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ARMY EDUCATIONAL OUTREACH PROGRAM

FY23 GEMS Evaluation Report
Summative Findings

June 2024

aeop
ARMY EDUCATIONAL OUTREACH PROGRAM

U.S. Army Contacts

Travis King, Ph.D.
Director for Basic Research
Office of the Deputy Assistant Secretary of the Army for Research and Technology
travis.l.king36.civ@army.mil

Mike Putnam
Senior Management Analyst
Office of the Deputy Assistant Secretary of the Army for Research and Technology
michael.b.putnam.ctr@army.mil

AEOP Cooperative Agreement Manager

Christina Weber
AEOP Cooperative Agreement Manager
U.S. Army Combat Capabilities Development Command (DEVCOM)
Christina.L.Weber.civ@army.mil

Brian Leftridge
Deputy AEOP Cooperative Agreement Manager
U.S. Army Combat Capabilities Development Command (DEVCOM)
brian.m.leftridge2.civ@army.mil

Battelle AEOP Cooperative Agreement Managers

David Burns
Project Director
burnsd@battelle.org

Augustina Jay
Project Manager
jaya@battelle.org

Stephanie Johnson
Program Manager
johnsonsa@battelle.org

Evaluation Team Contacts – Education Development Center, Inc.

Ginger Fitzhugh (co-PI)
gfitzhugh@edc.org

Alyssa Na'im (co-PI)
anaim@edc.org

Alemayehu Bekele
Cat Buechler
Leslie Goodyear
Jill Marcus
Tracy McMahon
Emely Medina-Rodriguez
Andresse St. Rose
Elissa West-Frazier

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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 team advisor the next generation of the nation's diverse talent through United States (U.S.) Army educational outreach programs.

Key findings from the evaluation are presented below.

Overview of Participants

In FY23, GEMS served a total of 2,935 participants, with 98% (2,870) being students and the remaining 2% (65) encompassing near-peer mentors and other supportive roles. Of the student participants, 50% (1,421) met two or more of the AEOP criteria for being considered underserved. Additionally, 24% (681 students) met one criterion for underserved status. AEOP's emphasis is on engaging participants who are often underrepresented and have fewer opportunities in STEM education, including those from diverse geographic settings like rural, urban, or frontier/tribal areas, females, racial/ethnic minorities, those eligible for free or reduced-price school meals, English Language Learners, first-generation college students, individuals with disabilities, and dependents of military service members or veterans. This strategy supports AEOP's objective to foster broad participation in STEM education and careers.

Participant Experience and Outcomes

Development of STEM Knowledge and Skills:

Students improved their STEM knowledge and skills, as reflected by widespread reports from both students and mentors involved in GEMS. For example, 98% of students reported gains in understanding how scientists and engineers solve real-world problems. This included improvements in comprehending scientific concepts and their practical applications. The experiential learning and hands-on activities central to the program played an important role in these improvements. Moreover, the data shows that 99% of students developed an in-depth understanding of STEM topics, and 97% increased their familiarity with everyday research work in STEM, which indicates the program's effectiveness in improving STEM education and skill development.

Development of 21st Century Skills

Students experienced sizable growth in 21st-century skills, with both students and mentors reporting improvements in problem-solving, collaboration, and communication. For example, 77% of students reported at least a medium to large increase in their ability to solve problems individually or within a team, and 78% improved their collaborative skills. Leadership skills also saw enhancement, with 62% of students recognizing a medium to large improvement in leading and guiding others. This development in essential 21st Century skills reflects the program's success in preparing students for future collaborative and impactful

endeavors in STEM fields, emphasizing the vital role of effective communication and teamwork in addressing real-world scientific and technological challenges.

Interest in STEM and STEM Careers

GEMS increased students' confidence in STEM, as well as their interest in further STEM education and careers. For example, 93% of students reported an increase in their confidence in STEM knowledge, skills, and abilities. This increased confidence is directly linked to a greater willingness among students to engage in STEM-related activities. Specifically, 78% of students expressed increased interest in joining STEM clubs, camps, or competitions, and 75% were keen to work on STEM projects in more advanced settings such as universities or professional contexts.

Perceptions of DoD

GEMS had an impact on students' perceptions of DoD research and related careers, demonstrating substantial appreciation for its societal contributions and practical applications. Students acknowledged the importance of DoD efforts in addressing real-world problems, advancing state-of-the-art technologies, and promoting progress in science and engineering. The results highlight the program's success in fostering well-informed perspectives on defense-related careers.

Impact of Mentors

Mentors play an important role in the success of GEMS, improving participants' ability to apply STEM skills in a collaborative and impactful manner. The program supported students in learning and practicing a range of STEM skills, with mentors providing structured guidance that fosters teamwork and the practical application of these skills. Importantly, mentors helped students recognize the relevance of STEM in everyday life and its potential to enhance the community. This mentorship extended to encouraging open discussions among students from diverse backgrounds. Additionally, mentors facilitated conversations about the educational pathways necessary for future careers in STEM, underscoring mentors' pivotal role in cultivating an awareness of STEM's societal impact.

Future Interest AEOP and Other STEM Programs

Student interest in AEOP's STEM programs is notably high, particularly in the GEMS Near-Peer Mentor Program and the SMART program, with 70% and 57% of students expressing enthusiasm, respectively. Other initiatives like the High School Apprenticeship Program and NDESG also drew significant attention. Despite this existing interest, many students remained unaware of the full scope of AEOP offerings, highlighting an opportunity for enhanced outreach. By improving program awareness, AEOP can further increase engagement and support students in pursuing STEM education and career pathways.

Recommendations

This report distills evaluation findings as they align with AEOP's overarching research questions. 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 program flexibility.** This includes offering more customizable options for students to select hand-on activities that align with their interests or grade levels. Tailoring the program in this way may increase student engagement and satisfaction with the program's structure.
- **Consider strengthening mentorship and guidance.** Consider increasing the involvement of near-peer mentors to provide more substantial support and guidance throughout the program. This could involve structured mentorship enhancements that offer consistent peer support, potentially improving student outcomes.
- **Continue encouraging hands-on learning.** Consider allowing students more autonomy in problem-solving and project execution. This approach should include more opportunities for hands-on learning and independent exploration, which may lead to improved engagement and learning outcomes.
- **Continue expanding career exploration and real-world connections for students.** Consider incorporating more activities and discussions focused on career paths and the application of STEM in real-world contexts. This could involve interactive sessions with STEM professionals and practical demonstrations of STEM applications, enhancing student understanding and engagement.
- **Consider improving communication and mentor engagement.** Consider optimizing communication strategies and enhancing mentor involvement in the program. This could include implementing more concise mentor interactions and the use of alternative communication platforms, ensuring a more efficient use of time and improved support structures.

Evaluation Considerations

- **Continue to examine ways to increase response rates.** While the near-peer mentor survey response rate was excellent (near 100%), the modest student survey response rate (68%) means that the findings may not be generalizable across the GEMS program. Explore strategies to improve response rates in the future.

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.

GEMS is an Army-sponsored summer STEM enrichment program for students in grades 5–12 held in the summer at participating Army Research Laboratories.

1.2 Overview of Participants

In FY23, the GEMS program served 2,935 participants – 98% were students, and the remaining 2% were near-peer mentors and other supportive roles.

AEOP emphasizes engaging participants who often have fewer STEM learning opportunities and who are underserved in STEM education and careers. AEOP categorizes underserved participants as those who exhibit at least two of the following characteristics: enrollment in a rural, urban, or frontier/tribal school; female identification; identification as a racial/ethnic minority in STEM fields such as Alaska Native, Native American, Black or African American, Hispanic, Native Hawaiian, and other Pacific Islander, among others; eligibility for free or reduced-price school meals; being an English Language Learner (ELL); being a first-generation college student; having disabilities; or being a dependent of a military service member or veteran.

Of the student participants in GEMS, 50% (1,421 students) met two or more of the AEOP criteria for being considered underserved. An additional 24% (681 students) met one AEOP criterion for underserved status.

2 Evaluation Approach

Education Development Center, Inc. (EDC) is AEOP's external evaluation partner. The primary tools for data collection were post-surveys for students and mentors. These surveys are designed to evaluate the benefits of participation, program strengths and challenges, and overall effectiveness in meeting AEOP and program objectives. GEMS program personnel facilitated the distribution of these online surveys to students and their near-peer mentors upon completion of the program activities.

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 to support 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 results from student and mentor surveys (Table 2).

Table 2. Participant and Mentor Survey Response Rates

	Participant Surveys		Near-Peer Mentor Surveys	
Program	Count	Response Rate	Count	Response Rate
GEMS	1,947	68%	64	98%

2.2 Site Visit

EDC conducted a site visit to the GEMS San Antonio site. The main purpose of the site visit was to learn first-hand about the range of participant experiences. EDC sought to gain understanding of program facilitation and structures through direct observation, and we spoke to participants to gather their input on how program influenced their interest in STEM as well as their perspectives on program strengths and areas of improvement. Furthermore, focus groups added depth to data collected through the surveys.

2.3 Limitations

It is essential to acknowledge that the survey results represent only the subset of individuals who completed the surveys within GEMS. With a response rate of 68% for participants (1,947 surveys) and a nearly complete response rate of 98% for near-peer mentors (64 surveys), the data provides substantial insights into these groups. However, while the high response rate from mentors offers a comprehensive view of this group, the modest student survey response rate means that the findings may not be generalizable across the GEMS program.

Moreover, it is critical to recognize the specific characteristics of the respondents, predominantly high school students, who may not be able to provide information regarding the longer-term outcomes of AEOP. Additionally, nearly 90% of mentor surveys were completed by near-peer mentors who are high school or college students themselves. This demographic may lack the perspective needed to accurately assess students' performance or predict their future inclinations towards educational attainment. This limitation is important because the AEOP's goals include postsecondary achievements that respondents may not yet have experienced.

2.3 Report Organization

Evaluation findings presented below are guided by the research questions and organized thematically by topic. Sections include the following:

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

3 Development of STEM Knowledge and Skills

Students demonstrated a marked improvement in their STEM knowledge and skills through their involvement in GEMS. Both students and near-peer mentors reported progress in students' understanding of scientific concepts and their practical applications.[1] Hands-on activities and experiential learning played a crucial role in improving students' STEM proficiency. These findings suggest that the program enhances students' understanding of core STEM concepts and research methodologies. Overall, the results attest to the effectiveness of GEMS in creating a robust STEM learning environment, crucial for equipping students with the necessary skills and knowledge for future success in STEM fields.

Most students and mentors reported sizable growth in students' understanding of various STEM concepts and research practices. In the surveys, students rated their learning on a scale from "did not learn anything new" to "learned a lot." Table 3 presents a consistent pattern of reported learning gains. Specifically, 98% of students confirmed they gained knowledge on how scientists and engineers solve real-world problems in STEM, with 49% stating they "learned a lot." In terms of developing an in-depth understanding of STEM topics, 99% of students acknowledged learning, with 57% indicating they "learned a lot." Additionally, 97% reported an increase in their familiarity with what everyday research work involves in STEM fields, with 47% believing they "learned a lot." Mentors also reported learning gains, with 100% noting advances in the areas surveyed for which data was available. These responses affirm the program's impact in enhancing STEM education and skill development, as evidenced by the considerable progress observed by both students and mentors in key areas of STEM learning.

Table 3. Students and Mentors Reported Increased STEM Knowledge

Response		I/they didn't learn anything new	I/they learned a little	I/they learned more than a little	I/they learned a lot	Overall learning
Knowledge of how scientists and engineers work on real problems in STEM	Participant	2%	15%	33%	49%	**98%**
	Mentor	0%	5%	40%	55%	**100%**
In-depth knowledge of a STEM topic(s)	Participant	1%	11%	30%	57%	**99%**
	Mentor	0%	0%	13%	88%	**100%**
Knowledge of what everyday research work is like in STEM	Participant	3%	17%	33%	47%	**97%**
	Mentor*	-	-	-	-	**-**

Due to rounding, totals may vary.
Participant Survey (n = 1,917)
Mentor Survey (n = 64)
*This item was not asked in the GEMS mentor survey.

[1] It is important to note that 88% of the mentor surveys were completed by near-peer mentors, who are high school and college students. Their relatively close age and educational stage to the program participants may influence their ability to comprehensively assess student performance.

GEMS offered students hands-on opportunities to engage in STEM.

“During the catabolite the one who is teaching us put us into groups of four… the leader and all of my group did an awesome job.”
- Student

“Teaching us about the types of things you would need to build or start a car. This would help us think of ideas on how to build a car.” - Student

“GEMS has helped me learn about topics that are sometimes not shown in school.” - Student

Students and mentors have both reported sizable improvements in students’ STEM skills. The results reflect notable improvements in practical STEM skills (see Table 4). For example, 95% of students reported that they improved their skills in carrying out an experiment, with 49% stating they learned “a lot.” When it comes to accurately recording data, 89% of participants reported learning, with 30% feeling they learned “a lot.” Mentors, who often have a more holistic understanding of the educational process, consistently reported higher levels of learning gains in these areas—99% of mentors observed advancements in students’ understanding of how to conduct experiments (with71% reporting that students learned “a lot”) and 95% of mentors noted improvements in students’ understanding of how to record data (with 28% saying students learned “a lot”). This disparity may reflect mentors’ ability to more clearly observe and appreciate the progress students make, progress that students themselves might not as readily acknowledge.

Table 4. Participants and Mentors Reported Improvements in Students’ Skills in STEM Research Methods and Tools

Response		I/they didn’t learn anything new	I/they learned a little	I/they learned more than a little	I/they learned a lot	Overall Learning
How to carry out an experiment	Participant	5%	14%	31%	49%	**95%**
	Mentor	2%	5%	23%	71%	**99%**
How to record data accurately	Participant	11%	27%	32%	30%	**89%**
	Mentor	5%	16%	51%	28%	**95%**

Due to rounding, totals may vary.
Participant Survey (n = 1,864)
Mentor Survey (n = 62)

4 Development of 21st Century Skills

Students developed 21st Century Skills through GEMS, particularly in problem-solving, collaboration, communication, and societal impact awareness. Both students and mentors reported students improved their ability to solve problems individually and/or collaboratively, as well as their ability to communicate and work effectively with others. Mentors, in particular, reported that students made large gains in these areas; however, it is worth noting that the majority of mentor respondents were near-peer mentors, who are close in age to the student participants. These findings suggest that AEOP helped students gain skills that could prepare themselves for future collaborative endeavors in a STEM field.

The surveys asked about 21st Century skills across three main domains, shown in Table 5. Results from each of these domains are described in the following sections.

Table 5. 21st Century Skills Assessed through the Evaluation

21st Century Areas	Description
Problem-solving and collaboration	• Solving problems individually or with a team • Working collaboratively with others • Leading and guiding others in a team
Communicating and interacting with others	• Communicate clearly with others orally • Communicate clearly with others in writing • Interacting with others in a respectful and professional
Community and real-world connections	• Thinking about how their work impacts the larger community

4.1 Problem Solving and Collaboration

Overall, students and mentors reported gains in students' problem-solving and collaboration skills. A majority of students reported gains in their ability to solve problems either individually or within a team, with 94% indicating at least a medium to large increase in this skill set (see Table 6). Similarly, 94% of students felt they improved their ability to work collaboratively with others. Students were somewhat less likely to report an increase in their leadership skills, with 88% of students recognizing a medium to large improvement in their capacity to lead or guide others in a team or group setting. Mentors observed these skill developments as even more pronounced, with all mentors noting some level of enhancement across these competencies—100% of mentors reported student growth in problem-solving, collaboration, and leadership skills. This difference in perception might highlight mentors' broader perspective on the students' development through the program.

Table 6. Students Improved their Problem-Solving and Collaboration Skills

Response		No increase	Small increase	Medium increase	Large increase	Overall Learning
Solving problems individually or with a team	Participant	6%	18%	40%	37%	**94%**
	Mentor	0%	3%	33%	64%	**100%**
Working collaboratively with others	Participant	6%	19%	42%	33%	**94%**
	Mentor	0%	3%	36%	61%	**100%**
Leading and guiding others in a team or group	Participant	12%	26%	34%	28%	**88%**
	Mentor	3%	13%	41%	43%	**97%**

Due to rounding, totals may vary.
Participant Survey (n = 1,901)
Mentor Survey (n = 63)

GEMS participants consistently reported developing teamwork and collaboration skills, essential components of the program's group-focused and problem-solving curriculum. The program fostered critical thinking and practical problem-solving abilities, with students engaging in diverse challenges, from software debugging to creative engineering and scientific experimentation. These collaborative and individual efforts helped students apply their theoretical knowledge in real-world contexts, which enhances their capacity to address contemporary scientific and technological issues.

GEMS offered opportunities for participants to problem-solve in teams, increasing their collaboration and teamwork skills.

"*We had to work in teams in robotics, so we had to communicate and talk. We also had to get along with each other. This way we could make a robot and complete everything.*"
- Student

"*Working with others on certain projects taught me how to interact with others better in groups.* *- Student*

"*I experienced a large increase in working collaboratively with others because the majority of the projects I worked on was with a group of different-minded people. This allowed me to work collaboratively with a diverse group of students, which was interesting and a great learning experience.* *- Student*

"*The students worked together to understand and solve problems within their code to have their robot accomplish a task.* *- Mentor*

4.2 Communicating and Interacting with Others

Students demonstrated sizable advancement in their communication skills. A total of 90% of students reported an improvement in their ability to communicate clearly with others orally, with 31% noting a large increase (see Table 7). This development is also reflected in mentor

observations, where all mentors noted improvements in students' ability to communicate clearly with others orally. Furthermore, 90% of students reported progress in interacting with others respectfully and professionally, with 36% experiencing a large increase. Mentors again confirmed this growth, with 100% observing gains in students' professional and respectful interactions.

Table 7. Students Improved Various Communication Skills

Response		No increase	Small increase	Medium increase	Large increase	Overall Learning
Communicating clearly with others orally	Participant	10%	23%	36%	31%	**90%**
	Mentor	5%	21%	48%	26%	**95%**
Interacting with others in a respectful and professional manner	Participant	10%	22%	32%	36%	**90%**
	Mentor	2%	6%	43%	49%	**98%**

Due to rounding, totals may vary.
Participant Survey (n = 1,901)
Mentor Survey (n = 63)

Students reflected on the improvement of their communication and interpersonal skills within the program. They learned to navigate discussions without resorting to conflict, which indicates the development of more constructive communication techniques. The program also strengthened their confidence in communicating, providing them with a greater understanding and more effective articulation of knowledge. Moreover, the opportunity to present projects improved their ability to express ideas clearly and interact positively with others. These improved communication skills were consistently applied in different collaborative contexts, from one-on-one interactions to group presentations.

“ *I learned how to communicate with other people without fighting.* - Student

“ *I think I'll have a better time communicating with other people, and I feel like I know a lot more than I did before I came here.* - Student

“ *During my GEMS experience, I learned how to communicate clearly with others by presenting projects.* - Student

“ *They worked in teams of two to research, design, create, and program their robots. So, each team worked a lot on communication and problem solving in a team.* - Mentor

4.3 Community and Real-World Connections

Students developed their ability to consider the broader impact of their work on the community, demonstrating a clear advancement in awareness. The majority of students

observed at least a small increase in their thoughtfulness regarding how their projects could influence the community, a reflection of their growing civic consciousness (see Table 8). Similarly, mentors noted improvements, with many reporting medium to large increases in students' awareness of their work's community impact.

Table 8. Students Showed Improved Awareness of Their Work's Impact on the Community

Response		No increase	Small increase	Medium increase	Large increase	Overall Learning
Thinking about how your work could impact the larger community	Participant	9%	21%	34%	35%	**91%**
	Mentor	3%	13%	34%	50%	**97%**

Due to rounding, totals may vary.
Participant Survey (n = 1,901)
Mentor Survey (n = 63)

Students reflected on the broader societal relevance of their projects, discussing how they could contribute to community well-being and environmental stewardship.

"*I learned how my work could impact a larger community by listening to the presentation and learn different jobs that use this skill.* - Student

"*I learned that even something simple like a door alarm could help the larger community by providing low-cost security.* - Student

"*I learned different jobs that could help the community. For example, I learned that being a scientist that works with water can help the environment since they can check if the water is clean or not and less people can be sick.* - Student

"*We went very in depth in the knowledge of how this can be used in the real world. We had criminal investigators come in and talk and give stories about experiences and the same with the K-9 unit and we also made the kids think about how every lab could be used in the real world to help with a forensic investigation.* - Mentor

5 Interest in STEM and STEM Careers

GEMS made a sizable impact on students' confidence in STEM and their interest in pursuing STEM-related activities and careers. Both students and mentors reported improvements in students' confidence levels, indicating the program's success in enhancing students' self-perception in STEM. Moreover, the program ignited a sustained interest in STEM among students, with many students expressing eagerness to participate in various STEM-related pursuits post-program. The results indicate GEMS' dual achievement of increasing confidence and fostering ongoing engagement with STEM disciplines and opportunities.

5.1 STEM Confidence

Most students and mentors reported sizable improvements in students' STEM confidence as a result of their participation in the program. A notable 93% of students confirming they are more confident in their STEM knowledge, skills, and abilities. Mentors particularly underscored this positive outcome, with 98% acknowledging a noticeable growth in students' confidence, further supporting the impactful nature of the program on students' self-perception in STEM (see Table 9).

Table 9. Participation in GEMS Increased Students' STEM Confidence

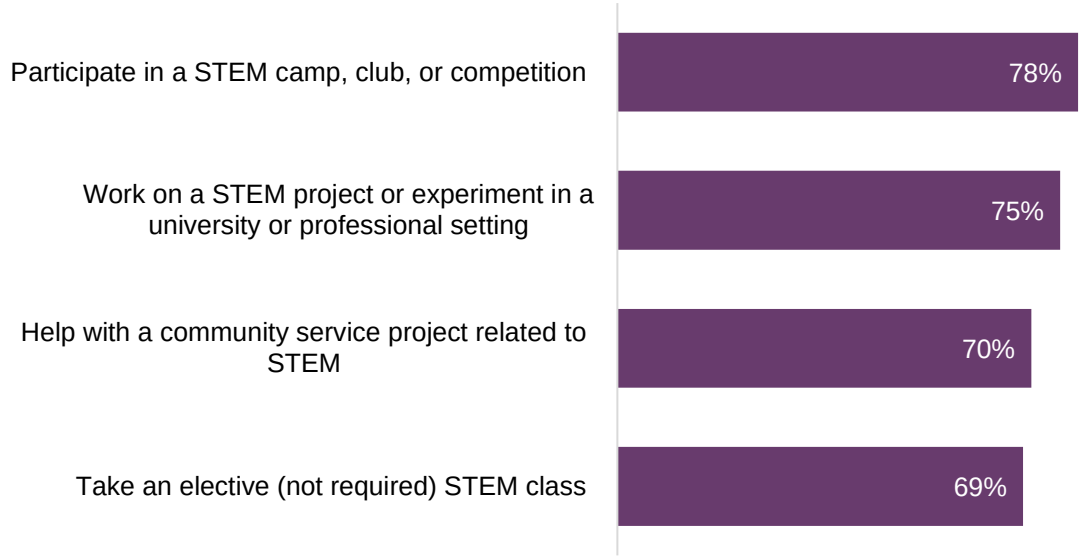
Response		Strongly Disagree	Disagree	Agree	Strongly Agree	Agree overall
I am/They are more confident in STEM knowledge, skills, and abilities	Participant	1%	6%	53%	40%	**93%**
	Mentor	0%	2%	37%	62%	**98%**

Due to rounding, totals may vary.
Participant Survey (n = 1,892)
Mentor Survey (n = 63)

5.2 Interest in STEM-related Activities

GEMS has made a sizable impact in fostering students' continued interest in STEM activities (see Figure 1). A substantial number of students reported an eagerness to participate in a range of STEM-related pursuits following their involvement in the program. For example, 78% of students showed an increased interest in joining a STEM camp, club, or competition. In addition, 75% of students were inclined to work on STEM projects or experiments within a university or professional context, showcasing a readiness to engage in advanced STEM applications. The program also inspired 70% of students to help with community service projects that have a STEM focus, demonstrating a commendable dedication to leveraging their STEM skills for community benefit. Moreover, taking elective STEM classes appealed to 69% of the participants, reflecting a genuine interest in extending their STEM education beyond the core requirements.

Figure 1. Student Reported Becoming More Interested in Participating in Other STEM-Related Activities after Participating in GEMS

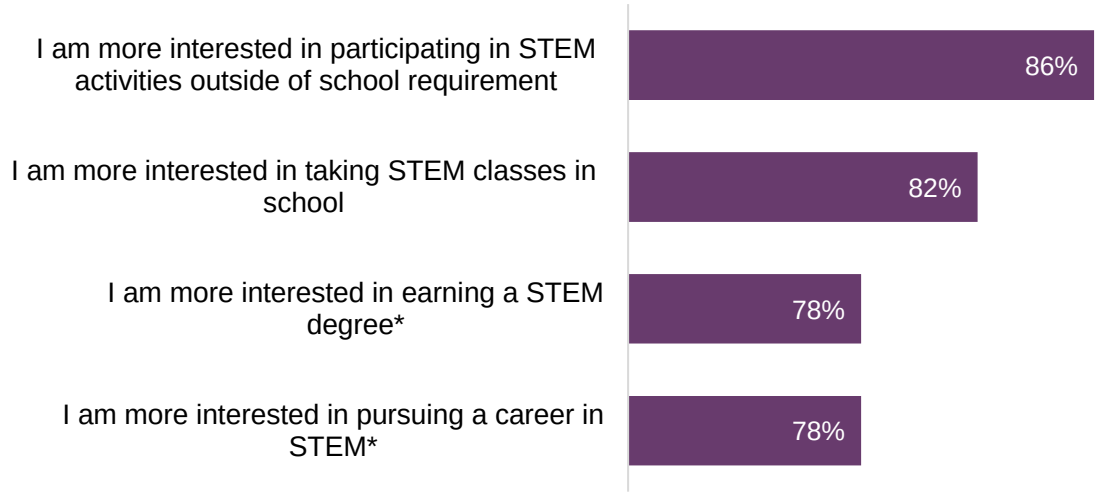


Participant Survey (n = 1,992)
Responses include those who reported "more likely" and "much more likely."

5.3 Interest in Pursuing STEM Education and Careers

GEMS had a positive effect on students' interest in STEM education and careers. The majority of students reported becoming more interested in engaging with STEM disciplines after participating in GEMS (see Figure 2). For example, 86% of students felt a greater inclination to participate in STEM activities outside of school and 82% of students reported an increased interest in taking STEM classes at school. When looking to the future, 78% of students expressed a higher interest in pursuing a STEM degree and in pursuing a career in STEM.

Figure 2. GEMS Had a Positive Effect on Students' Interest in STEM Education and Careers



Participant Survey (n = 1,712)
Responses include those who reported Agree or Strongly Agree.

Students described increasing their knowledge of STEM jobs.

"*From this GEMS program, I have learned a ton and I mean a ton of things about how Scientists and Engineers actually work on a daily basis.* - Student

"*I learned a lot about the investigators and how they do their everyday job.* - Student

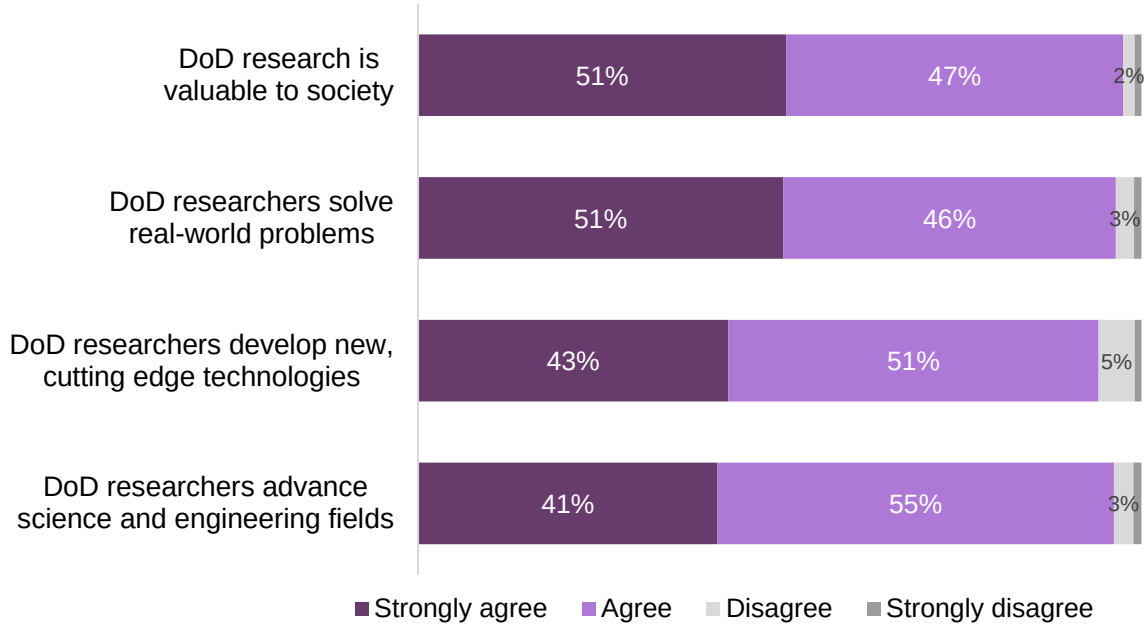
6 Perceptions of DoD

AEOP plays a pivotal role in educating students' understanding of the Department of Defense (DoD) research landscape and its societal impact. Evaluation results reveal a strong consensus among students regarding the value of DoD research, with 98% acknowledging its significance in addressing real-world challenges. These findings underscore the program's effectiveness in instilling an appreciation for the critical role of DoD research in driving progress and fostering interest in STEM careers within the DoD among both mentors and students.

6.1 Understanding of DoD Research

The survey results indicate that students understand that DoD research is important. An overwhelming majority of students—98%—agreed that DoD research is valuable to society, with 51% strongly agreeing with this statement (see Figure 3). In addition, 97% of students concurred that DoD researchers solve real-world problems, which underlines that students recognize the relevance and application of DoD's work. In terms of innovation, 94% of participants agreed that DoD researchers develop new, cutting-edge technologies, which suggests a high regard for these forward-thinking advancements. Moreover, 96% of students agreed that DoD researchers advance science and engineering fields, signifying a deep respect for DoD's role in driving progress in STEM disciplines.

Figure 3. Students Understand that DoD Research is Important



Participant Survey (n = 1,716)
For each category, 1-2% of respondents chose "Strongly disagree."

7 Impact of Mentors on AEOP Participants[2]

The survey results strongly support the program's effectiveness in fostering teamwork, improving STEM skills, and linking these skills to community improvement. The majority of students reported that their mentors used strategies to help engage and support their learning (see Table 10). For example, 92% of students reported their mentors provided extra help when needed and 87% reported that their mentor gave them feedback to help them improve. The majority of students (86%) also reported that their mentors helped them become aware of STEM in their everyday life. A somewhat smaller percentage of students and mentors reported that they engaged in conversations about the education required for STEM careers, with 75% of students and 79% of mentors reporting they had had such discussions.

Table 10. Participants and Mentors Reported Common Strategies Used Across AEOP

Response		
Helped me learn or practice a variety of STEM skills	Participant	94%
Provided guidance to help students practice a variety of STEM skills	Mentor	97%
Gave me extra support when I needed it	Participant	92%
Provided additional support to students as needed	Mentor	95%
Gave me feedback to help me improve in STEM*	Participant	87%
Helped me become aware of STEM in my everyday life	Participant	86%
Helped students become aware of the role(s) that STEM plays in their everyday lives	Mentor	89%
Encouraged me to share ideas with others who have different backgrounds or viewpoints	Participant	82%
Had student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	Mentor	92%
Helped me understand how I can use STEM to improve my community	Participant	81%
Helped students understand how STEM can help them improve their own community	Mentor	89%
Talked to me about the education I need for a STEM career	Participant	75%
Talked to students about the education they need for STEM careers	Mentor	79%

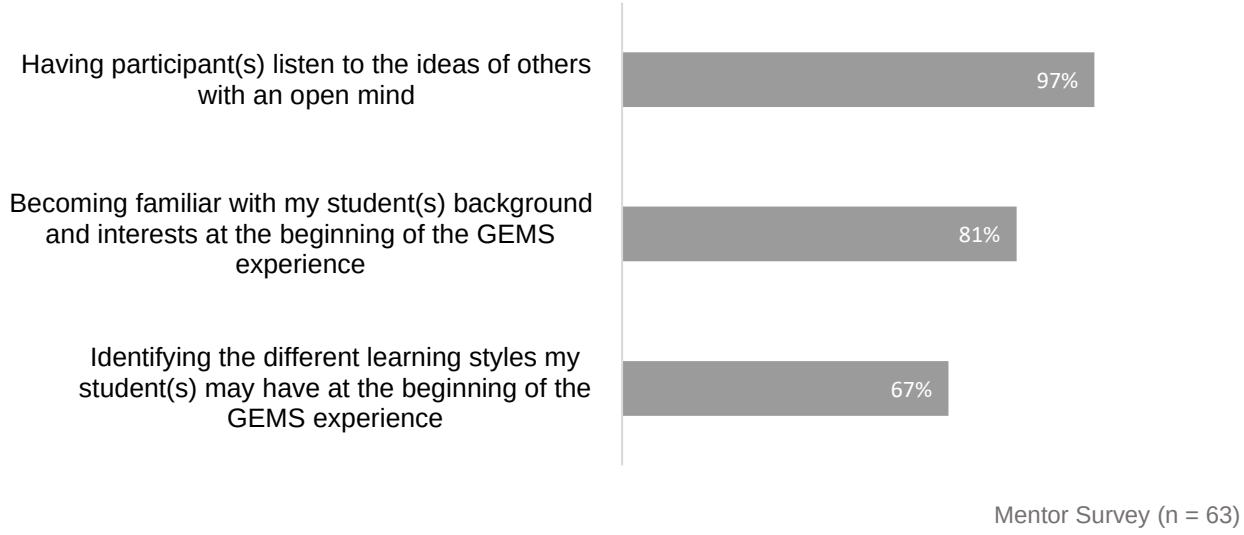
Participant Survey (n = 1,798)
Mentor Survey (n = 63)
*This item was not asked in the GEMS mentor survey.

Mentors employed various methods to support the diverse needs of students in the program. Feedback indicates that mentors frequently promoted open-mindedness, with a

[2] It is important to note that students results reflect their experiences with near-peer mentors. Additionally, 88% of mentor surveys were completed by near-peer mentors, who are high school or college students.

remarkable 97% encouraging students to consider the ideas of others (see Figure 4). Understanding the background and interests of their students at the start of the GEMS program was also a common practice, acknowledged by 81% of mentors. However, identifying the unique learning styles of each student at the program's commencement was reported slightly less, at 67%. This feedback points to a strong emphasis on promoting inclusivity and personalized engagement, yet also highlights the potential to offer mentor training about recognizing and adapting to the individual learning preferences of students.

Figure 4. Mentors Used Multiple Strategies to Meet Students' Needs



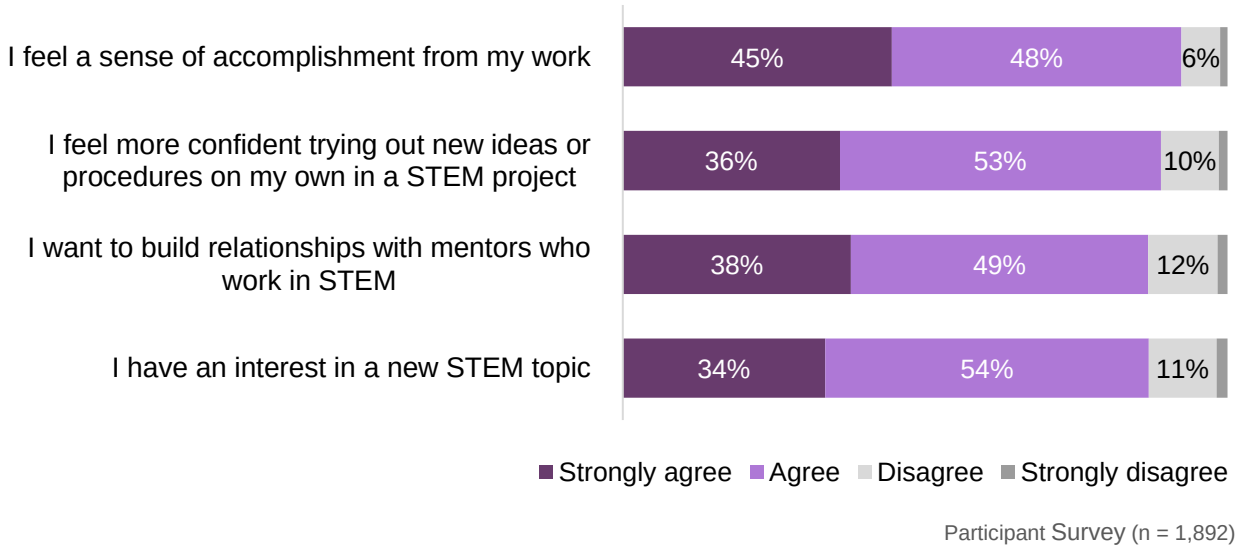
8 Overall Experience

Students indicated positive responses about their participation in GEMS. In addition, there is a notable interest in participating in various AEOP STEM programs, particularly the GEMS Near Peer Mentor and the SMART program. However, there remains an opportunity to increase awareness of these programs among students, as indicated by the percentage of students not familiar with each program.

8.1 Overall Impressions

Students shared overwhelmingly positive responses in their experiences with GEMS (see Figure 5). The results demonstrate that a substantial majority, over 85%, expressed agreement or strong agreement with key facets of their participation. Specifically, 93% reported feeling a sense of accomplishment from their work, with 45% strongly agreeing. Similarly, 89% agreed they were more confident independently trying out new ideas or procedures in STEM projects, with 36% strongly agreeing. The desire to forge relationships with mentors in the STEM field was evident, with 87% of students indicating agreement, and 38% feeling strongly about this aspect. Additionally, 88% of students showed an eagerness for new STEM topics, with 34% strongly agreeing.

Figure 5. Students Report Positive Experiences in GEMS Program



Participant Survey (n = 1,892)

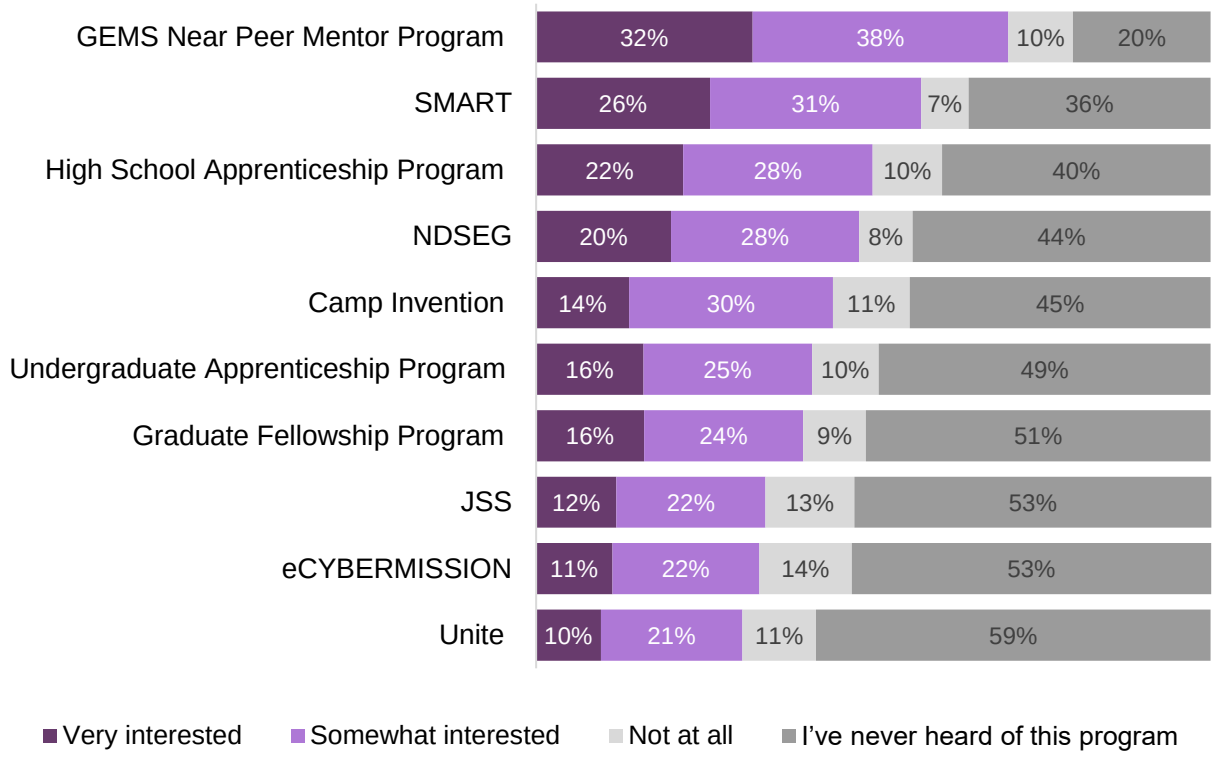
8.2 Future Interest in Other STEM Programs

Students were generally interested in participating in AEOP and other STEM programs, but there is room for greater awareness of these opportunities. GEMS students reported varying degrees of interest in participating in AEOP's diverse STEM programs, with a notable inclination towards the GEMS Near-Peer Mentor Program. Around 70% of students were somewhat or very interested in the GEMS Near Peer Mentor Program (32% very interested, 38% somewhat interested). The SMART program also garnered notable interest, with 57% of

students expressing eagerness to participate (26% very interested, 31% somewhat interested). Other programs like the High School Apprenticeship Program and NDESG also captured the attention of about half of the students surveyed. This data signifies a strong base of interest that AEOP can build upon to deepen engagement with STEM programs.

However, there is room to increase awareness among students about AEOP offerings. While there is a solid core of interest, with the lowest interest for any single program being 10% for Unite, the percentage of students not familiar with each program suggests an opportunity for more outreach and education. By raising awareness and knowledge of the full range of programs available, AEOP could help more students to take advantage of the programs that facilitate their STEM education and career pathways.

Figure 6. Students Expressed Interest in AEOP and Other STEM Programs, with Opportunities for Increased Awareness



Participant Survey (n=1,885)

8.3 Program Satisfaction

Students and mentors expressed high levels of satisfaction with the GEMS program, highlighting its engaging, hands-on approach that significantly enhances the learning experience. Participants appreciated the program for its fun and educational activities. For example, one student notably appreciating the opportunity to learn binary coding from a mentor, describing it as learning a new "language." Another student expressed enthusiasm for recommending the program to friends and family due to its enjoyable nature.

Students and mentors offered praise for GEMS.

❝ *"I loved this program. The hands-on factor of the activities made this camp amazing for me."* - Student

❝ *GEMS was really fun, and I would probably recommend it to a friend of family member,"* - Student

❝ *I overall had a great time and learned a lot. My mentor showed me how to use simple binary and I am happy that I learned a new 'language.'* - Student

❝ *I have found the GEMS program to be extremely valuable to upcoming generations of students, especially those who would otherwise be unaware of the various STEM topics covered by GEMS.* - Mentor

8.4 Suggestions for Improvement

8.4.1 Participants' Suggestions for Improvement

The participant survey included a question which asked, "What are two ways [this program] could be improved?" High-level findings are summarized below.

Program structure and flexibility. Students expressed a desire for more options in choosing activities based on their interests or grade levels. Providing customizable options could improve student engagement and satisfaction with the program structure.

Mentorship and guidance. Some students suggested increasing the involvement of near-peer mentors in guiding and supporting them throughout the program activities.

Hands-on learning and autonomy. Some students indicated a preference for more autonomy in problem-solving and project execution, which suggests that they be allowed to figure things out or conduct activities themselves. Encouraging hands-on learning experiences and providing

opportunities for independent exploration may enhance student engagement and learning outcomes.

Career exploration and real-world connections. Several students expressed a desire for more discussions about career paths and how STEM concepts are applied in real-world situations. Incorporating more activities that showcase the practical applications of STEM and providing information about various STEM careers could enhance student understanding.

Improved communication and mentor engagement. Participants highlighted the importance of effective communication and mentor involvement. Suggestions included shorter "mentor moments" to allow more time for activities, using a different platform for online meetings to overcome technical limitations, and scheduling mentor-student interactions outside of STEM sessions to offer additional support and guidance.

8.4.2 Mentors' Suggestions for Improvement

The mentor survey also included a question which asked, "What are two ways GEMS could be improved?" High-level findings are summarized below.

Increased mentor support and engagement. Mentors emphasized the need for improved mentor support and engagement. Recommendations included increasing mentor-to-teacher ratios to ensure more personalized guidance, extending mentor training periods to enhance readiness, and fostering clearer communication channels between mentors and students.

Revised curriculum structure. Feedback highlighted the importance of revising the curriculum structure for better understanding. Proposed improvements included simplifying curriculum content to enhance accessibility, offering clearer experiment instructions to reduce confusion, and providing a more cohesive progression between program years for a smoother learning experience.

Improved facilities and resources. Suggestions from Mentors focused on optimizing facilities and resources to better accommodate program activities. Strategies involved allocating more physical space to accommodate larger groups, ensuring access to a wider range of supplies and materials for diverse experiments, and enhancing overall program organization to streamline logistics.

Increased student engagement and learning. Mentors underscored the importance of promoting increased student engagement and learning opportunities. Recommendations included incorporating more hands-on activities to bolster involvement, offering a broader range of camps and curriculums tailored to diverse STEM fields, and providing real-world applications to enhance relevance and understanding.

Emphasized real-world application and relevance. Suggestions highlighted the importance of emphasizing real-world applications and relevance within the program. Recommendations included describing educational pathways (including scholarships) and career pathways and showcasing the impact of DoD research to underscore its relevance to lesson content.

9 Recommendations

This report distills evaluation findings as they align with AEOP's overarching research questions. 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 program flexibility.** This includes offering more customizable options for students to select hands-on activities that align with their interests or grade levels. Tailoring the program in this way may increase student engagement and satisfaction with the program's structure.
- **Strengthen mentorship and guidance.** Consider increasing the involvement of near-peer mentors to provide more substantial support and guidance throughout the program. This could involve structured mentorship enhancements that offer consistent peer support, potentially improving student outcomes.
- **Encourage hands-on learning and autonomy.** Consider allowing students more autonomy in problem-solving and project execution. This approach should include more opportunities for hands-on learning and independent exploration, which may lead to improved engagement and learning outcomes.
- **Expand career exploration and real-world connections for students.** Consider incorporating more activities and discussions focused on career paths and the application of STEM in real-world contexts. This could involve interactive sessions with STEM professionals and practical demonstrations of STEM applications, enhancing student understanding and engagement.
- **Improve communication and mentor engagement.** Consider optimizing communication strategies and enhancing mentor involvement in the program. This could include the implementation of more concise mentor interactions and the use of alternative platforms for communication, ensuring more efficient use of time and improved support structures.

Evaluation Considerations

- **Continue to examine ways to increase response rates.** While the near-peer mentor survey response rate was excellent (98%), the modest student survey response rate (68%) means that the findings may not be generalizable across the GEMS program. Explore strategies to improve response rates in the future.