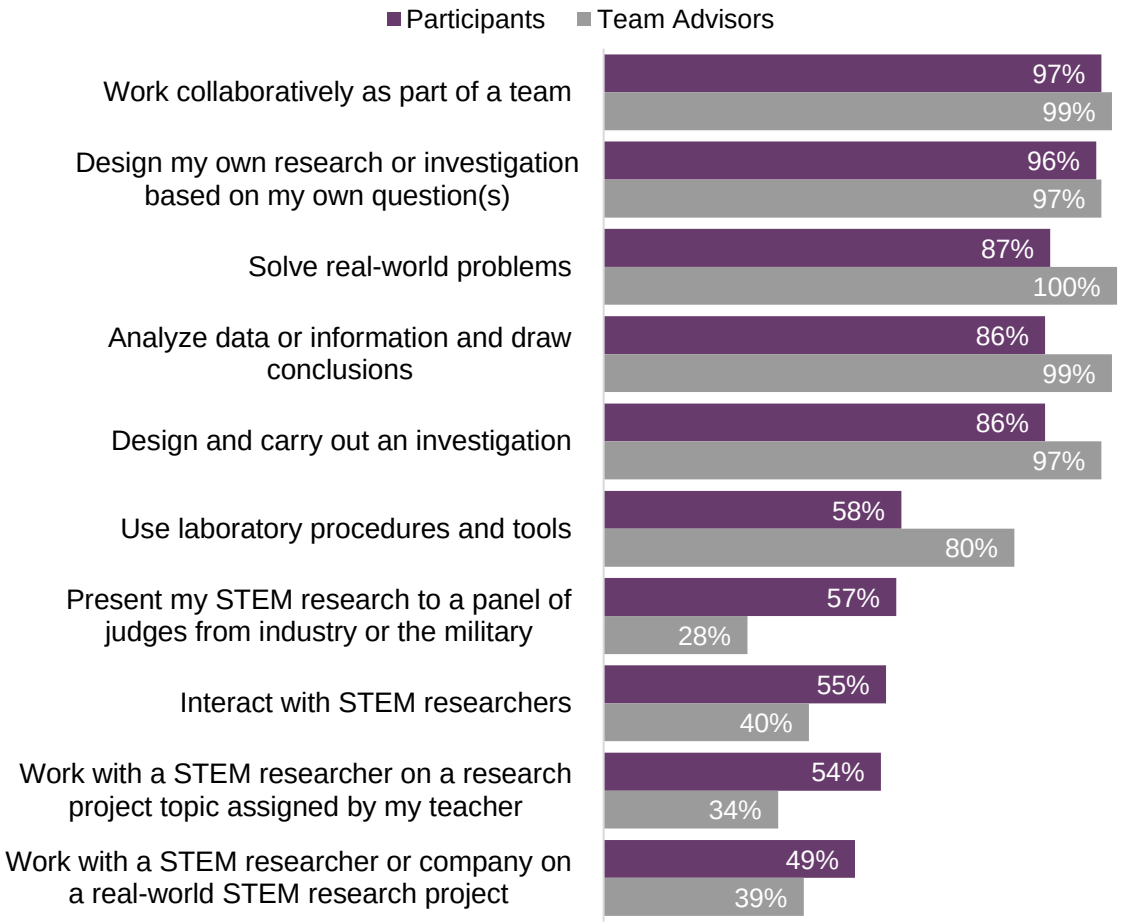
eCYBERMISSION offered students the opportunity to engage in a variety of STEM-related activities. According to survey results from both students and Team Advisors, the majority of students had experience working in teams, solving real-world problems, and designing and conducting research. At least 86% of students and 97% of Team Advisors reported that students had these opportunities. A smaller proportion of students had the experience to present their research or interact in capacity with STEM researchers. Between 54% and 58% of students and 28% and 34% of Team Advisors reported this took place.

4.1 STEM Practices

eCYBERMISSION participants had opportunities to engage in a variety of STEM activities. Most students reported that they had the opportunity to work collaboratively as part of a team (97%), design their own research or investigation (96%), solve real-world problems (87%), analyze data or information and draw conclusions (86%), and design and carry out an investigation (86%). Results from Team Advisors surveys were similar, with the vast majority of Team Advisors reporting that their students engaged in each of these activities (between 97% and 100%, Figure 2).

Students were less likely to report having an opportunity to use laboratory procedures and tools (58%), present their STEM research (57%) or interact with STEM researchers in some capacity (between 49% and 55%). Team Advisors similarly were less likely to report the occurrence of these activities, which may indicate that these activities are less common in the eCYBERMISSION program.

Figure 2. eCYBERMISSION participants had opportunities to engage in a variety of STEM activities



Participant Survey (n = 1,257)
Mentor/Team Advisor Survey (n = 71)
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.”

5 Development of STEM Skills

Students reported gains in a number of STEM research skills as a result of their participation in eCYBERMISSION. For example, students reported that they improved their knowledge of STEM topics and increased their knowledge of how scientists and engineers work on real-world problems through everyday research within the STEM field. Team Advisors were only slightly more likely than students to report that they experienced gains as a result of their participation in eCYBERMISSION.

5.1 STEM Skills

Survey findings indicate that the majority of eCYBERMISSION students increased their knowledge of STEM and various aspects of STEM research. Both students and Team Advisors 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"); Team Advisors were asked to indicate to what degree their students had experienced gains in the same areas (from "no gain" to "large gain"). As Table 5 shows, students and Team Advisors consistently reported increases in all areas. Team Advisors were more likely than students to report gains from their participation in eCYBERMISSION.

Table 5. Students increased their knowledge of STEM and various aspects of STEM research

Response	*Participant* / *Team Advisor*	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	9%	30%	39%	22%	**91%**
	Team Advisor	0%	17%	49%	34%	**100%**
Knowledge of how scientists and engineers work on real problems in STEM	Participant	11%	28%	33%	27%	**89%**
	Team Advisor	1%	34%	42%	23%	**99%**
Knowledge of what everyday research work is like in STEM	Participant	13%	32%	35%	20%	**87%**
	Team Advisor	3%	24%	49%	24%	**97%**
Supporting an explanation with STEM knowledge	Participant	6%	27%	39%	29%	**95%**
	Team Advisor	0%	25%	41%	34%	**100%**
Making a model to show how something works	Participant	16%	32%	32%	21%	**85%**
	Team Advisor	6%	20%	44%	30%	**94%**

Participant Survey (n = 1,241)

Mentor/Team Advisor Survey (n = 71)

5.2 Planning and Carrying out Experiments

Most students improved skills associated with planning and carrying out investigations. Like the items above, both students and Team Advisors were asked to report to what extent students learned or experienced gains in a number of areas related to conducting experiments. Team Advisors consistently were more likely than their students to report gains, though percentages were generally high across all areas (see Table 6).

Table 6. Students improved skills related to planning and carrying out investigations

Response	*Participant* / *Team Advisor*	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	9%	30%	36%	26%	**92%**
	Team Advisor	0%	18%	51%	31%	**100%**
Creating a hypothesis or explanation that can be tested in an experiment/problem	Participant	8%	31%	41%	20%	**92%**
	Team Advisor	0%	23%	45%	32%	**100%**
Carrying out an experiment and recording data accurately	Participant	8%	28%	36%	29%	**93%**
	Team Advisor	1%	18%	51%	30%	**99%**
Presenting an argument that uses data and/or findings from an experiment or investigation	Participant	9%	34%	36%	21%	**91%**
	Team Advisor	3%	34%	38%	25%	**97%**

Participant Survey (n = 1,179)

Mentor/Team Advisor Survey (n = 71)

5.3 Analyzing and Interpreting Data

Students developed skills in data analysis and interpretation. Students and Team Advisors were also asked about to what extent students learned or gained experience with analyzing and interpreting data. Students were least likely to report that they learned how to identify the limitations of the methods and tools used for collecting data. They also were less likely to report learning to create charts or graphs to display data; in fact, 15% students said that they "did not learn" either one of these skills in their AEOP program, which maybe be an indication that this was not a major component of their experience eCYBERMISSION experience. Table 8 shows the full list of items related to analyzing and interpreting data.

Table 7. Students developed skills in data analysis and interpretation

Response	*Participant* / *Team Advisor*	Did not learn / No gain	Learned a lot / Large gain	Learned more than a little / Medium gain	Learned just a little / Small gain	Overall Learning or Gain
Considering multiple interpretations of data to decide if something works as intended	Participant	8%	32%	37%	23%	**92%**
	Team Advisor	3%	34%	39%	24%	**97%**
Identifying the strengths and limitations of data or arguments presented in technical or STEM texts	Participant	10%	34%	37%	19%	**90%**
	Team Advisor	3%	32%	41%	24%	**97%**
Identifying the limitations of the methods and tools used for collecting data	Participant	15%	33%	35%	20%	**88%**
	Team Advisor	0%	27%	49%	24%	**100%**
Creating charts or graphs to display data and find patterns	Participant	15%	33%	31%	22%	**86%**
	Team Advisor	1%	23%	44%	32%	**99%**

Participant Survey (n = 1,179)

Mentor/Team Advisor Survey (n = 71)

6 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 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:

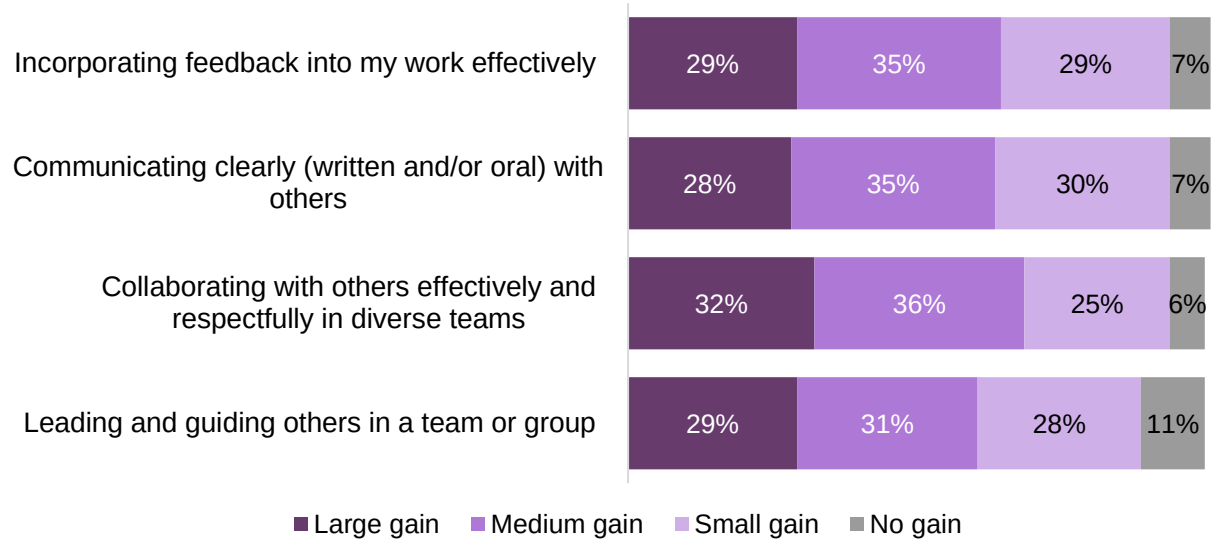
1. Communication and Collaboration
2. Critical Thinking and Problem Solving
3. Creativity and Innovation
4. Initiative, Self-Direction, and Flexibility
5. Media and Technological Literacy

Results from each domain are below.

6.1 Communication and Collaboration

Overall, students overwhelmingly reported gains in their communication and collaboration skills. They reported that they gained skills in incorporating feedback into their work (93%), communicating clearly (written and/or oral) with others (93%), and collaborating with others effectively and respectfully in diverse teams (94%). Students were least likely to report gains in leading and guiding others in a team or group (89%), though this may not have been a central focus of the eCYBERMISSION program. Figure 3 below shows responses to these items, including the full range of scaled responses (i.e., from “no gain” to “large gain”).

Figure 3. Students improved their communication and collaboration skills, but were less likely to report improved skills leading within a team

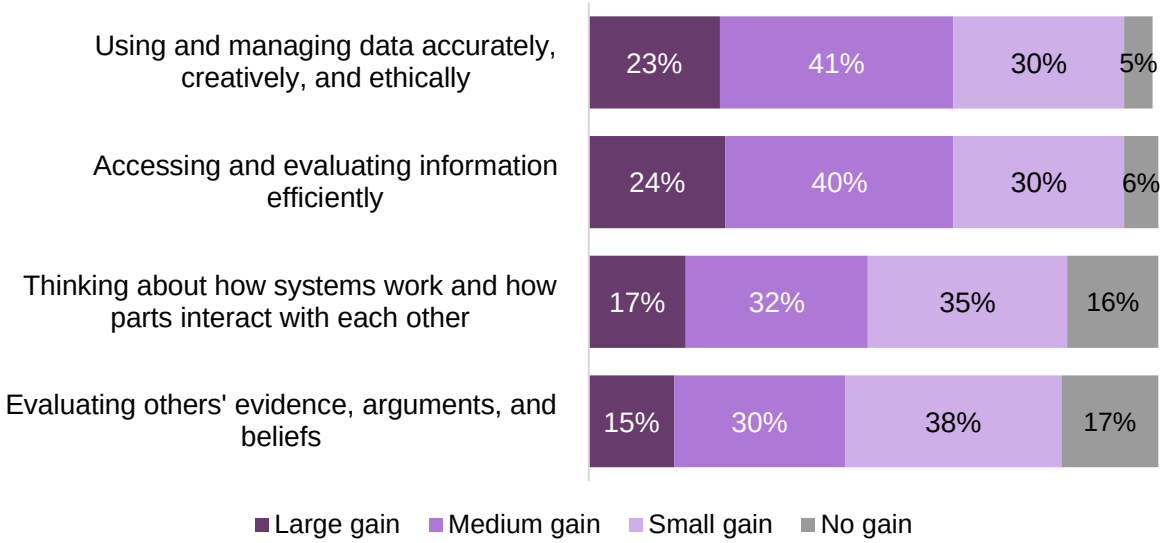


Participant Survey (n = 1,145)

6.2 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 (95%); access and evaluate information efficiently (94%); think about how systems work and how parts interact with each other (84%); and evaluate others' evidence, arguments, and beliefs (83%). See Figure 4 below for the full range of responses to these items.

Figure 4. Students improved various critical thinking and problem-solving skills

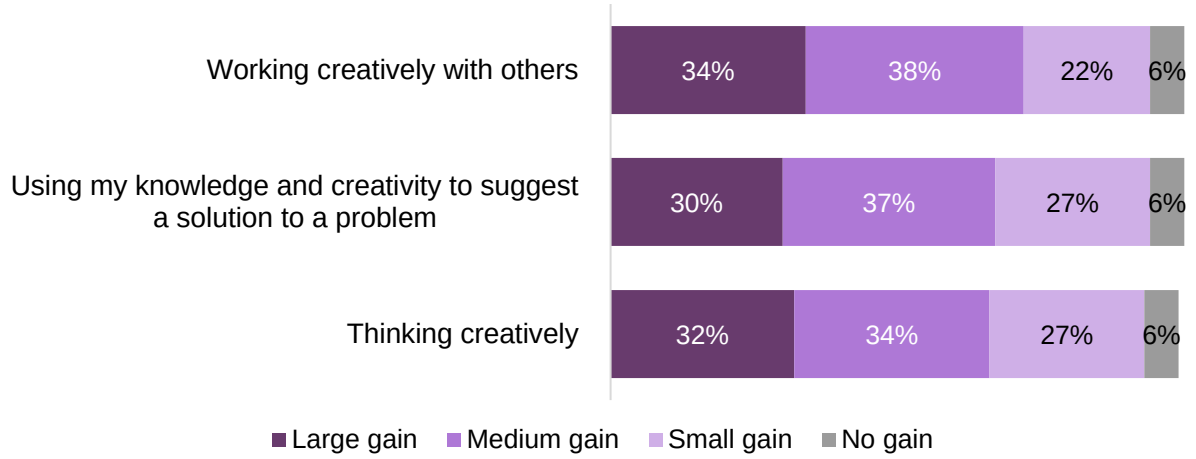


Participant Survey (n = 1,149)

6.3 Creativity and Innovation

eCYBERMISSION students consistently reported that they increased their innovation skills and ability to use creative approaches to address problems. As Figure 5 shows, most students reported that they increased their skills at working creatively with others, using knowledge and creativity to suggest a solution to a problem, and thinking creatively. Ninety-four percent of students reported gains in each of these areas.

Figure 5. Students increased their ability to work more flexibly and creatively.



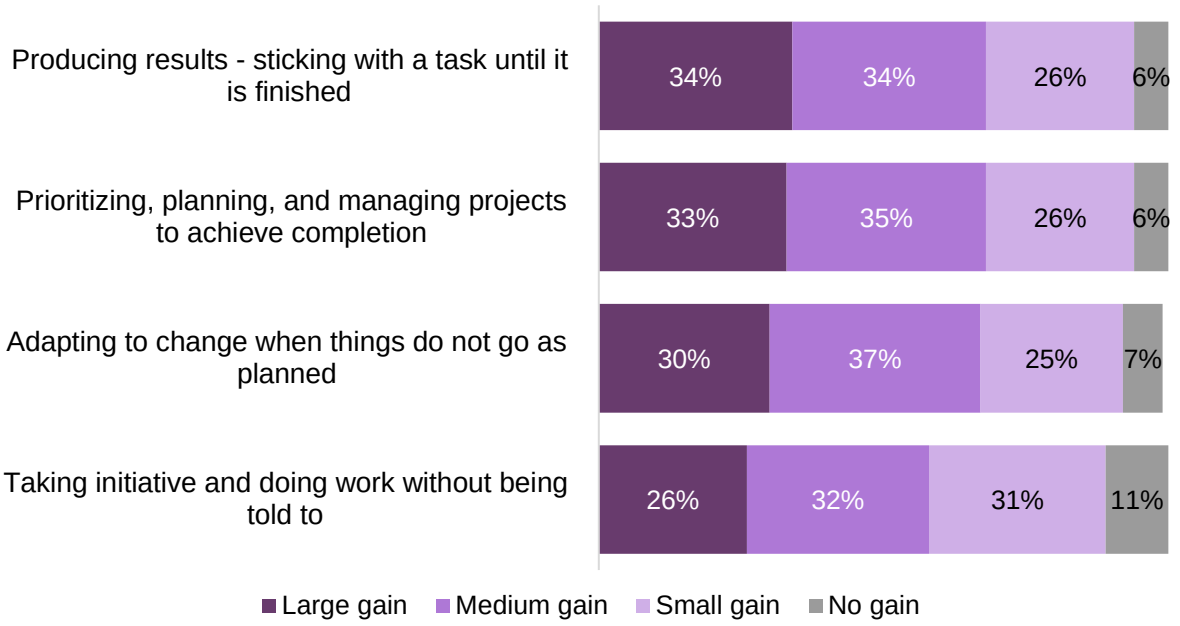
Participant Survey (n = 1,148)

6.4 Initiative, Self-Direction, and Flexibility

Most students reported gains in work habits related to taking initiative, self-direction, and flexibility. On a list of several items, producing results, prioritizing, planning, and managing projects to achieve completion, and adapting to change when things do not go as planned were at the top of the list, with at least 93% of all students reporting gains in each of these areas.

A slightly smaller, but still high, proportion of students (89%) reported improvement in taking initiative and doing work without being told to. In addition, this item had the highest relative proportions of students who reported “no gain” (11%) or “a small gain” (31%). See Figure 6 for the full list of items and range of responses.

Figure 6. Students increased work habits related to taking initiative, self-direction, and flexibility

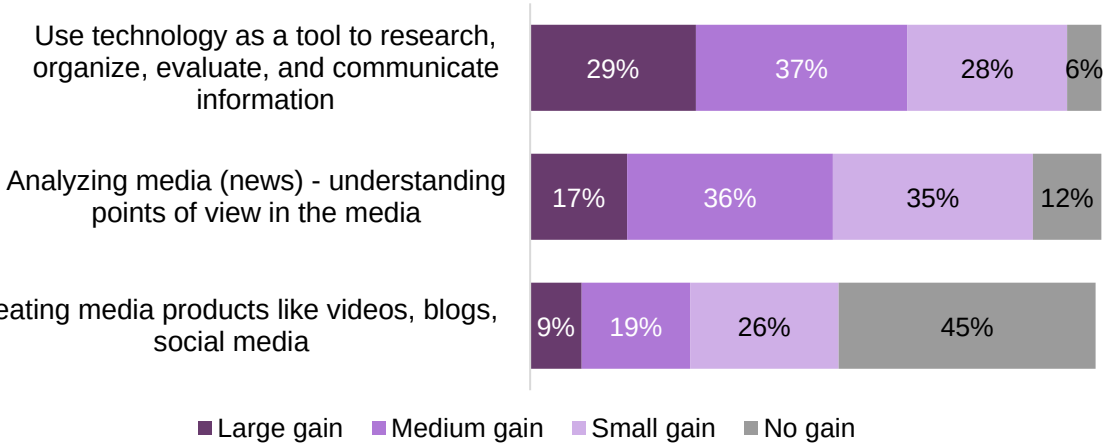


Participant Survey (n = 1,127)

6.5 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. Within this grouping of items, creating media products like videos, blogs, and social media had the lowest relative proportion of students reporting improvements (55%, Figure 7). This lower percentage is most likely due to the eCYBERMISSION program not engaging in related activities.

Figure 7. Students were less likely to report gains in media and technological literacy



Participant Survey (n = 1,130)

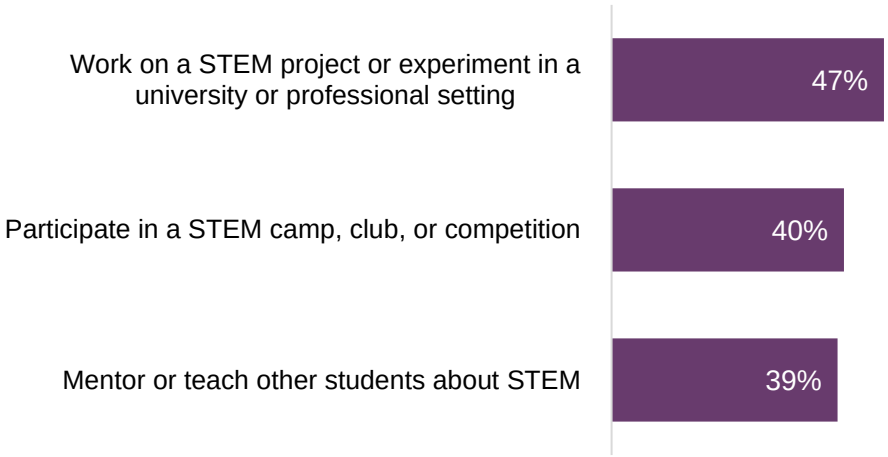
7 Interest in STEM and STEM Careers

The survey results show that participating in eCYBERMISSION positively influenced students' inclination toward STEM education, interest and exploration, and confidence with STEM. The program also led to modest increases in students' interest in pursuing a STEM career and Army or DoD research, and many students learned about Army, or DoD careers through AEOP.

7.1 Interest in STEM

Many students reported that they were more likely to engage in other STEM activities after their participation in eCYBERMISSION. As shown in Figure 8, between 39% and 47% of all students reported a higher inclination to engage in STEM education opportunities such as working on a STEM project or experiment (47%) or participating in a STEM camp, club, or competition (40%), or mentor or teach other students about STEM (39%).

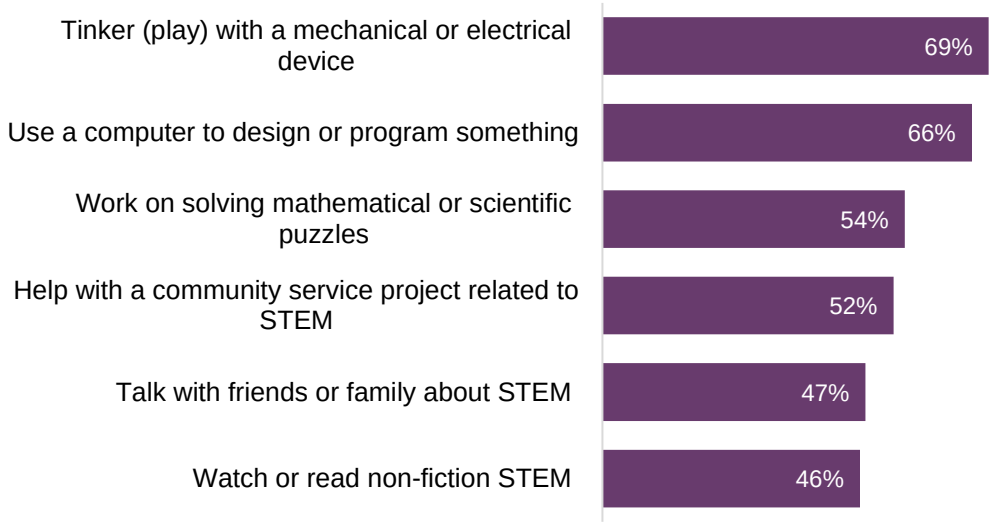
Figure 8. Many students reported an increase in their interest in participating in other kinds of STEM-related activities



Participant Survey (n = 1,096)
Responses include those who reported, "more likely" and "much more likely."

As Figure 9 shows, a notable proportion of students were also more interested in tinkering with a mechanical or electrical device (69%) or using a computer to design or program something (66%). Respondents were least likely to report interest in talking with friends or family about STEM (47%) or watch or read non-fiction STEM (46%).

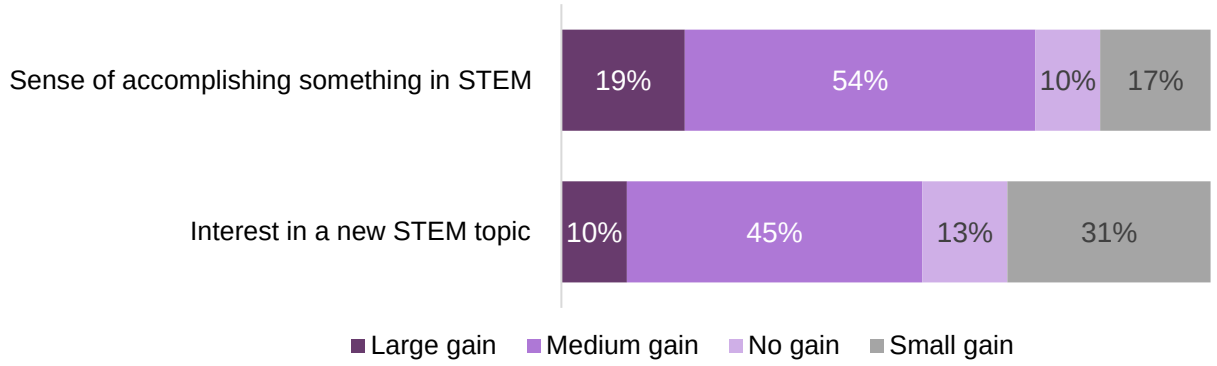
Figure 9. Roughly one-half of students or more reported an increase in their interest in STEM information and exploration



Participant Survey (n = 1,098)
Responses include those who reported, "more likely" and "much more likely."

The majority of all students indicated they gained a sense of accomplishing something in STEM (73%) and an interest in a new STEM topic (55%) due to participating in eCYBERMISSION (Figure 10).

Figure 10. Most students said AEOP increased their STEM Confidence



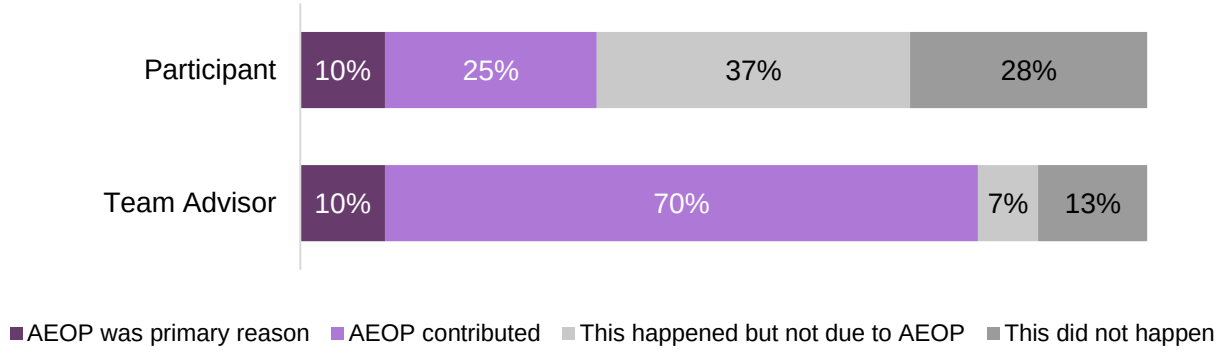
Participant Survey (n = 1,130)

7.2 Interest in Pursuing STEM Education and Careers

eCYBERMISSION students reported that the program had a modest influence on their interests in STEM education and careers. The surveys asked both students and Team Advisors about students' interests in earning a STEM degree and pursuing a STEM career (see Figure 11 and Figure 12). Overall, both groups reported students had increased interest,

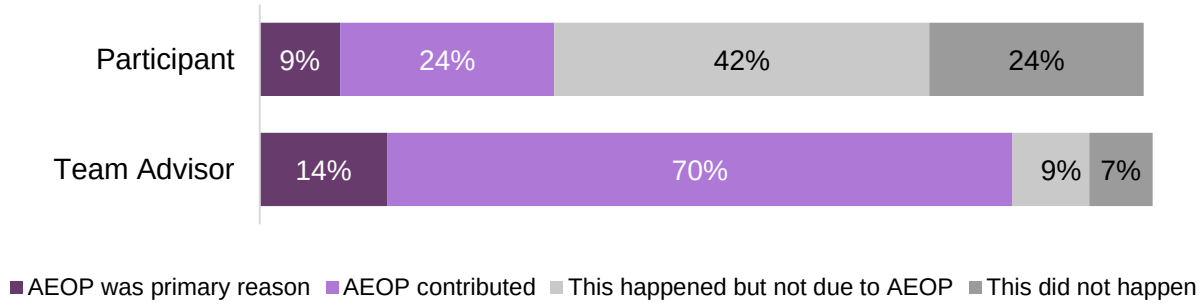
although a much higher proportion of Team Advisors than students reported that AEOP contributed to students' interest. As Figure 11 shows, 35% of students and 80% of Team Advisors reported that the program influenced students' interest in *pursuing a STEM degree*. When asked about their interest in *pursuing a STEM career*, 33% of students and 84% of Team Advisors indicated that AEOP had an influence (Figure 12).

Figure 11. AEOP had a positive influence on students' interest in earning a STEM degree



Participant Survey (n = 1,082)
Mentor/Team Advisor Survey (n = 70)

Figure 12. AEOP contributed to increasing students' interests in pursuing a STEM career



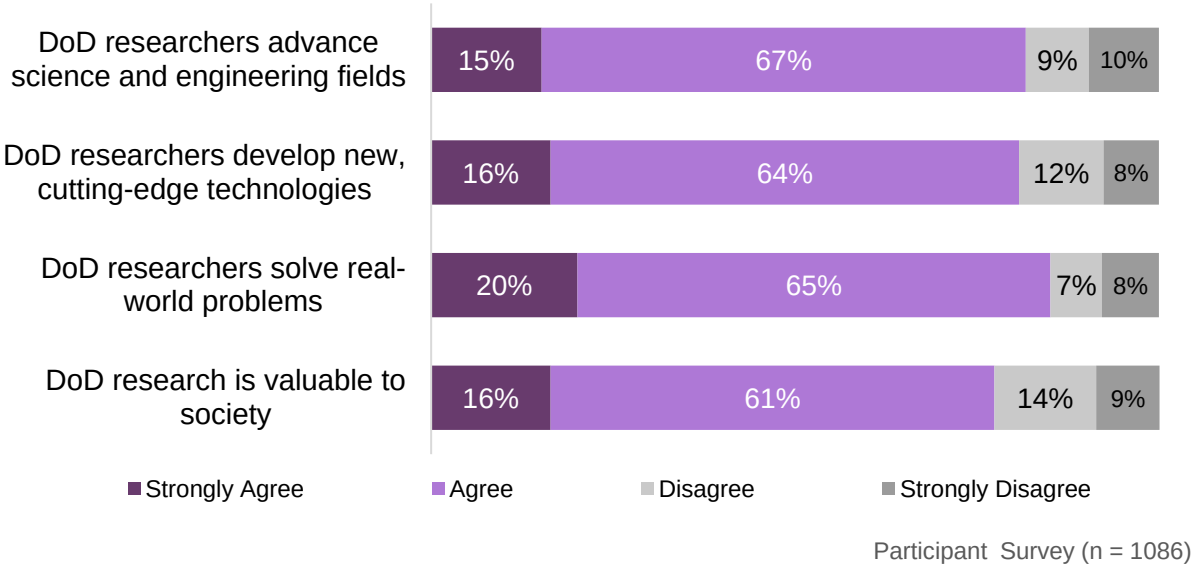
Participant Survey (n = 1,082)
Mentor/Team Advisor Survey (n = 70)

7.3 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 eCYBERMISSION. AEOP has an explicit connection to the Army and DoD. Overall, students also agreed that DoD research is important (Figure 13). At least roughly 80% of students agreed or strongly agreed that DoD researchers advance science

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.

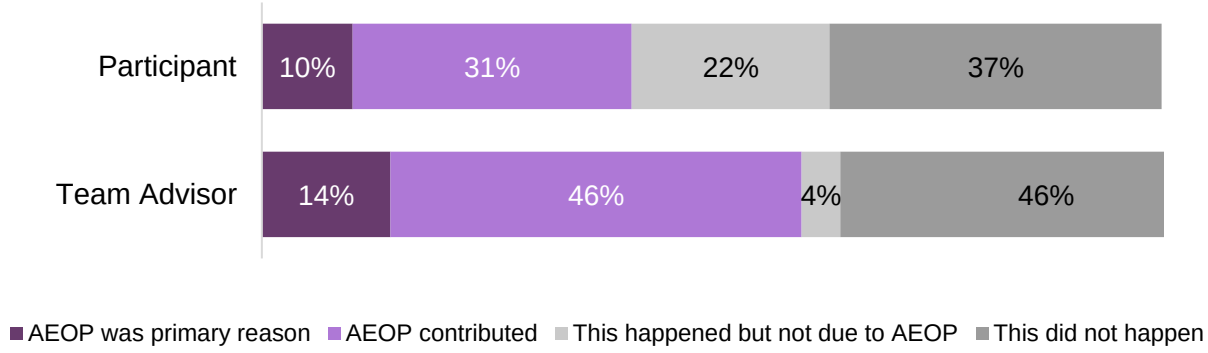
Figure 13. Students understand that DoD research is important



Participant Survey (n = 1086)

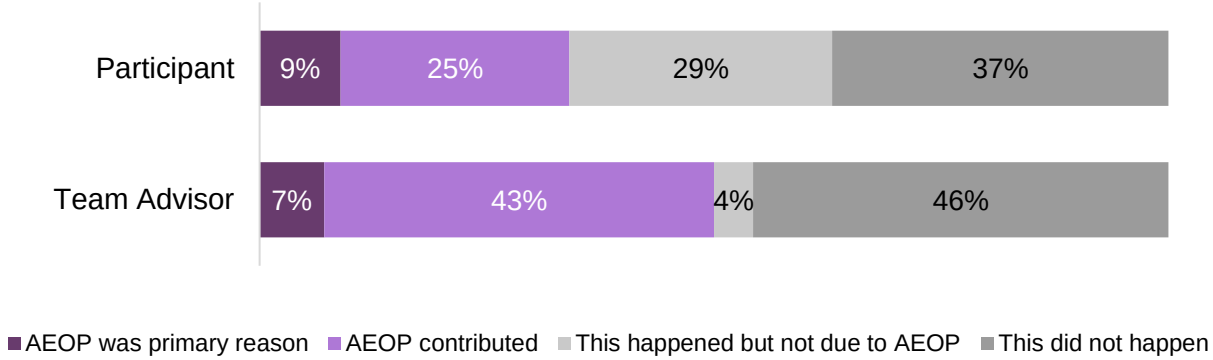
Many students (41%) and Team Advisors (60%) agreed that eCYBERMISSION contributed to students' appreciation of Army/DoD research (Figure 14). In addition, 34% of students reported that their interests in an Army or DoD career increased as result of eCYBERMISSION (Figure 15).

Figure 14. eCYBERMISSION contributed to increasing students' appreciation for Army/DoD research



Participant Survey (n = 1090)
Mentor/Team Advisor Survey (n = 70)

Figure 15. eCYBERMISSION contributed to increasing students' interest in Army/DoD STEM Careers



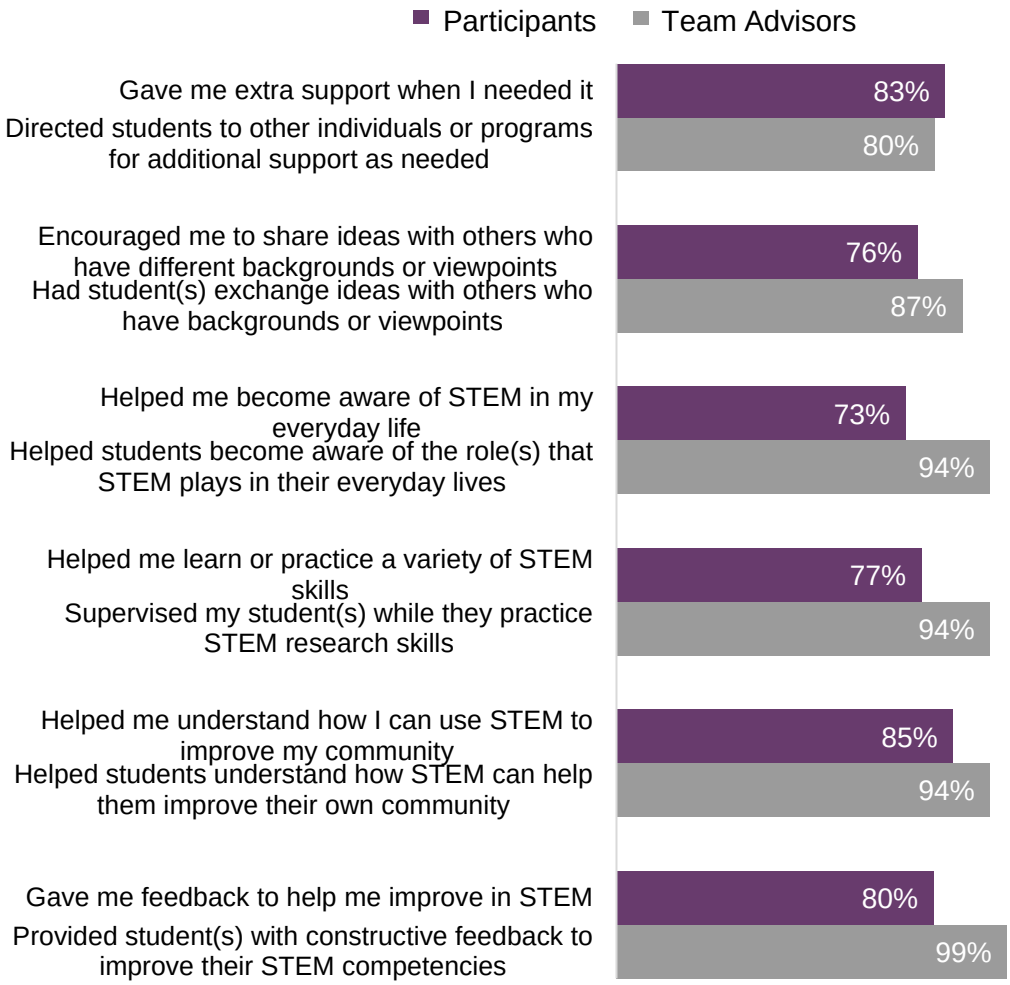
Participant Survey (n = 1,071)
Mentor/Team Advisor Survey (n = 70)

8 Impact of Team Advisors on AEOP participants

Mentors and Team Advisors play an important role in AEOP. Although their roles may differ across the program and in eCYBERMISSION specifically, students reported positive experiences working with their Team Advisors and the survey results suggest they had a strong impact on participants. It is important to note that eCYBERMISSION and AEOP do not provide Team Advisors to students. Team Advisors put teams of students together to participate in eCYBERMISSION.

Students and Team Advisors reported a high use of common strategies to achieve AEOP goals. The survey asked both students and Team Advisors about a range of strategies employed in eCYBERMISSION (see Figure 16). For example, 73% of students reported that Team Advisors helped them become aware of STEM in everyday life, while 85% of students indicated that Team Advisors helped them to understand how they can use STEM to improve their community. Team Advisors' reports on the use of these strategies were consistently higher than students. For example, 94% of Team Advisors reported they helped students become aware of the role that STEM plays in their everyday lives, and 94% of Team Advisors said they helped students to understand how to use STEM to improve their community.

Figure 16. Participants and Team Advisors reported common strategies used across AEOP



Participant Survey (n = 1,123)
Mentor/Team Advisor Survey (n = 71)

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

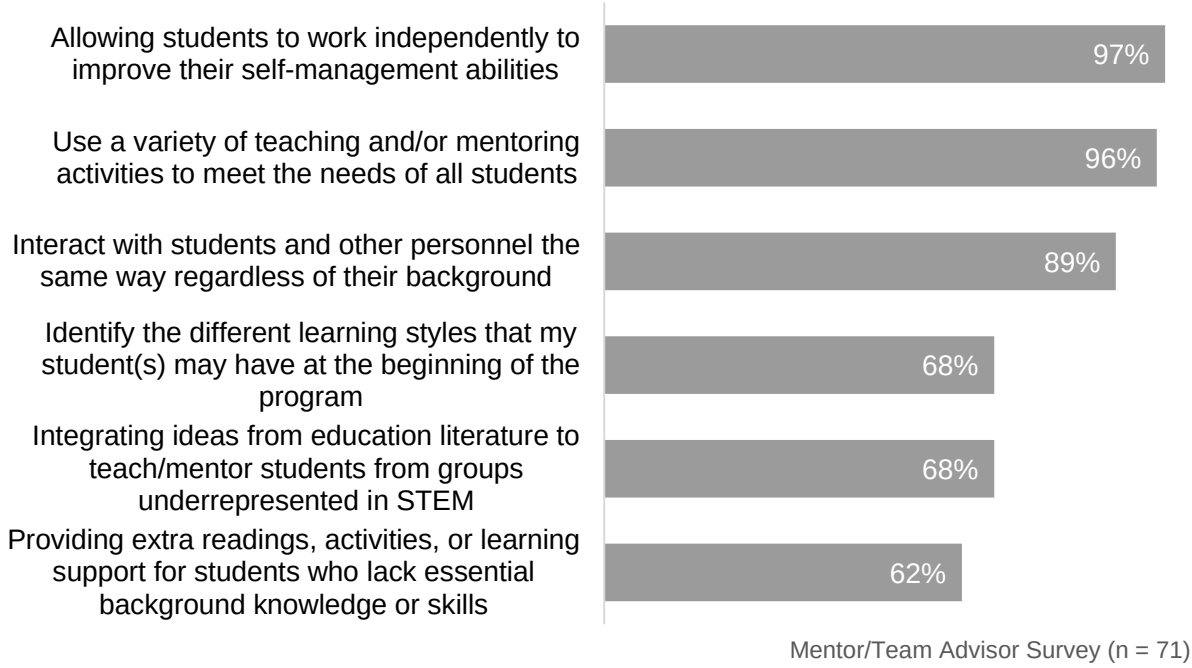
1. Supporting the Diverse Needs of Students as Learners
2. Establishing the Relevance of Learning Activities
3. Supporting Student Development of Collaboration and Interpersonal Skills
4. Supporting Student STEM Activities and Educational Pathways

Findings from each of these core areas are below.

8.1 Supporting the Diverse Needs of Students as Learners

Team Advisors used multiple strategies to meet students' diverse needs. For example, as shown in Figure 17, Team Advisors most commonly reported that they allowed students to work independently (97%) and used a used a variety of teaching and/or mentoring activities to meet the needs of students (96%). Even the lowest reported teaching strategies— identifying different learning styles (68%), integrating ideas from education literature to teach students from underrepresented groups 68%), and providing extra support for students who lack essential background 62%)—were reported as being used by the majority of Team Advisors.

Figure 17. Team Advisors used multiple strategies to meet students' diverse needs

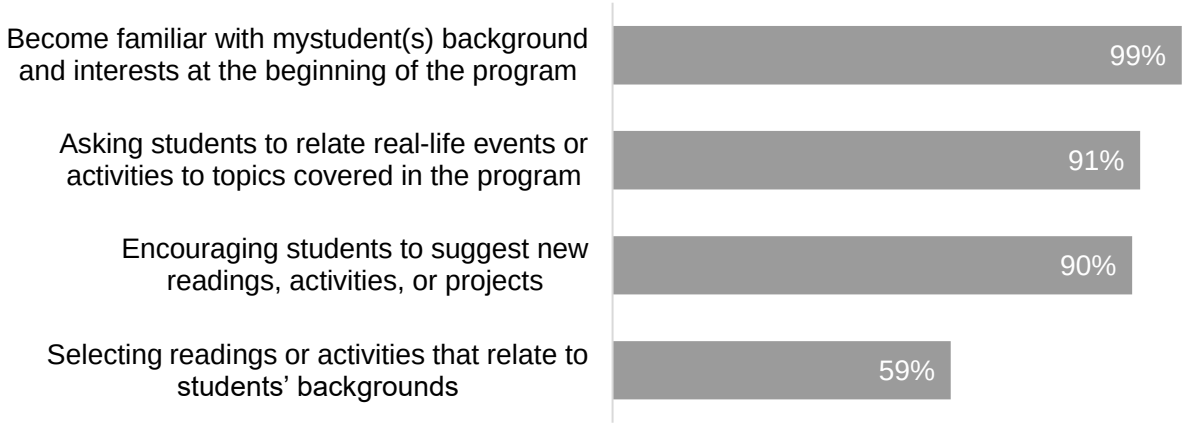


Mentor/Team Advisor Survey (n = 71)

8.2 Establishing the Relevance of Learning Activities

Team Advisors used different teaching strategies to enhance the relevance of learning activities. Additional strategies Team Advisors used to positively impact participants included becoming familiar with student background and interests at the beginning of the program (99%); asking students to relate real-life events or activities to topics covered in the program (91%); encouraging students to suggest new readings, activities, or projects (90%); and selecting readings or activities that relate to students' backgrounds (59%, Figure 18).

Figure 18. Team Advisors used different teaching strategies to enhance the relevance of learning activities

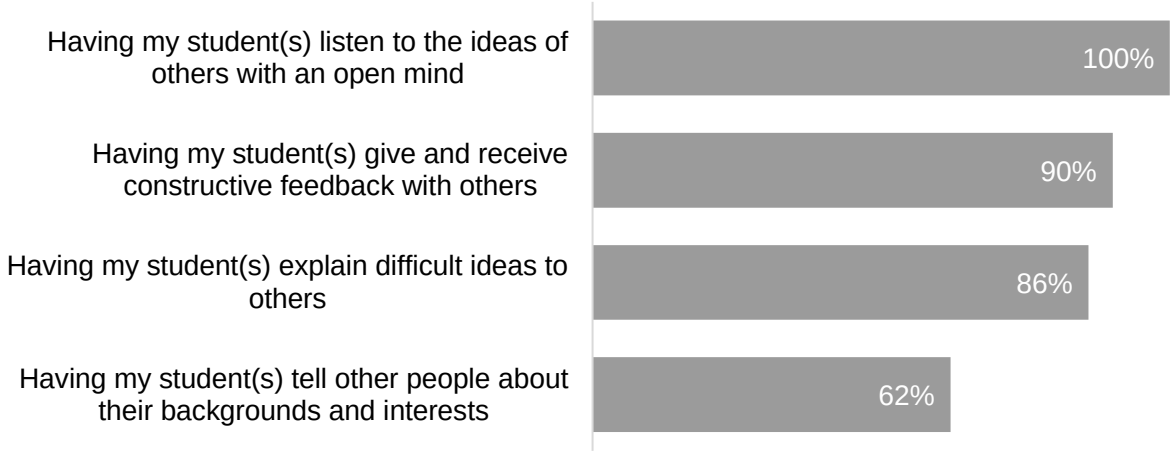


Mentor/Team Advisor Survey (n = 70)

8.3 Supporting Student Development of Collaboration and Interpersonal Skills

Team Advisors frequently fostered communication and interpersonal skills. All Team Advisors reported having students listen to the ideas of others with an open mind and nearly all Team Advisors also noted having students give and receive constructive feedback with others (90%). The least reported strategy was having students tell other people about their backgrounds and interests (62%). See Figure 19 for the full list of responses.

Figure 19. Team Advisors frequently fostered communication and interpersonal skills

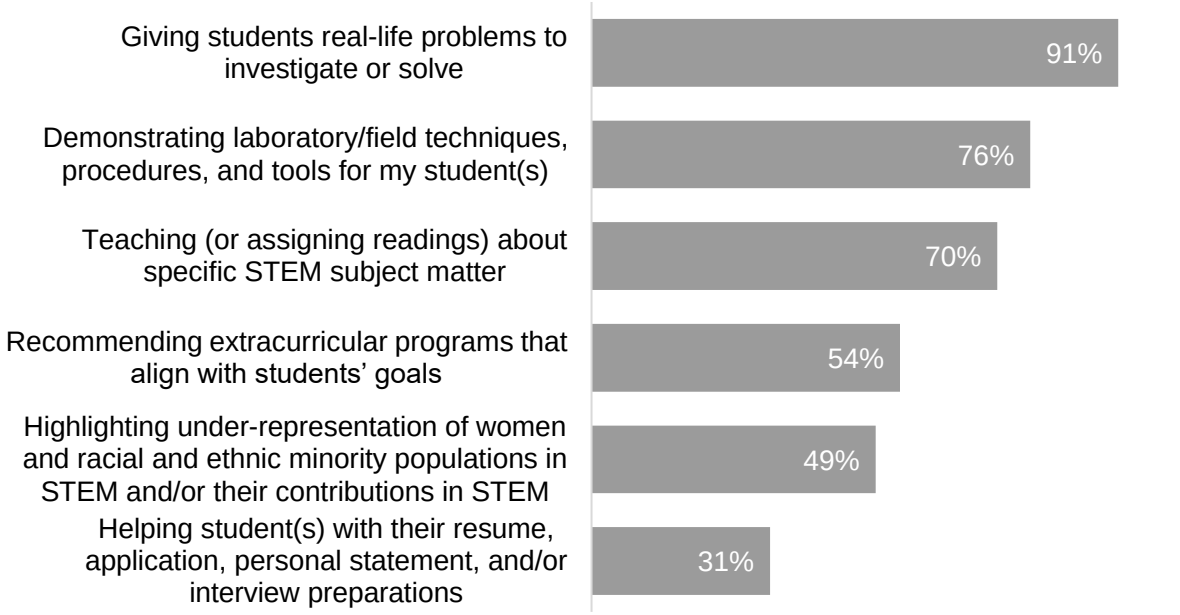


Mentor Survey/Team Advisor (n = 71)

8.4 Supporting Student STEM Activities and Educational Pathways

Team Advisors reported using different strategies to support student engagement in STEM, with hands-on research approaches being the most common strategy. The majority of Team Advisors (91%) reported giving students real-life problems to investigate or solve; demonstrating laboratory and field techniques to students (76%); and teaching or assigning readings about specific STEM topics (70%). A relatively smaller proportion of Team Advisors reported recommending extracurricular programs aligned with student goals (54%). Team Advisors were least likely to report highlighting under-representation of women and racial and ethnic minorities contributions in STEM (49%) or helping students with their resumes, applications, personal statements, and interview preparation (31%); the latter actively is most likely not a major component of eCYBERMISSION, and, therefore, we would not expect to see high numbers reporting this.

Figure 20. Team Advisors reported using different strategies to support student engagement in STEM, with hands-on research strategies being the most common strategy



9 Recommendations

This report distills findings across the student participant and Team Advisors 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 eCYBERMISSION program; however, based on the results presented above, we offer the following recommendations:

Programmatic Considerations

Continue to provide hands-on, relevant experiences with real-world applications. Student participants enjoyed doing research that was meaningful to them, hands-on, and working in teams to solve problems that connected to their communities.

Consider multiple modalities for communicating requirements and deadlines. Team Advisors indicated that they wanted better communication during peak times, including having resources that were easier to understand. One suggestion was to develop visual infographics or a quick reference two-pager that could be accessed easily or downloaded from the website with links to more detailed descriptions for individuals who need it.

Consider improving the website to be more user-friendly. Both students and Team Advisors indicated that improvements were needed regarding login and easier website navigation. More specifically, students wanted easier access and use of mission folder online and a simpler login process.

Help teachers develop strategies to support students who are required to participate in eCYBERMISSION but experience challenges. Responses from students indicate that some students attending schools where eCYBERMISSION was embedded in their science curriculum wanted more choice in their projects. Others struggled to manage all of the mandatory requirements while balancing school specific responsibilities. Team Advisors additionally indicated that some students struggled with community engagement outside of their school day, as eCYBERMISSION projects were different from traditional science projects.

Consider pairing new Team Advisors **with more experienced ones for increased knowledge-sharing.** Team Advisors indicated that there was a learning curve for newer Team Advisors who were not clear on all program requirements. Connecting newer Team Advisors with seasoned ones, can open up an opportunity for shared resources, and newer Team Advisors will feel better equipped to meet the needs of students.

Evaluation Considerations

Continue to examine ways to increase response rates. As noted above, the relatively low response rates for both participants and Team Advisors (15% and 18%, respectively), make it difficult to generalize the findings across the eCYBERMISSION program. The EDC evaluation team is working with IPAs to troubleshoot these issues and develop strategies to improve response rates.