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Army Educational Outreach Program

eCYBERMISSION

2017 Annual Program Evaluation Report

PART 2: Evaluation Findings

April 2018

ARMY EDUCATIONAL OUTREACH PROGRAM

1 | AEOP Consortium Contacts

U.S. Army Contacts

Matthew Willis, Ph.D.
Director, Laboratory Management
Office of the Assistant Secretary of the Army
Acquisition, Logistics, and Technology
matthew.p.willis.civ@mail.mil

Andrea Simmons
Army Educational Outreach Program (AEOP) Director
Office of the Assistant Secretary of the Army
Acquisition, Logistics, and Technology
andrea.e.simmons.ctr@mail.mil

AEOP Cooperative Agreement Manager

Louie Lopez
AEOP Cooperative Agreement Manager
U.S. Army Research, Development, and
Engineering Command (RDECOM)
louie.r.lopez.civ@mail.mil

Battelle Memorial Institute – Lead Organization

David Burns
Project Director, AEOP CA
Director of STEM Innovation Networks
burnsd@battelle.org

eCM Program Administrators

Erin Lester
eCM Program Director
National Science Teachers Association
elester@nsta.org

Sue Whitsett
Principal Investigator
National Science Teachers Association
swhitsett@nsta.org

Evaluation Team Contacts – Purdue University

Carla C. Johnson, Ed.D.
Evaluation Director, AEOP CA
carlacjohnson@purdue.edu

Toni A. Sondergeld, Ph.D.
Assistant Director, AEOP CA
tonisondergeld@metriks.com

Janet B. Walton, Ph.D.
Assistant Director, AEOP CA
walton25@purdue.edu

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2 | Table of Contents

3 | Introduction

The Army Educational Outreach Program (AEOP) vision is to offer a collaborative and cohesive portfolio of Army sponsored science, technology, engineering and mathematics (STEM) programs that effectively engage, inspire, and attract the next generation of STEM talent through K-college programs and expose participants to Department of Defense (DoD) STEM careers. The consortium, formed by the Army Educational Outreach Program Cooperative Agreement (AEOP CA), supports the AEOP in this mission by engaging non-profit, industry, and academic partners with aligned interests, as well as a management structure that collectively markets the portfolio among members, leverages available resources, and provides expertise to ensure the programs provide the greatest return on investment in achieving the Army's STEM goals and objectives.

AEOP Priorities

Goal 1: STEM Literate Citizenry. Broaden, deepen, and diversify the pool of STEM talent in support of our defense industry base.

Goal 2: STEM Savvy Educators. Support and empower educators with unique Army research and technology resources.

Goal 3: Sustainable Infrastructure. Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.

This report documents the evaluation of one of the AEOP elements, the eCYBERMISSION program (eCM), which is administered on behalf of the Army by the National Science Teachers Association (NSTA). The evaluation study was performed by Purdue University in cooperation with Battelle, the Lead Organization (LO) in the AEOP CA consortium.

Program Overview

eCM is sponsored by the U.S. Army and managed by the National Science Teachers Association (NSTA). Since the program's inception in 2002, more than 175,000 students from across the United States, U.S. territories, and Department of Defense Educational Activities (DoDEA) schools worldwide have participated in eCM. The program is a web-based STEM competition designed to engage sixth- to ninth-grade students in real-world problem solving through Mission Challenges that address local community needs through the use of either scientific practices or the engineering design process. eCM teams work collaboratively to research and implement their projects, which are documented and judged via the submission of Mission Folders hosted on the eCM website. Regional winners receive an expense-paid trip to the National Judging & Educational Event (NJ&EE) in Washington, D.C.

In FY17, the five eCM regional sites registered 21,277 students, a 3% increase over the 20,607 students

who participated in FY16. Table 1 summarizes student participation by site.

Table 1. 2017 eCM State-Level Participation

State/DoDEA/ Territories	No. of Participants	State/DoDEA/ Territories	No. of Participants
AE-E	63	**NH**	0
AK	25	**NJ**	1399
AL	156	**NM**	196
AP	191	**NV**	339
AR	92	**NY**	422
AZ	749	**OH**	789
CA	1939	**OK**	27
CO	346	**OR**	20
CT	393	**PA**	183
DC	66	**PR**	35
DE	32	**RI**	43
FL	4399	**SC**	219
GA	2316	**SD**	4
GU	125	**TN**	745
HI	135	**TX**	1508
IA	107	**UT**	159
ID	2	**VA**	653
IL	275	**VT**	124
IN	115	**WA**	336
KS	79	**WI**	174
KY	46	**WV**	159
LA	14	**WY**	21
MA	128	**INTER**	4
MD	204		
ME	61	**Total Participation**	**21,277**
MI	482		
MN	168		
MO	350		
MS	152		
MT	4		
NC	70		
ND	381		
NE	53		

Table 2. 2017 eCM Student Profile				
Demographic Category	**Overall Participants**		**eCM-NJ&EE Participants**	
Participant Gender (n= 21,277)				
Female	10,816	51%	45	61%
Male	10,461	49%	29	39%
Participant Race/Ethnicity (n=21,277)				
Asian	2,145	10%	22	30%
Black or African American	2,211	10%	3	4%
Hispanic or Latino	3.953	19%	4	5%
Native American or Alaska Native	252	1%	0	0%
Native Hawaiian or Other Pacific Islander	131	1%	1	1%
White	10,163	48%	36	49%
Other race or ethnicity (self-reported, some more than 1 race)	978	5%	4	5%
Choose not to report	1.444	6%	4	5%
Participant Grade Level (n=21,277)				
6th	5129	24%	20	27%
7th	6924	33%	18	24%
8th	7534	35%	19	26%
9th	1690	8%	17	23%
Participant Eligible for Free/Reduced-Price (n=21,277)				
Yes	5,877	27%	4	5%
No	11,816	56%	62	84%
Choose not to report	30	8%	8	11%

Table 3. 2017 eCM Team Advisor Participation	
Participant Group	**No. of total Participants**
Team Advisors from DoDEA	20
Team Advisors from Home School	4
Team Advisors from Online School	4
Team Advisors Rural	117
Team Advisors Suburban	335
Team Advisors Urban	231
Choose not to report	20
No responses	62
Total	**795**

Regional participation data indicate that 51% of participants were female and 49% were male. Nearly half (48%) of students identified themselves as White with another 19% identifying themselves as

Hispanic or Latino/a. While 6% of students chose not to report their race/ethnicity, 10% identified themselves as Black or African American and 10% as Asian. Native American students comprised 1% of the students reporting their race/ethnicity, and 1% were Native Hawaiian or Pacific Islanders. Six percent chose not to report race/ethnicity. These demographics are similar to those for FY16, although there was slightly more participation by Black or African American students in FY15 (10% in FY17 as compared to 8% in FY16). Slightly over a quarter (27%) of students reported being eligible for free-or-reduced price lunch – and indicator of low socioeconomic status. These demographic data indicate that eCM was successful in attracting participation from female students—a population that is historically underserved in some STEM fields – and that eCM had limited success in providing outreach to students from historically underserved racial/ethnic groups and low-income groups. In addition to the 41% of students from suburban schools, eCM served students who regularly attended school in urban areas (28%) and rural areas (17%).

National finalists consisted of 39% males. The race/ethnicity demographics for national finalists were, from highest percentage to lowest, 47% White, 30% Asian, 5% Hispanic or Latino/a, 5% choose not to report, 5% identified as other, 4% Black or African American, and 1% Native Hawaiian or other Pacific Islander. As the competitions progressed, a proportionally higher percent of Asians participated in both regionals and nationals, while a higher population of Whites participated in regionals, but not nationals. After an initial dip in the percentage of Hispanic or Latino/a students to regionals, the percentage of this category of race/ethnicity remained the same for nationals. The opposite trend occurred for Black or African American students, who stayed constant for regional competition, but decreased for national competition.

The total cost of the 2017 eCM program was $2,980,003, including $556,746 provided in scholarships and awards. The average cost per student participant for 2017 eCM was $140.

Table 4. 2017 eCM Program Costs	
2017 eCM – Summative Cost Breakdown	
Administrative costs (includes salaries, fringe, indirect)	$1,470,332
eCYBERMISSION Mini-Grant Awards	$192,471
National Judging and Educational Event	$322,828
Scholarships and Awards	$556,746
Other Operational Costs	$437,626
Total Cost	$2,980,003
Cost per Student Participant	$140

4 | Evidence - Based Program Change

The AEOP had three key priorities for programs in FY17: (1) increase outreach to populations that are historically underserved in STEM; (2) increase participants' awareness of Army/DoD STEM careers; and (3) increase participants' awareness of other AEOP opportunities. The FY17 eCM Program Objectives and associated actions/tasks, which were developed in light of programmatic recommendations from the Army and LO, the key AEOP priorities, site visits conducted by NSTA and the LO, and the FY16 eCM evaluation study, are listed below:

I. Increase number of student and Team Advisor registrants and folder submissions

a. Exhibited and presented at 32 national, state, and regional conferences/meetings with a total attendance of 80,610. Improved outreach at conferences through strategic booth placement and targeted regional areas with low registration enrollment.
b. Sent recruiting e-blasts to past Team Advisors and conference leads.
c. Increased regular communication to registered students and Team Advisors. Communication efforts included registration and submission reminders, Mission Folder Checklist information, advertising bimonthly Live CyberGuide Chats, and improved Mission Control efforts.
d. Refined Team Advisor support with the Team Advisor Mentor Program and established a monthly Team Advisor newsletter.
e. Worked with AEOP Strategic partners to reach new audiences and market eCM program opportunities such as Mini Grant Program.
f. Met with DoDEA School Representatives.
g. Promoted the Mini-Grant opportunity to encourage districts and schools to adopt eCM as part of their curriculum.
h. Supported Ambassadors with training and materials as they recruited participants from local schools.
i. Used marketing and advertising in print and online.

II. Increase the number of paricipants from Title I schools

a. Targeted Mini-Grant outreach to Title I Schools/districts.
b. Set up meetings with district leadership and curriculum specialists in Title I districts.
c. Targeted marketing for Title I teachers.
d. Promoted Mini-Grant opportunity to schools and districts, and at national conferences.
e. Administered award program.
f. Awarded 183 Mini-Grants to Team Advisors from 87 schools with 11,573 students.
g. Met with school district officials to promote districtwide or grade-level adoption of eCM.

h. Assigned a Point of Contact for Mini-Grant awardees to support them through the competition.
i. Targeted outreach for recruiting Mini-Grant applicants to schools with high percentage underserved.
j. Worked with AEOP Strategic Outreach Initiative Partners to increase percentage.
k. Targeted conference outreach to engage with educators and community groups that serve underserved populations.

III. Increase number of volunteers and Army volunteers

a. Conducted Road Shows at CERDEC, ARDEC, NSRDEC, ARL Adelphi, CERL, and USACE HQ to promote volunteer participation as Ambassadors, CyberGuides, and Virtual Judges. Each Road Show was unique but eCM Outreach involved a volunteer registration table, information brief with leadership, and participation in community events at Army Installations. In total, 46 Army labs and Organizations supported eCYBERMISSION and participated in the Army Volunteer Incentive Program.
b. Explored opportunities to expand volunteer efforts at other branches of the military, military academies, and other government agencies.
c. Worked closely with Army Volunteer Incentive Points of Contact to secure volunteers and ensure a successful Army Volunteer Incentive effort.
d. Promoted Volunteer Opportunities at conferences, via social media and email campaigns, and through outreach to corporations, universities and colleges.
e. Collaborated with strategic partners to market volunteer opportunities.
f. Worked closely with the U.S. military to increase Virtual Judge participation.
g. Supported and further engaged volunteers through the monthly Mission Minutes newsletters, bimonthly CyberGuide Chats, Team Talk and Discussion Forums, online training materials, and personal contact via phone and email.
h. Clearly communicated volunteer roles and responsibilities to improve recruitment and retention.
i. Managed the competition judging process including the recruiting, training, and supporting pre-screeners, Virtual Judges, Regional Judges, and National Judges.
j. Pre-screeners reviewed folders in a timely manner and provided better feedback to students and Team Advisors. eCM staff supported the pre-screeners by reviewing comments posted by the pre-screeners. Virtual Judging ended on time this year. Virtual Judged posted a total of 10,311 scores and comments between March 8 and March 24, 2017. Twenty Regional Judges reviewed finalists in April and National Judges attended the National Judging & Education Event in June.

IV. Increase Team Advisor retention rate and implement programs to exceed our target rate

a. Transitioned Team Advisor mentoring program from pilot to operational to increase TA comfort level with and knowledge of the competition.
b. Updated Team Advisor resources on the website.

c. Increased the frequency of Team Advisor newsletters and Team Advisor communication overall.
d. Encouraged districts and schools to adopt eCM as part of their curriculum.
e. Reached out to Team Advisors from previous competition years to re-engage them as Team Advisors, volunteers, and mentors.
f. Provided a Team Advisor STEM Kit to all registered Team Advisors.
g. Provided personalized customer service through a specific POC for each region and Mini-Grants.

V. Increase number of classroom integrated programs

a. Recruited for, processed, and administered grant program to support schools, districts, and teachers as they implement the program.
b. Promoted Mini-Grant opportunity to schools, districts, and at national conferences.
c. Administered award program.
d. Awarded 183 Mini-Grants to Team Advisors from 87 schools with 11,573 students.
e. Met with school district officials to promote district-wide or grade-level adoption of eCM.

VI. Increase number of students from DoDEA schools:

a. Conducted targeted outreach to DoDEA schools.
b. Collaborated with Teresa Moon, Department of Defense Education Program Manager.
c. Provided eCM information to DoDEA Schools for distribution at various schools.
d. Worked with Ambassadors at OCONUS DoDEA locations to increase participation.

VII. Increase participants' awareness of other AEOP and DoD STEM opportunities and Army/DoD technologies; and increase stduent interest in STEM learning and pursuit of STEM-related degrees:

a. Coordinated and promoted 13 Live CyberGuide Chats.
b. Continued to integrate S/E into NJ&EE. During NJ&EE 3 AEOP Alumni panelists, 1 S&T Keynote, 9 S/E and NCO mentors, 9 STEM Challenge Workshop Leaders, and Award Luncheon presenters exposed students to the breadth and depth of AEOP and DoD/Army research and career opportunities.
c. Promoted AEOP opportunities through social media and blogs.
d. Encouraged student and TA use of Discussion Forms and Team Talk to connect with CyberGuides

5 | Evaluation At-A-Glance

Purdue University, in collaboration with NSTA, conducted a comprehensive evaluation of eCM. The Unite logic model below presents a summary of the expected outputs and outcomes for NSTA in relation to the AEOP and eCM-specific priorities. This logic model provided guidance for the overall eCM evaluation strategy.

Inputs	Activities	Outputs	Outcomes (Short term)	Impact (Long Term)
• NSTA providing oversight for all aspects of the competition • Students participating in state, regional and national levels competitions • STEM professionals and educators serving as Team Advisors, judges, CyberGuides, and Ambassadors • Awards for student competitors and teams. All students who submit a mission folder also receive recognition. • Centralized branding and comprehensive marketing • Centralized evaluation	• Students conduct "authentic" STEM and humanities research, often with Team Advisors • Students recognize the real-life applications of STEM • Teams of three or four students ask questions or define problems and then construct explanations or design solutions based on identified problems in their community • Team Advisors oversee the student led projects • STEM professionals judge the top 60 teams during the regional judging • Regional winners advance to the NJ&EE • Program activities that expose students to AEOP programs and/or STEM careers in the Army or DoD	• Number and diversity of student participants engaged in programs • Number and diversity of STEM professionals and educators serving as Team Advisors, CyberGuides, and Ambassadors • Number and diversity of DoD scientists and engineers and other military personnel engaged in programs • Number and Title 1 status of schools served through participant engagement • Students, Team Advisors, and NSTA contributing to evaluation	• Increased participant knowledge, skills and abilities, and confidence in STEM • Increased student interest in future STEM engagement • Increased participant awareness of and interest in other AEOP opportunities • Increased participant awareness of and interest in DoD STEM research and careers • Implementation of evidence-based recommendations to improve eCM regional and national programs	• Increased student participation in other AEOP and DoD-sponsored programs • Increased student pursuit of STEM coursework in secondary and post-secondary schooling • Increased student pursuit of STEM degrees • Increased student pursuit of STEM careers • Increased student pursuit of DoD STEM careers • Continuous improvement and sustainability of eCM

The eCM evaluation gathered information from multiple participant groups about eCM processes, resources, activities, and their potential effects in order to address key evaluation questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP

and eCM program objectives.

The assessment strategy for eCM included student and Team Advisor questionnaires, two focus groups with eCM students at the NJ&EE, one focus group with Team Advisors at the NJ&EE, observations at the NJ&EE, and the Annual Program Report (APR) prepared by NSTA. Findings are reported herein for students who competed at the regional level (referred to as Regional students, eCM-R students, or overall students, since all participants competed at this level) and for students who competed at the NJ&EE (referred to as National students, eCM-N students or NJ&EE students). Tables 5-10 outline the information collected in student and Team Advisor questionnaires and focus groups as well as information from the APR that is relevant to this evaluation report.

Key Evaluation Questions

- What aspects of eCM motivate participation?
- What aspects of eCM structure and processes are working well?
- What aspects of eCM could be improved?
- Did participation in eCM:
  - Increase student STEM competencies?
  - Increase student interest in future STEM engagement?
  - Increase student awareness of and interest in other AEOP opportunities?
  - Increase student awareness of and interest in Army/DoD STEM research and careers?

Table 5. 2017 Student Questionnaires

Category	Description
Profile	**Demographics:** Participant gender, age, grade level, race/ethnicity, and socioeconomic status indicators
	Education Intentions: Degree level, confidence to achieve educational goals, field sought
AEOP Goal 1	**Capturing the Student Experience:** In-school vs. In-program experience
	STEM Competencies: Gains in Knowledge of STEM, Science & Engineering Practices; contribution of AEOP
	Transferrable Competencies: Gains in 21st Century Skills
	STEM Identity: Gains in STEM identity, intentions to participate in STEM, and STEM-oriented education and career aspirations; contribution of AEOP
	AEOP Opportunities: Past participation, awareness of, and interest in participating in other AEOP programs; contribution of AEOP, impact of AEOP resources
	Army/DoD STEM: Exposure to Army/DoD STEM jobs, attitudes toward Army/DoD STEM research and careers, change in interest for STEM and Army/DoD STEM jobs; contribution of AEOP, impact of AEOP resources
AEOP Goal 2 and 3	**Mentor Capacity:** Perceptions of mentor/teaching strategies (students respond to a subset)
	Comprehensive Marketing Strategy: impact of AEOP resources on awareness of AEOPs and Army/DoD STEM research and careers
Satisfaction & Suggestions	Benefits to participants, suggestions for improving programs, overall satisfaction

Table 6. 2017 Mentor Questionnaires	
Category	**Description**
Profile	**Demographics:** Participant gender, race/ethnicity, occupation, past participation
Satisfaction & Suggestions	Awareness of HSAP, satisfaction with and suggestions for improving HSAP programs, benefits to participants
AEOP Goal 1	**Capturing the Student Experience:** In-program experience
	STEM Competencies: Gains in Knowledge of STEM, Science & Engineering Practices; contribution of AEOP
	Transferrable Competencies: Gains in 21st Century Skills
	AEOP Opportunities: Past participation, awareness of other AEOP programs; efforts to expose students to AEOPs, impact of AEOP resources on efforts; contribution of AEOP in changing student AEOP metrics
	Army/DoD STEM: attitudes toward Army/DoD STEM research and careers, efforts to expose students to Army/DoD STEM research/careers, impact of AEOP resources on efforts; contribution of AEOP in changing student Army/DoD career metrics
AEOP Goal 2 and 3	**Mentor Capacity:** Perceptions of mentor/teaching strategies
	Comprehensive Marketing Strategy: how mentors learn about AEOP, usefulness of AEOP resources on awareness of AEOPs and Army/DoD STEM research and careers
Satisfaction & Suggestions	Benefits to participants, suggestions for improving programs, overall satisfaction

Table 7. 2017 Student Focus Group Interviews	
Category	**Description**
Satisfaction & Suggestions	Awareness of HSAP, motivating factors for participation, awareness of implications of research topics, satisfaction with and suggestions for improving HSAP programs, benefits to participants
AEOP Goal 1 and 2 Program Efforts	**Army STEM: AEOP Opportunities –** Extent to which students were exposed to other AEOP opportunities
	Army STEM: Army/DoD STEM Careers – Extent to which students were exposed to STEM and Army/DoD STEM jobs

Table 8. 2017 Team Advisor Focus Group Interviews	
Category	**Description**
Satisfaction & Suggestions	Perceived value of HSAP, benefits to participants suggestions for improving HSAP programs
AEOP Goal 1 and 2 Program Efforts	**Army STEM: AEOP Opportunities –** Efforts to expose apprentices to AEOP opportunities
	Army STEM: Army/DoD STEM Careers – Efforts to expose students to STEM and Army/DoD STEM jobs
	Mentor Capacity: Local Educators – Strategies used to increase diversity/support diversity in HSAP

Table 9. 2017 Annual Program Report	
Category	**Description**
Program	Description of symposia categories and activities
AEOP Goal 1 and 2	**Underserved Populations:** mechanisms for marketing to and recruitment of students from underserved populations

Program Efforts	**Army STEM: Army/DoD STEM Careers –** Exposure to Army STEM research and careers (varies by regional, national event); Participation of Army engineers and/or Army research facilities in event activities (varies by regional, national event)
	Mentor Capacity: Local Educators - University faculty and student involvement, teacher involvement

Detailed information about methods and instrumentation, sampling and data collection, and analysis are described in Part Three of the Evaluation Report (separate document). The reader is strongly encouraged to review Appendix A to clarify how data are summarized, analyzed, and reported in this document. Findings of statistical and/or practical significance are noted in the report narrative, with

tables and footnotes providing results from tests for significance. Focus group protocols are provided in Appendix B (students) and Appendix C (Team Advisors); questionnaires are provided in Appendix D (Students), and Appendix E (Team Advisors). Major trends in data and analyses are reported herein.

Study Sample

Questionnaire responses were received from 438 regional eCM students, 69 national eCM students, and 72 adults participating in eCM. Table 10 shows the number of student and adult respondents by site.

Table 10. 2017 ECM Site Survey Respondent Numbers

2017 ECM Site	R-ECM Students		N-ECM Students		Adults/Team Advisors	
	No. of Participants	No. (percentage) of Survey Respondents	No. of Participants	No. (percentage) of Survey Respondents	No. of Participants	No. (percentage) of Survey Respondents
Alabama	156	2 (0.71%)	3	1 (1.72%)	1	1 (3.57%)
Alaska	25	0 (0.00%)	0	0 (0.00%)	0	0 (0.00%)
Arizona	749	34 (12.10%)	0	0 (0.00%)	0	0 (0.00%)
Arkansas	92	0 (0.00%)	0	0 (0.00%)	0	2 (7.14%)
California	1939	25 (8.9%)	7	5 (8.62%)	2	5 (17.86%)
Colorado	346	0 (0.00%)	3	1 (1.72%)	1	0 (0.00%)
Connecticut	393	0 (0.00%)	0	0 (0.00%)	0	0 (0.00%)
DoD Schools-Europe	Not provided	0 (0.00%)	0	0 (0.00%)	0	0 (0.00%)
DoD Schools-Pacific	Not provided	6 (2.14%)	0	0 (0.00%)	0	0 (0.00%)
District of Columbia	66	0 (0.00%)	0	0 (0.00%)	0	0 (0.00%)
Florida	4399	11 (3.91%)	4	4 (6.90%)	1	2 (7.14%)
Georgia	2316	11 (3.91%)	0	0 (0.00%)	0	0 (0.00%)
Hawaii	135	3 (1.07%)	4	2 (3.45%)	1	1 (3.57%)
Illinois	275	1 (0.36)	3	3 (5.17%)	1	2 (7.14%)

Indiana	115	25 (8.90%)	0	0 (0.00%)	0	0 (0.00%)
Iowa	107	0 (0.00%)	0	0 (0.00%)	0	0 (0.00%)
Kentucky	46	0 (0.00%)	0	0 (0.00%)	0	0 (0.00%)
Louisiana	14	11 (3.91%)	0	0 (0.00%)	0	0 (0.00%)
Maine	61	0 (0.00%)	0	0 (0.00%)	0	1 (3.57%)
Maryland	204	0 (0.00%)	0	0 (0.00%)	0	0 (0.00%)
Massachusetts	128	0 (0.00%)	4	3 (5.17%)	1	0 (0.00%)
Michigan	482	0 (0.00%)	7	6 (10.34%)	2	1 (3.57%)
Missouri	152	5 (1.78%)	0	0 (0.00%)	0	2 (7.14%)
New Jersey	1399	1 (0.36%)	0	0 (0.00%)	0	0 (0.00%)
New Mexico	196	0 (0.00%)	7	5 (8.62%)	2	0 (0.00%)
New York	422	46 (16.37%)	10	9 (15.52%)	3	2 (7.14%)
North Carolina	70	0 (0.00%)	7	7 (12.07%)	2	0 (0.00%)
Ohio	789	0 (0.00%)	3	2 (3.45%)	1	2 (7.14%)
Oregon	20	0 (0.00%)	3	2 (3.45%)	1	0 (0.00%)
Pennsylvania	183	9 (3.20%)	0	0 (0.00%)	0	2 (7.14%)
Puerto Rico	35	0 (0.00%)	0	0 (0.00%)	0	0 (0.00%)
Rhode Island	43	5 (1.78%)	0	0 (0.00%)	0	0 (0.00%)
South Carolina	219	12 (4.27%)	0	0 (0.00%)	0	0 (0.00%)
Tennessee	745	2 (0.71%)	0	0 (0.00%)	0	0 (0.00%)
Texas	1508	2 (0.71%)	4	4 (6.90%)	1	4 (14.29%)
Utah	159	60 (21.35%)	0	0 (0.00%)	0	0 (0.00%)
Vermont	124	1 (0.36%)	0	0 (0.00%)	0	0 (0.00%)
Virginia	653	1 (0.36%)	4	4 (6.90%)	1	1 (3.57%)
Washington	336	0 (0.00%)	0	0 (0.00%)	0	0 (0.00%)
West Virginia	159	0 (0.00%)	0	0 (0.00%)	0	0 (0.00%)
Wisconsin	174	0 (0.00%)	0	0 (0.00%)	0	0 (0.00%)
Wyoming	21	0 (0.00%)	0	0 (0.00%)	0	0 (0.00%)
Did Not Report	NA	166 (59.07%)	NA	11 (18.97%)	NA	44 (61.11%)
Total		**438**	**73**	**69**	**21**	**72**

Table 11 provides an analysis of student and Team Advisor participation in the eCM questionnaires, the response rate, and the margin of error at the 95% confidence level (a measure of how representative the sample is of the population). The margin of error for both Team Advisor surveys is larger than generally acceptable, indicating that the sample may not be representative of the overall population.

Table 11. 2017 eCM Questionnaire Participation				
Participant Group	**Respondents (Sample)**	**Total Participants (Population)**	**Participation Rate**	**Margin of Error @ 95% Confidence[1]**
eCM-R Students	438	21,277	2.06%	±4.63%
eCM-N Students	69	73	94.5%	±2.78%
Team Advisors	72	792	9.1%	±11.02%

Focus groups were conducted at the NJ&EE in Washington, DC. The two student focus groups included 21 students in grades 6 to 9, including 8 males and 13 females. One adult focus group was also conducted at the NJ&EE, which included 20 adults, including 10 males and 10 females. Focus groups were not intended to yield generalizable findings; rather they were intended to provide additional evidence of, explanation for, or illustrations of questionnaire data. They add to the overall narrative of eCM's efforts and impact, and highlight areas for future exploration in programming and evaluation.

Respondent Profiles

Apprentice Demographics

Table 12 provides an overview demographic information collected from FY17 eCM questionnaire respondents. Gender data for only 266 of the overall questionnaire were available. Of these 266, half were female and half were male. Slightly more than half of respondents to the eCM-NJ&EE questionnaire (55%) were female and 45% were male. Similar to 2016 respondents, more eCM respondents identified with the race/ethnicity category of White (59.68%) than any other single race/ethnicity category. Survey participants who competed at the NJ&EE were predominantly White (49.28%) and Asian (26.09%). However, there was some representation of Hispanic or Latino populations overall (11.39%) and also for respondents who participated at the NJ&EE (5.80%). Nearly half (41.23%) of overall respondents were 9th graders. Most questionnaire respondents reported that they did not qualify for free or reduced-price lunch (FRL)—a common indicator of low-income status (67.12% overall and 81.16% of NJ&EE participants). A majority of respondents overall attended suburban schools (65.50%) and nearly a third attended urban schools (30.13%).

Survey respondent demographic composition was somewhat different when comparing the overall respondents to the NJ&EE respondents. Students reporting an Asian race/ethnicity had an increased

[1] "Margin of error @ 95% confidence" means that 95% of the time, the true percentage of the population who would select an answer lies within the stated margin of error. For example, if 47% of the sample selects a response and the margin of error at 95% confidence is calculated to be 5%, if you had asked the question to the entire population, there is a 95% likelihood that between 42% and 52% would have selected that answer. A 2-5% margin of error is generally acceptable at the 95% confidence level.

representation from overall (10.93%) to NJ&EE (26.09%), whereas Native American or Alaska Native, and Native Hawaiian or Other Pacific Islander representation was quite low overall and dropped to none for NJ&EE (0.23% to 0.00%, and 0.68% to 0.00%, respectively). Students reporting as being Black or African American, Hispanic or Latino/a, and White experienced decreased participation from overall to NJ&EE (5.01% to 4.35%, 11.39% to 5.80% and 59.68% to 49.28%, respectively). In FY17 eCM and NJ&EE participants reported participating in multiple other AEOPs such as Camp Invention (eCM=13, NJ&EE=1), GEMS (eCM=6, NJ&EE=0), JSHS (eCM=2, NJ&EE), and JSS (eCM=2, NJ&EE=0). Additionally, 16 NJ&EE participants and 34 overall participants reported past participation in eCM.

Table 12. 2017 eCM Student Respondent Profile

Demographic Category	eCM Questionnaire Respondents		eCM-NJ&EE Questionnaire Respondents	
Respondent Gender (eCM n = 266, eCM NJ&EE n =57)				
Female	133	50.00%	32	56.14%
Male	133	50.00%	25	43.86%
Choose not to report	0	0.00%	0	0.00%
Respondent Race/Ethnicity (eCM n = 438, eCM NJ&EE n = 69)				
Asian	48	10.93%	18	26.09%
Black or African American	22	5.01%	3	4.35%
Hispanic or Latino	50	11.39%	4	5.80%
Native American or Alaska Native	1	0.23%	0	0.00%
Native Hawaiian or other Pacific Islander	3	0.68%	0	0.00%
White	262	59.68%	34	49.28%
Other race or ethnicity (specify):[†]	17	3.87%	4	5.80%
Choose not to report	35	8.20%	6	8.70%
Respondent Grade Level (eCM n = 438, eCM NJ&EE n = 69)				
6th	24	5.47%	5	7.25%
7th	112	25.51%	13	18.84%
8th	102	23.23%	18	26.09%
9th	181	41.23%	18	26.09%
Other	19	4.56%	15	21.74%
Respondent Eligible for Free/Reduced-Price Lunch (eCM n = 438, eCM NJ&EE n = 69)				
Yes	88	20.09%	9	13.04%
No	294	67.12%	56	81.16%
Choose not to report	56	12.79%	4	5.80%

[†] Other = Asian and White; mixed: black and white; Mixed (3); White, Asian, African American; Asian Indian; African American and White; Filipino; Arab; Asian and Hispanic; Haitian, French and Turkish; Italian, Filipino; Caucasian, Indian; White/European; Black, Mexicano; Multiracial; Cocasian/Asian; Indian and Greek; Indian-American; Mexican American

Team Advisor Demographics

Table 13 summarizes the 2017 Adult/Team Advisor demographic information. With regard to gender, more responding Team Advisors were male than female (70.42% vs. 28.17%). As with the responding students, most of the responding Team Advisors identified themselves as White (76.06%). The majority of the Team Advisors were teachers (81.69%). Many Team Advisors responded in more than one category for the question about their role, with Competition Advisor being the most frequently chosen response (64.56%), followed by Teacher (60.568%), and Research Mentor (8.45%).

Table 13. 2017 eCM Adult Respondent Profile

Demographic Category	Questionnaire Respondents	
Respondent Gender (n = 71)		
Female	20	28.17%
Male	50	70.42%
Choose not to report	1	1.14%
Respondent Race/Ethnicity (n = 71)		
Asian	9	12.68%
Black or African American	2	2.28%
Hispanic or Latino	2	2.28%
Native American or Alaska Native	0	0.00%
Native Hawaiian or other Pacific Islander	0	0.00%
White	54	76.06%
Other race or ethnicity, (specify):†	2	2.28%
Choose not to report	2	2.28%
Respondent Occupation (n = 71)		
Teacher	58	81.69%
Other school staff	2	2.82%
University educator	2	2.82%
Scientist, Engineer, or Mathematician in training (undergraduate or graduate student, etc.)	1	1.41%
Scientist, Engineer, or Mathematics professional	2	2.82%
Other, (specify):‡	6	8.45%
Respondent Role in eCM (n = 71)*		
Research Mentor	6	8.45%
Competition advisor	46	64.79%
Teacher	43	60.56%
Other, (specify)§	0	0.00%

*Note: Some adults selected more than one option for this response, resulting in than 100% response rate for this item.

‡ No responses provided.

6 | Actionable Program Evaluation

The Actionable Program Evaluation is intended to provide assessment and evaluation of program processes, resources, and activities for the purpose of recommending improvements as the program moves forward. This section highlights information outlined in the Satisfaction & Suggestions sections of Tables 5-10. A focus of the Actionable Program Evaluation is efforts toward the long-term goal of eCM and all of the AEOP to increase and diversify the future pool of talent capable of contributing to the nation's scientific and technology progress. eCM Team Advisors and volunteers are engaged in outreach efforts to identify underserved populations who are capable of succeeding in eCM. Thus, it is important to consider how eCM is marketed and the factors that motivate students to participate in eCM, participants' perceptions of and satisfaction with activities, what value participants place on program activities, and what recommendations participants have for program improvement. The following sections report student and Team Advisor perceptions that pertain to current programmatic efforts and recommend evidence-based improvements to help eCM achieve outcomes related to AEOP programs and objectives—specifically, to help eCM continue to expand participation from and support STEM education for students from underserved groups.

Marketing and Recruiting Underserved Populations

eCM recruits Team Advisors who engage in outreach activities specifically targeted to recruiting populations underserved in STEM careers. These efforts are largely developed and implemented at a local level. Other recruitment methods undertaken by NSTA in 2017 included:

- Targeted Mini-Grant outreach to Title I Schools/districts.
- Set up meetings with district leadership and curriculum specialists in Title I districts.
- Targeted marketing for Title I teachers.
- Targeted outreach for recruiting Mini-Grant applicants to schools with high percentage U/U.
- Worked with AEOP Strategic Outreach Initiative Partners to increase percentage.
- Targeted conference outreach to engage with educators and community groups that serve U/U populations.
- Exhibited and presented at 32 national, state, and regional conferences/meetings with a total attendance of 80,610. Improved outreach at conferences through strategic booth placement and target regional areas with low registration enrollment.
- Worked with AEOP Strategic partners to reach new audiences and market eCM program opportunities such as Mini Grant Program.
- Promoted the Mini-Grant opportunity to encourage districts and schools to adopt eCM as part

of their curriculum.

In order to determine what recruitment methods are most effective, students were asked to indicate all of the ways they learned about eCM. As seen in Tables 14N and 14R, large proportions of students learned about eCM from someone who works at the school they attend (eCM-R=46.95%, eCM-N=53.70%). Other frequently chosen sources of information about eCM were friends (eCM-R=4.96%, eCM-N=38.89%), family members (eCM-R=3.43%, eCM-N=24.07%), and a past participant (eCM-R=6.87%, eCM-N=22.22%). Fewer than 10% of students learned about eCM from the other sources listed. It should be noted, however, that nearly a quarter of Regional students (24.43%) chose not to report how they learned about eCM.

Table 14N. How National Students Learned about eCM (n=54)

Choice	Response Percent	Response Total
Army Educational Outreach Program (AEOP) Website	3.70 %	2
AEOP on Facebook, Twitter, Instagram, or other social media	0.00 %	0
School or university newsletter, email, or website	0.00 %	0
Past participant of program	22.22 %	12
Friend	38.89 %	21
Family Member	24.07 %	13
Someone who works at the school or university I attend	53.70 %	29
Someone who works with the program	0.00 %	0
Someone who works with the Department of Defense (Army, Navy, Air Force, etc.)	0.00 %	0
Community group or program	7.40 %	4
Choose Not to Report	1.85 %	1

14R. How Regional eCM Students Learned about eCM (n=262)

Choice	Response Percent	Response Total
Army Educational Outreach Program (AEOP) Website	0.76 %	2
AEOP on Facebook, Twitter, Instagram, or other social media	0.00 %	0
School or university newsletter, email, or website	0.00 %	0
Past participant of program	6.87 %	18

Friend	4.96 %	13
Family Member	3.43 %	9
Someone who works at the school or university I attend	46.95 %	123
Someone who works with the program	0.00 %	0
Someone who works with the Department of Defense (Army, Navy, Air Force, etc.)	0.00 %	0
Community group or program	3.05 %	8
Choose Not to Report	24.43 %	64

These findings were echoed in focus groups where students primarily reported learning about eCM through a parent, a teacher, or friends and some commented that they believed the program should engage in additional outreach efforts. Several focus group participants indicated that they had participated in eCM as a school requirement and therefore learned about eCM from their teachers or Team Advisors. For example:

> *I think eCM or AEOP could definitely do a better job of just getting themselves out there. The only reason a lot of people hear about it is through school, through heir teachers, or even through friends sometimes. A lot of people still don't know what it is or what their [AEOP's} programs are.* (e-CM NJ&EE Student)

> *I come from a small school and we don't have that many STEM opportunities. My mom and I were researching some of these opportunities, and we found [eCM]. We though it was really cool, so I signed up with my teammates.* (e-CM NJ&EE Student)

> *My whole research class entered into the competition because my teacher had done it in past years…It went along with the projects we were doing.* (e-CM NJ&EE Student)

Factors Motivating Apprentice Participation

Tables 15N and 15R display the factors that motivated students to participate in eCM. The top two reasons for participating varied between overall eCM participants and NJ&EE participants. Regional eCM participants reported external factors such as teacher or professor encouragement (41.43%) and an academic requirement or school grade (38.65%). In contrast, NJ&EE participants' top two reasons were more internally driven: the desire to learn something new or interesting (40.74%) and having fun (37.04%). It should be noted, however, that over a quarter (27%) of Regional students chose not to report their motivation for participating.

Students participating in focus group had a variety of motivations for participating. Some were

motivated to participate by their teachers and course requirements while others reported that they participated because of the problem solving opportunities, to have fun, and to learn. Others indicated that they participated because of the low cost and because of parent encouragement. For example:

> *I participated in this because it seemed really fun, working in a team on a science project that you get to think of your own idea for.* (eCM-N Student)

> *I participated in this because I saw it as a chance to actually be able to solve a real world problem and have an impact on our world.* (eCM-N Student)

> *My team's reason [for participating] was because farming and making sure the soil is healthy has always really been our way of life [and] because that's something that most of us will grow up to be doing.* (eCM-N Student)

Table 15N. Factors Motivating National Students to Participate in eCM (n=54)

Choice	Response Percent	Response Total
Teacher or professor encouragement	24.07 %	13
An academic requirement or school grade	18.52 %	10
Desire to learn something new or interesting	40.74 %	22
The mentor(s)	0.00 %	0
Building college application or résumé	0.00 %	0
Networking opportunities	1.85 %	1
Interest in science, technology, engineering, or mathematics (STEM)	0.00 %	0
Interest in STEM careers with the Army	5.56 %	3
Having fun	37.04 %	20
Earning stipends or awards for doing STEM	3.70 %	2
Opportunity to do something with friends	18.52 %	10
Opportunity to use advanced laboratory technology	3.70 %	2
Desire to expand laboratory or research skills	7.41 %	4
Learning in ways that are not possible in school	7.41 %	4
Serving the community or country	11.11 %	6
Exploring a unique work environment	3.70 %	2

Figuring out education or career goals	3.70 %	2
Seeing how school learning applies to real life	12.96 %	7
Recommendations of past participants	5.56 %	3
Choose Not to Report	1.85 %	1

Table 15R. Factors Motivating Regional Students to Participate in eCM (n=251)

Choice	Response Percent	Response Total
Teacher or professor encouragement	41.43 %	104
An academic requirement or school grade	38.65 %	97
Desire to learn something new or interesting	19.52 %	49
The mentor(s)	3.98 %	10
Building college application or résumé	0.00 %	0
Networking opportunities	0.80 %	2
Interest in science, technology, engineering, or mathematics (STEM)	0.40 %	1
Interest in STEM careers with the Army	0.80 %	2
Having fun	31.87 %	80
Earning stipends or awards for doing STEM	3.19 %	8
Opportunity to do something with friends	11.55 %	29
Opportunity to use advanced laboratory technology	2.79 %	7
Desire to expand laboratory or research skills	3.59 %	9
Learning in ways that are not possible in school	5.18 %	13
Serving the community or country	9.16 %	23
Exploring a unique work environment	5.98 %	15
Figuring out education or career goals	3.19 %	8
Seeing how school learning applies to real life	6.37 %	16
Recommendations of past participants	3.59 %	9
Choose Not to Report	27.49 %	69

The eCM Experience

Increasing both the number and diversity of students who pursue STEM careers is a goal of the AEOP. Therefore, the student questionnaire asked participants to report how many STEM jobs/careers in general as well as DoD STEM jobs/careers more specifically they learned about during their eCM experience. Tables 16N and 16R illustrate that 65.75% of the overall eCM students and all NJ&EE students reported learning about at least one STEM job/career. While over three-quarters (76.81%) of NJ&EE students reported learning about five or more STEM jobs/careers while only 11.64% of overall eCM students had learned about this number of STEM jobs/careers.

Table 16N. Number of STEM Jobs/Careers National Students Learned About During eCM (n =69)

Choice	Response Percent	Response Total
None	0.00 %	0
1	0.00 %	0
2	2.90 %	2
3	10.14 %	7
4	10.14 %	7
5 or more	76.81 %	53

Table 16R. Number of STEM Jobs/Careers Regional Students Learned About During eCM (n =438)

Choice	Response Percent	Response Total
None	34.25 %	150
1	15.98 %	70
2	18.26 %	80
3	15.30 %	67
4	4.57 %	20
5 or more	11.64 %	51

Tables 17N and 17R show that while all NJ&EE students reported learning about at least one DoD STEM job/career, only 31.50% of overall eCM students had learned about any DoD STEM jobs/careers. Likewise, only 3.42% of overall eCM students reported learning about 5 or more different STEM jobs/careers in the DoD while, in contrast, 68.12% of NJ&EE participants reported learning about five or more STEM DoD STEM jobs/careers.

Table 17N. Number of DoD STEM Jobs/Careers National Students Learned About During eCM (n =69)

Choice	Response Percent	Response Total

None	0.00 %	0
1	1.45 %	1
2	4.35 %	3
3	17.39 %	12
4	8.70 %	6
5 or more	68.12 %	47

Table 17R. Number of DoD STEM Jobs/Careers Regional Students Learned About During eCM (n =438)

Choice	Response Percent	Response Total
None	68.49 %	300
1	11.42 %	50
2	7.76 %	34
3	7.76 %	34
4	1.14 %	5
5 or more	3.42 %	15

NJ&EE students participating in focus groups were also asked about whether they had learned about STEM career opportunities in the DoD and how they had learned about those careers during eCM. Students responded enthusiastically about the speakers at the NJ&EE providing exposure to DoD STEM careers and several students expressed interest in pursuing careers with the Army or DoD themselves. For example:

> *I've always wanted to pursue STEM as a career, but when I came here I saw a lot of the opportunities that the Army has to offer. I think that a lot of the engineers here are really impressive people. Now I'm starting to realize that the Army is a really great place to pursue a STEM career.* (eCM-NJ&EE student)

> *I never really thought of pursuing STEM because it seemed like a job where you had to sit behind a desk and type on a computer…After doing eCM and talking to the Army officers and everyone, it makes it seem like there are so many more opportunities*. (eCM-NJ&EE student)

> *I learned about Army STEM through all the speakers that were here, and I might pursue being in the Army*. (eCM-NJ&EE student)

Students were also asked how often they engaged in various STEM practices in eCM. Tables 18N and 18R show that the majority of students had engaged in all STEM practices and all NJ&EE students

reported solving real world problems in eCM. In general, eCM fewer overall, or regional, participants reported having engaged in these STEM practices than NJ&EE participants. Table 18R shows that some eCM Regional students reported participating in all of the STEM practices everyday including working collaboratively as a team (23.1%) and solving real world problems (17.1%). Large majorities of overall eCM students reported engaging in practices such as designing their own research or investigation based on their own questions (78.8%), and using laboratory procedures or tools (76%) at least once during eCM. Between 8.0% and 63.9% of regional eCM students reported that they had not engaged in the STEM practices at all during eCM.

A composite score was calculated for this set of items, titled "Engaging in STEM Practices in eCM."[2] Response categories were converted to a scale of 1 = "Not at all" to 5 = "Every day" and the average across all items in the scale was calculated. The composite score was used to test whether there were differences in student experiences by completion level (national vs. regional, race/ethnicity group (minority vs. non-minority students), and Socioeconomic Status (SES – Free/Reduced Lunch vs. Regular Lunch). Significant group differences were found in terms of Engaging with STEM Practices in eCM for competition level, race/ethnicity, and SES. National completion level students reported significantly higher engagement in STEM practices in eCM than Regional level students[3] (moderate effect size of d = 0.637). Minority students reported significantly higher levels compared to non-minority students[4] (small effect of d = 0.218 standard deviations). Low-SES students reported significantly higher levels compared to non-free/reduced lunch students[5] (small effect size of d = 0.260).

To examine how the eCM experience compares to their typical school experience, students were asked how often they engaged in the same activities in school. Students reported significantly greater Engagement with STEM in eCM than in school[6] (moderate effect of d = 0.462 standard deviations) students (see Chart 1).

[2] The Cronbach's alpha reliability for these 11 items was 0.868.
[3] Two-tailed independent samples t-test: $t(505) = 7.16$, $p < .0001$.
[4] Two-tailed independent samples t-test: $t(463) = 2.35$, $p = 0.019$.
[5] Two-tailed independent samples t-test: $t(445) = 2.76$, $p = .006$.
[6] Two-tailed dependent samples t-test: $t(506) = 5.20$, $p < 0.001$.

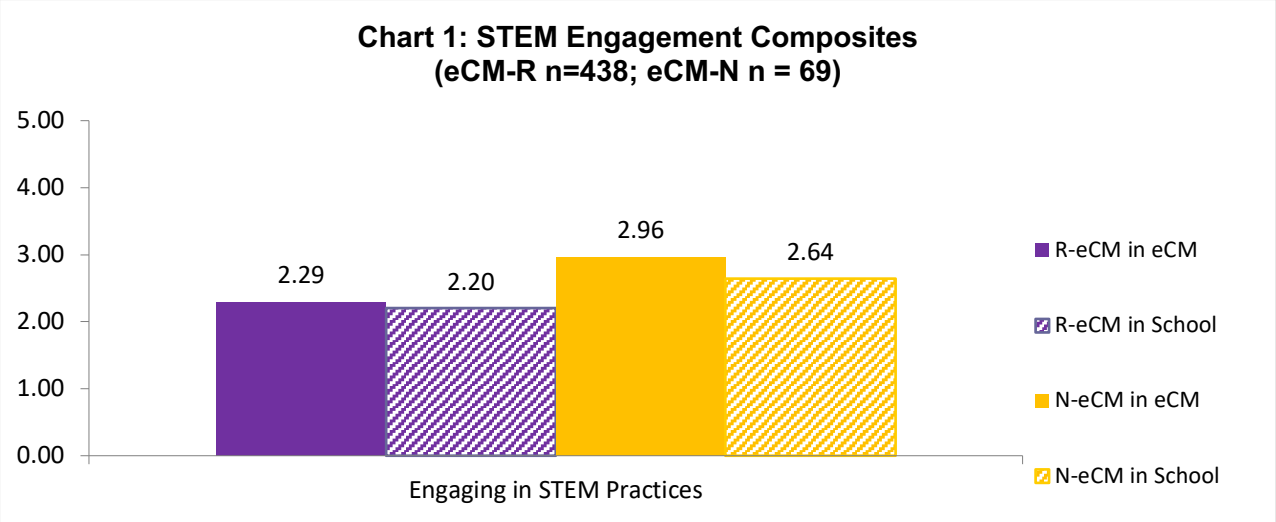

Table 18N. STEM Engagement for eCM National Respondents (n=69)

	Not at all	At least once	Monthly	Weekly	Every day	Response Total
Work with a STEM researcher or company on a real-world STEM research project	21.7%	42.0%	13.0%	8.7%	14.5%	
	15	29	9	6	10	**69**
Work with a STEM researcher on a research project topic assigned by my teacher	33.3%	40.6%	17.4%	1.4%	7.2%	
	23	28	12	1	5	**69**
Design my own research or investigation based on my own question(s)	5.8%	42.0%	23.2%	7.2%	21.7%	
	4	29	16	5	15	**69**
Present my STEM research to a panel of judges from industry or the military	10.1%	69.6%	8.7%	2.9%	8.7%	
	7	48	6	2	6	**69**
Interact with STEM researchers	11.6%	46.4%	26.1%	4.3%	11.6%	
	8	32	18	3	8	**69**
Use laboratory procedures or tools	5.8%	20.3%	30.4%	20.3%	23.2%	
	4	14	21	14	16	**69**
Identify questions or problems to investigate	1.4%	20.3%	23.2%	24.6%	30.4%	
	1	14	16	17	21	**69**
Design and carry out an investigation	1.4%	30.4%	24.6%	23.2%	20.3%	
	1	21	17	16	14	**69**

Analyze data or information and draw conclusions	2.9%	20.3%	24.6%	26.1%	26.1%	
	2	14	17	18	18	**69**
Work collaboratively as part of a team	1.4%	10.1%	11.6%	26.1%	50.7%	
	1	7	8	18	35	**69**
Build or make a computer model	31.9%	40.6%	11.6%	11.6%	4.3%	
	22	28	8	8	3	**69**
Solve real world problems	0.0%	29.0%	15.9%	18.8%	36.2%	
	0	20	11	13	25	**69**

Table 18R. STEM Engagement for eCM Regional Respondents (n=438)

	Not at all	**At least once**	**Monthly**	**Weekly**	**Every day**	**Response Total**
Work with a STEM researcher or company on a real-world STEM research project	56.2%	26.7%	7.1%	6.8%	3.2%	
	246	117	31	30	14	**438**
Work with a STEM researcher on a research project topic assigned by my teacher	46.8%	32.2%	9.8%	8.7%	2.5%	
	205	141	43	38	11	**438**
Design my own research or investigation based on my own question(s)	21.2%	43.4%	14.4%	16.4%	4.6%	
	93	190	63	72	20	**438**
Present my STEM research to a panel of judges from industry or the military	63.9%	28.5%	3.4%	3.4%	0.7%	
	280	125	15	15	3	**438**
Interact with STEM researchers	54.3%	28.1%	5.5%	8.2%	3.9%	
	238	123	24	36	17	**438**
Use laboratory procedures or tools	23.7%	35.2%	21.7%	14.2%	5.3%	

	104	154	95	62	23	**438**
Identify questions or problems to investigate	10.0%	39.5%	19.4%	23.5%	7.5%	
	44	173	85	103	33	**438**
Design and carry out an investigation	14.8%	37.7%	22.6%	19.6%	5.3%	
	65	165	99	86	23	**438**
Analyze data or information and draw conclusions	8.2%	32.0%	23.3%	25.1%	11.4%	
	36	140	102	110	50	**438**
Work collaboratively as part of a team	8.0%	22.1%	16.4%	30.4%	23.1%	
	35	97	72	133	101	**438**
Build or make a computer model	57.5%	28.1%	7.1%	5.3%	2.1%	
	252	123	31	23	9	**438**
Solve real world problems	16.0%	34.9%	14.2%	17.8%	17.1%	
	70	153	62	78	75	**438**

The Role of Team Advisors/Adults

Team Advisors and other adults play a critical role in the eCM program. Adults/Team Advisors provide one-on-one support to students, chaperone students, advise students on educational and career paths, may provide opportunities for students to use laboratory space and/or equipment, and generally serve as STEM role models for eCM students. Adults responding to a questionnaire item asking how many students they worked with reported working with a range of 3-300 students with an average of 46 students per adult. Adults were asked whether or not they used a number of strategies when working with students. These strategies comprised five main areas of effective team advising:[7]

[7] Mentoring strategies examined in the evaluation were best practices identified in various articles including:

1. Establishing the relevance of learning activities;
2. Supporting the diverse needs of students as learners;
3. Supporting students' development of collaboration and interpersonal skills;
4. Supporting students' engagement in "authentic" STEM activities; and
5. Supporting students' STEM educational and career pathways.

Adults were asked to respond to questionnaire items asking them whether they used strategies associated with effective team advising. Tables 19-23 display these responses and show that the majority of adults reported using strategies associated with effective team advising.

Table 19 shows that a majority of responding adults used multiple strategies to establish the relevance of learning activities to students. For example, giving students real-life problems to investigate or solve, and helping students understand how STEM can help them improve their own community were reported as being used by nearly all Team Advisors (90.1%). The strategy used least often was selecting readings or activities that relate to students' backgrounds (52.1%).

Table 19. Team Advisors Using Strategies to Establish the Relevance of Learning Activities (n = 71)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Become familiar with my student(s) background and interests at the beginning of the JSHS experience	73.2%	26.8%	
	52	19	**71**
Giving students real-life problems to investigate or solve	90.1%	9.9%	
	64	7	**71**
Selecting readings or activities that relate to students' backgrounds	52.1%	47.9%	
	37	34	**71**

Maltese, A. V., & Tai, R. H. (2011). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among US students. *Science Education*, *95*(5), 877-907.

Ornstein, A. (2006). The frequency of hands-on experimentation and student attitudes toward science: A statistically significant relation (2005-51-Ornstein). *Journal of Science Education and Technology*, *15*(3-4), 285-297.

Sadler, P. M., Sonnert, G., Hazari, Z., & Tai, R. (2012). Stability and volatility of STEM career interest in high school: A gender study. *Science Education*, *96*(3), 411-427.

Encouraging students to suggest new readings, activities, or projects	76.1%	23.9%	
	54	17	**71**
Helping students become aware of the role(s) that STEM plays in their everyday lives	88.7%	11.3%	
	63	8	**71**
Helping students understand how STEM can help them improve their own community	90.1%	9.9%	
	64	7	**71**
Asking students to relate real-life events or activities to topics covered in eCybermission	84.5%	15.5%	
	60	11	**71**

Adult respondents also reported using a variety of strategies to support the diverse needs of students as learners. As can be seen in Table 20, almost all Team Advisors reported using a variety of teaching and/or mentoring activities to meet the needs of all students (93.0%) while a large majority used the strategy of interacting with students and other personnel the same way regardless of their background (87.3%). The least used strategy for supporting diverse needs of learners was highlighting underrepresentation of women and racial/ethnic minority populations in STEM (56.3%).

Table 20. Team Advisors Using Strategies to Support the Diverse Needs of Learners (n = 71)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Identify the different learning styles that my student (s) may have at the beginning of the JSHS experience	64.8%	35.2%	
	46	25	**71**
Interact with students and other personnel the same way regardless of their background	87.3%	12.7%	
	62	9	**71**
Use a variety of teaching and/or mentoring activities to meet the needs of all students	93.0%	7.0%	
	66	5	**71**
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	66.2%	33.8%	
	47	24	**71**
Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	62.0%	38.0%	
	44	27	**71**
Directing students to other individuals or programs for additional	74.6%	25.4%	

support as needed	53	18	**71**
Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	56.3%	43.7%	
	40	31	**71**

Team Advisors also used a variety of strategies to support students' development of collaboration and interpersonal skills (see Table 21). For example, 94.4% of respondents had students listen to the ideas of others with an open mind; 88.7% of Team Advisors had students give and receive constructive feedback with others; 84.5% had students exchange ideas with others whose backgrounds or viewpoints are different from their own; and 83.1% had students explain difficult ideas to others.

Table 21. Team Advisors Using Strategies to Support Participant Development of Collaboration and Interpersonal Skills (n = 71)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Having participant(s) tell other people about their backgrounds and interests	60.6%	39.4%	
	43	28	**71**
Having participant(s) explain difficult ideas to others	83.1%	16.9%	
	59	12	**71**
Having participant(s) listen to the ideas of others with an open mind	94.4%	5.6%	
	67	4	**71**
Having participant(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	84.5%	15.5%	
	60	11	**71**
Having participant(s) give and receive constructive feedback with others	88.7%	11.3%	
	63	8	**71**

Next, Team Advisors were asked to indicate what strategies they used to support student engagement in authentic STEM activities (Table 22). Three-quarters or more of respondents indicated they employed all of the strategies on the survey. Almost all Team Advisors reported allowing participant(s) to work independently to improve their self-management abilities (94.4%); providing participant(s) with constructive feedback to improve their STEM competencies (90.1%); and supervising participant(s) while they practice STEM research skills (90.1%).

Table 22. Team Advisors Using Strategies to Support Participant Engagement in Authentic STEM Activities (n = 71)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Teaching (or assigning readings) about specific STEM subject matter	76.1%	23.9%	
	54	17	**71**
Having participant(s) search for and review technical research to support their work	87.3%	12.7%	
	62	9	**71**
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	74.6%	25.4%	
	53	18	**71**
Supervising participant(s) while they practice STEM research skills	90.1%	9.9%	
	64	7	**71**
Providing participant(s) with constructive feedback to improve their STEM competencies	90.1%	9.9%	
	64	7	**71**
Allowing participant(s) to work independently to improve their self-management abilities	94.4%	5.6%	
	67	4	**71**

Finally, Team Advisors were asked to report on the Advising strategies they used to support students' STEM educational and career pathways (see Table 23). Responses indicate that these strategies were used by fewer Advisors than any of the other previous strategy sets, although more than two-thirds of respondents reported using strategies such as asking students about their educational and career interests (66.2%), and providing guidance to students about educational pathways that would prepare them for a STEM career (73.2%).

Since a goal of the AEOP is to increase participants' awareness of DoD STEM career opportunities, it is important to note that less than a third of adults (29.6%) indicated they discussed STEM career opportunities within the DoD or other government agencies. Similarly, while an AEOP goal is to increase participants' awareness of AEOP opportunities, only 31.0% of adults reported recommending other AEOPs that align with student goals.

Table 23. Team Advisors Using Strategies to Support Participant STEM Educational and Career Pathways (n = 71)

	Yes - I used this strategy	No - I did not use this strategy	Response Total
Asking participant(s) about their educational and/or career goals	66.2%	33.8%	
	47	24	**71**
Recommending extracurricular programs that align with participants' goals	62.0%	38.0%	
	44	27	**71**
Recommending Army Educational Outreach Programs that align with participants' goals	31.0%	69.0%	
	22	49	**71**
Providing guidance about educational pathways that will prepare participant(s) for a STEM career	73.2%	26.8%	
	52	19	**71**
Discussing STEM career opportunities within the DoD or other government agencies	29.6%	70.4%	
	21	50	**71**
Discussing STEM career opportunities in private industry or academia	57.7%	42.3%	
	41	30	**71**
Discussing the economic, political, ethical, and/or social context of a STEM career	45.1%	54.9%	
	32	39	**71**
Recommending student and professional organizations in STEM to my student(s)	50.7%	49.3%	
	36	35	**71**
Helping participant(s) build a professional network in a STEM field	33.8%	66.2%	
	24	47	**71**
Helping participant(s) with their resume, application, personal statement, and/or interview preparations	23.9%	76.1%	
	17	54	**71**

Table 24 shows results from an item on the questionnaire that asked Team Advisors which of the AEOP programs they explicitly discussed with their students during eCM. As would be expected, the most frequently discussed program was eCM (90.1%). Very few responding Team Advisors (less than 10%) indicated discussing other specific AEOPs with students, while 33.8% of Team Advisors indicated they discussed AEOP programs in general. The most frequently discussed specific AEOPs other than eCM were SMART (8.5%) and SEAP (7.0%).

Table 24. Team Advisors Responses to AEOP Programs that were Explicitly Discussed with Participants (n = 71)

	Yes - I discussed this program with my student(s)	No - I did not discuss this program with my student(s)	Response Total
Unite	4.2%	95.8%	
	3	68	**71**
Junior Science & Humanities Symposium (JSHS)	5.6%	94.4%	
	4	67	**71**
Science & Engineering Apprenticeship Program (SEAP)	7.0%	93.0%	
	5	66	**71**
Research & Engineering Apprenticeship Program (REAP)	5.6%	94.4%	
	4	67	**71**
High School Apprenticeship Program (HSAP)	2.8%	97.2%	
	2	69	**71**
College Qualified Leaders (CQL)	1.4%	98.6%	
	1	70	**71**
GEMS Near Peer Mentor Program	4.2%	95.8%	
	3	68	**71**
Undergraduate Research Apprenticeship Program (URAP)	1.4%	98.6%	
	1	70	**71**
Science Mathematics, and Research for Transformation (SMART) College Scholarship	8.5%	91.5%	
	6	65	**71**
National Defense Science & Engineering Graduate (NDSEG) Fellowship	2.8%	97.2%	
	2	69	**71**
I discussed AEOP with participant(s) but did not discuss any specific program	33.8%	66.2%	
	24	47	**71**
eCybermission	90.1%	9.9%	

	64	7	**71**

In an effort to understand what resources are most valuable for exposing eCM participants to AEOPs, adults were asked to respond to an item about the resources they found most valuable for this purpose (see Table 25). Participating in eCM (70.4%) and the eCM website (66.2%) were the resources most likely to be ranked as "very much" useful by respondents. Many (44%-89%) indicated they did not experience the other resources listed.

Table 25. Usefulness of Resources for Exposing Students to AEOPs (n = 71)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
eCybermission website	5.6%	0.0%	7.0%	21.1%	66.2%	
	4	0	5	15	47	**71**
Army Educational Outreach Program (AEOP) website	56.3%	0.0%	5.6%	15.5%	22.5%	
	40	0	4	11	16	**71**
AEOP on Facebook, Twitter, Pinterest or other social media	71.8%	0.0%	7.0%	9.9%	11.3%	
	51	0	5	7	8	**71**
AEOP brochure	69.0%	0.0%	5.6%	12.7%	12.7%	
	49	0	4	9	9	**71**
It Starts Here! Magazine	88.7%	1.4%	1.4%	2.8%	5.6%	
	63	1	1	2	4	**71**
eCybermission Program administrator or site coordinator	43.7%	0.0%	5.6%	21.1%	29.6%	
	31	0	4	15	21	**71**
Invited speakers or "career" events	69.0%	1.4%	1.4%	7.0%	21.1%	
	49	1	1	5	15	**71**
Participation in eCybermission	2.8%	0.0%	2.8%	23.9%	70.4%	
	2	0	2	17	50	**71**

Another questionnaire item asked Team Advisors how useful these same resources were for exposing students to DoD STEM careers (see Table 26). Again, adults were most likely to rate participation in eCM as useful, with 49.3% indicating this was "very much" useful. Similarly, 47.9% of adults found the eCM website to be very useful in exposing students to DoD STEM careers. Large proportions of adults (57.7%-87.3%) again reported not having experienced most listed AEOP resources.

Table 26. Usefulness of Resources for Exposing Students to DoD STEM Careers (n = 71)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
eCybermission website	15.5%	1.4%	8.5%	26.8%	47.9%	
	11	1	6	19	34	**71**
Army Educational Outreach Program (AEOP) website	57.7%	1.4%	4.2%	14.1%	22.5%	
	41	1	3	10	16	**71**
AEOP on Facebook, Twitter, Pinterest or other social media	74.6%	1.4%	5.6%	7.0%	11.3%	
	53	1	4	5	8	**71**
AEOP brochure	71.8%	1.4%	5.6%	12.7%	8.5%	
	51	1	4	9	6	**71**
It Starts Here! Magazine	87.3%	1.4%	4.2%	2.8%	4.2%	
	62	1	3	2	3	**71**
eCybermission Program administrator or site coordinator	60.6%	2.8%	4.2%	9.9%	22.5%	
	43	2	3	7	16	**71**
Invited speakers or "career" events	70.4%	0.0%	2.8%	7.0%	19.7%	
	50	0	2	5	14	**71**
Participation in eCybermission	18.3%	0.0%	5.6%	26.8%	49.3%	
	13	0	4	19	35	**71**

Satisfaction with eCM

To assess satisfaction with eCM, both student and adult participants and were asked how satisfied they were with a number of features of the eCM program. Tables 27N and 27R provide eCM-National and eCM-Regional student responses to these questions. Approximately half of responding NJ&EE students were very much satisfied with the eCM registration (52.2%), the eCM website (52.2%), the submission process (46.4%), the variety of STEM mission folder challenges (46.4%), and educational materials (46.4%). However, roughly a quarter of the NJ&EE students reported that they did not experience the eCM Cyber Guide live chat (23.2%), Cyber Guide feedback (21.7%), and Cyber Guide forum (23.2%). Regional students reported lower satisfaction rates compared to national participants. For example, nearly 10% of Regional students reported not being satisfied with the submission process, and 12%-13%

were not satisfied with the Mission Control phone and email response time. The highest satisfaction rates for eCM-R students ("very much satisfied") were eCM registration (26.0%), educational materials (28.1%), submission (31.3%), and the eCM website (37.4%). Similar to NJ&EE students, many Regional students also reported not having experienced the eCM Cyber Guide live chat (39.7%), Cyber Guide feedback (37.7%), and Cyber Guide forum (39.7%).

Table 27N. Student Satisfaction with eCM-N Program Features (n = 69)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Applying or registering for the program	5.8%	0.0%	11.6%	30.4%	52.2%	
	4	0	8	21	36	**69**
Submission process	2.9%	1.4%	7.2%	42.0%	46.4%	
	2	1	5	29	32	**69**
Value of Cyber Guide live chat	23.2%	8.7%	14.5%	23.2%	30.4%	
	16	6	10	16	21	**69**
Variety of STEM mission folder challenges available	7.2%	2.9%	14.5%	29.0%	46.4%	
	5	2	10	20	32	**69**
Value of Cyber Guides feedback	21.7%	4.3%	11.6%	30.4%	31.9%	
	15	3	8	21	22	**69**
Value of Cyber Guides forum	23.2%	7.2%	20.3%	21.7%	27.5%	
	16	5	14	15	19	**69**
Educational materials (e.g., workbooks, online resources, etc.) used during program activities	7.2%	2.9%	15.9%	27.5%	46.4%	
	5	2	11	19	32	**69**
eCybermission website	2.9%	1.4%	11.6%	31.9%	52.2%	
	2	1	8	22	36	**69**
Mission control (phone) response time	31.9%	1.4%	10.1%	20.3%	36.2%	
	22	1	7	14	25	**69**
Mission control (email) response time	33.3%	2.9%	14.5%	20.3%	29.0%	
	23	2	10	14	20	**69**

Table 27R. Student Satisfaction with eCM-R Program Features (n = 438)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Applying or registering for the program	6.4%	9.1%	25.6%	32.9%	26.0%	
	28	40	112	144	114	**438**
Submission process	4.6%	9.6%	23.1%	31.5%	31.3%	
	20	42	101	138	137	**438**
Value of Cyber Guide live chat	53.2%	14.8%	13.5%	9.6%	8.9%	
	233	65	59	42	39	**438**
Variety of STEM mission folder challenges available	17.6%	12.3%	26.7%	23.1%	20.3%	
	77	54	117	101	89	**438**
Value of Cyber Guides feedback	37.7%	14.8%	21.2%	13.5%	12.8%	
	165	65	93	59	56	**438**
Value of Cyber Guides forum	39.7%	13.5%	22.8%	13.0%	11.0%	
	174	59	100	57	48	**438**
Educational materials (e.g., workbooks, online resources, etc.) used during program activities	14.8%	7.5%	22.6%	26.9%	28.1%	
	65	33	99	118	123	**438**
eCybermission website	4.8%	8.4%	20.3%	29.0%	37.4%	
	21	37	89	127	164	**438**
Mission control (phone) response time	54.6%	13.0%	13.7%	9.6%	9.1%	
	239	57	60	42	40	**438**
Mission control (email) response time	49.1%	12.3%	16.0%	11.6%	11.0%	
	215	54	70	51	48	**438**

In order to understand more about students' satisfaction with their overall eCM experience, students were asked to respond to open-ended items on the questionnaire. A 33% sample (155) of the 516 responses to this item was analyzed. Of the students who responded to this question, nearly three-quarters (72%) had only positive things to say about the program. Many responses were simple affirmations of the student's experience in the program. For example, students said, "I loved it and want to do it again," "it was fun," and "it was great!" Students who provided more specific responses wrote about their team experiences, learning about community problems, opportunities to conduct research,

and learning about STEM. For example,

> *eCM was a great way for students like me to be exposed to using STEM to solve/investigate a real world problem. I was able to learn about [a] problem in my community that I didn't know was a threat, and then I had a chance to investigate it. This was my school's first year participating, and I am extremely happy that we did, this is a great educational program and I look forward to competing next year!* (eCM overall participant)

> *eCM was engaging and fun. It helped me get to know my peers more…This whole project has helped me see science in a different way. Not just school work, but an engaging activity that's fun and entertaining.* (eCM overall participant)

> *I was very satisfied with eCybermission. I worked harder than I have previously worked at science projects. eCybermission has encouraged me to use new ways of thinking with STEM and it has encouraged me to put more effort into a presentation than I have before.* (eCM overall participant)

Some other respondents (16%) also offered positive comments but included some caveats. These caveats were focused on time management issues, the amount of work, and issues with teamwork. For example:

> *I liked it when we did the real part of the project and the scientific part and writing about it, but I don't like how stressful it is when it is close to being due.* (eCM overall participant)

A small number of students (11%) expressed dissatisfaction with the program. The sources of dissatisfaction were focused on the amount of work, stress, boredom, lack of information or resources, and issues with teamwork.

Students were also asked in an open-ended questionnaire item to list three ways in which eCM could be improved. Of the sample of eCM overall respondents (33% sample of 516 responses), 70% offered at least one suggestion for improvement. The most often-mentioned improvements were focused on aspects of the challenge (66 responses) with a focus on the clarity and complexity of the challenge (36 responses) and the availability of information and guidelines (27 responses). A relatively large number of responses were also focused on the Mission Folder and website format and usability (51 responses). In particular, 17 of these responses requested improvements in the website, which some participants described as "glitchy," 15 focused on the format of the Mission Folder, with comments about lost work as a result of site time-outs and the difficulty of typing into the folder and including attachments, and 7 focused on difficulties with folder submission. Twelve students also noted that they would like a format in which multiple users could work on the document simultaneously. Another 31 responses focused on

time constraints, with students requesting more time to complete the challenge and suggesting incremental deadlines within the challenge in order to help them to manage their time. Twenty-seven responses indicated that students would like more mentor support, while 13 requested more online resources and e-CyberChats. Other responses included comments requesting more options for topics (18 responses), about communication (6 requests for emails about deadlines and event information and 4 indicating that they received too many emails), requesting examples of past projects (7), and requesting different times for e-CyberChats (13 responses).

Students in focus groups also offered several suggestions for improvements. These suggestions included providing guidelines for the Team Advisor role, providing access to assistance and support apart from the Team Advisor, using a platform other than Blackboard for regional judging, providing more specific rules, more free time at the NJ&EE, and promoting the program more widely.

Team Advisor satisfaction with eCM program features is summarized in Table 28. Many adults reported being "very much" or "somewhat" satisfied with the program features they experienced. For example, over 90% of Team Advisors reported they were "very much" or "somewhat" satisfied with the application or registration process, the submission process, and the eCM website. Also, 83.1% of adults reported being "very much" or "somewhat" satisfied with variety of STEM mission folders available, and 78.9% reported being "very much" or "somewhat" satisfied with educational materials. However, approximately one half of Team Advisors reported that they did not experience several of the features such as Cyber Guide live chats, feedback, or forums.

Like the student questionnaire, the adult questionnaire included open-ended items asking participants to share their opinions about the program. Adults were asked to the three most important strengths of eCM. Responses focused on a variety of program strengths. Over half of responses (68%) focused on aspects of eCM that enhance students' 21st Century skills, including teamwork (43% of responses), and skills such as problem solving, critical thinking, perseverance, and communication skills. Nearly half of adult responses (47%) noted that the focus on real-world problems, community involvement, and hands-on application of knowledge are key strengths of e-CM. Over a quarter (26%) included the opportunity for students to develop research skills as a strength of eCM, 19% cited student choice in projects, and another 19% noted that the resources, guidelines, and support provided are strengths of the program. Other strengths mentioned in 15% or fewer of responses included student time management, the online format, the guidelines and information provided, exposure to STEM, the opportunity for students to work with professionals, and career information.

Adult focus group participants at the NJ&EE noted similar strengths when asked about the value of eCM. For example,

> *As a teacher, I appreciate the fact that [eCM] is more real-world. Science fair is typically you're by yourself, you pick your project, you do your project. Science and engineering aren't like that.*

There's a lot of interdependence that needs to occur. Being able to teach them some of those skills starting early on in sixth grade and through ninth grade, is really going to help them develop as individuals and as collaborators for the future. I think that's really unique about this competition. (eCM Adult)

I think the program is so well organized and it's got so many resources that I can get a group of sixth grader to stick with a topic and work on a project for almost an entire year… it's very open-ended and they get to pick a topic. It's part of their community. They feel that direct connection. They take ownership for what they're doing. They become experts in what they're doing. They develop patience. They're collaborating. They're managing time. Their developing all of these skills, I think, is invaluable. (eCM Adult)

Table 28. Team Advisor Satisfaction with eCM Program Features (n = 176)

	Did not experience	Not at all	A little	Somewhat	Very much	Response Total
Application or registration process	1.4%	2.8%	4.2%	32.4%	59.2%	
	1	2	3	23	42	**71**
Communication with National Science Teachers Association (NSTA)	23.9%	1.4%	2.8%	29.6%	42.3%	
	17	1	2	21	30	**71**
Submission process	0.0%	0.0%	7.0%	22.5%	70.4%	
	0	0	5	16	50	**71**
Value of Cyber Guide live chat	56.3%	2.8%	4.2%	12.7%	23.9%	
	40	2	3	9	17	**71**
The variety of STEM mission folder challenges available	7.0%	0.0%	9.9%	26.8%	56.3%	
	5	0	7	19	40	**71**
Value of Cyber Guides feedback	47.9%	1.4%	2.8%	19.7%	28.2%	
	34	1	2	14	20	**71**
Value of Cyber Guides forum	53.5%	1.4%	2.8%	12.7%	29.6%	
	38	1	2	9	21	**71**
eCybermission website	0.0%	0.0%	8.5%	32.4%	59.2%	
	0	0	6	23	42	**71**
Educational materials	9.9%	2.8%	8.5%	25.4%	53.5%	

	7	2	6	18	38	**71**
Mission control (phone) response time	52.1%	1.4%	1.4%	4.2%	40.8%	
	37	1	1	3	29	**71**
Mission control (email) response time	26.8%	0.0%	2.8%	9.9%	60.6%	
	19	0	2	7	43	**71**

Adults were also asked to respond to an open-ended item asking them to describe three ways eCM could be improved for future participants. Fifty-four adults provided at least one suggestion for program improvement. A wide range of improvements was suggested. The most frequently mentioned improvements (mentioned in 15 responses) were requests for more resources in terms of general support, mentors, and outlines for teachers. Another 10 responses included requests for more examples of high quality projects, and 10 responses included comments about website issues and requests for an easier uploading process. Seven responses focused on additional flexibility in team composition, including requests for flexibility in team size (e.g., allowing pairs or single students to be able to compete), and the ability to combine grade levels in teams. Another 7 responses indicated that adults would like to receive information earlier, and 6 responses indicated that a timeline would be useful and/or that incremental due dates for portions of the project would improve eCM. Other comments, mentioned in 5 or fewer responses, included requests for providing more options for project topics, more funding, more detailed feedback from judges, real time-collaboration, communication about deadlines to students, more AEOP information, improvements to the application and survey website, and providing rubrics for each section of the project.

Adult focus group participants also suggested improvements including using a system other than Blackboard Connect (some teachers are not able to access it at their schools and some found it difficult to use) and ensuring that judging is consistent across projects. A suggestion for judging was to provide a rubric that awards scores for each section of the project.

Adult respondents were also asked to comment on their overall satisfaction with their eCM experience in an open-ended questionnaire item. Of the 58 adults who responded to this question, nearly all included positive comments about eCM. For example:

> *I love eCybermission! I have used it for several years and believe that if more people understood how it provides motivation and a framework to complete a detailed STEM event they would participate. I coordinate with math, science, and language arts teachers to meet as many standards as possible by using this competition.* (eCM Team Advisor)

The eCybermission program has changed the way I teach. It is an amazing experience for students and I have all my 6-9 students participate…The networking for the students with real researchers is one of the most important aspects, as is the students' freedom to pick their own projects and interests. The support staff for eCybermission is incredible…this is my 15th year of participation. Kudos to the program! (eCM Team Advisor)

eCybermission continues to help my students grow as science students. They become better researchers, writers, and problem solvers. (eCM Team Advisor)

Twelve adult respondents offered positive comments but included some caveats. Most caveats focused on the time and stress associated with completing projects by the deadline (mentioned in 5 responses) and providing examples and support for new teachers (mentioned in 3 comments). For example:

This was my first year with eCybermission and I realized that I need to do more to set the students up for success. Before I allow students to start on their mission, I need to walk them through a sample mission as a group and show them how to complete the steps. It would be helpful to have a couple of examples on the website that students could work through in their teams…I did not find worksheets or templates that I could print out for the students that would help them when it was time to complete their mission folder online…I am looking forward to a better, more exciting year next year. (eCM Team Advisor)

It was a stressful program for the students, the parents, the teacher, and the advisor. In the end, it is well worth it, though. Students learn confidence and a lot about science. (eCM Team Advisor)

Because I teach Life Science classes I was still required to maintain the pace of the curriculum while trying to find time to work on eCybermission…It created stress for the students and myself at times…If I am allowed to use the program again I will, but I will start earlier and spread out the parts of the research. Once I got the hang of the program it made a lot of sense and was actually exciting to see some of the students embracing the challenge. (eCM Team Advisor)

Three of the adult respondents offered no positive comments. Two of these were focused on disappointment with funding and one expressed having difficulties with registration.

7 | Outcomes Evaluation

The evaluation of eCM included measurement of several outcomes relating to AEOP and program objectives, including impacts on students' STEM competencies, STEM identity and confidence, interest in and intent for future STEM engagement, attitudes toward research, and their knowledge of and interest in participating in additional AEOP opportunities.[8] STEM competencies, including foundational knowledge, skills, and abilities in STEM, as well as the confidence to apply them appropriately, are necessary for a STEM-literate citizenry. STEM competencies are important for those engaging in STEM enterprises, but also for all members of society as critical consumers of information and effective decision makers in a world that is heavily reliant on STEM. The eCM evaluation measured students' self-reported gains in STEM competencies and engagement.

STEM Knowledge and Skills

Nearly all eCM students responding to the survey reported some level of gain in their STEM knowledge as a result of participating in eCM (see Tables 29N and 29R). NJ&EE students, however, consistently reported greater gains compared to Regional students. For example, "large" gains were reported by 79.7% of NJ&EE students on knowledge of research conducted in a STEM topic or field, but only 18.0% of Regional students felt similarly. Additionally, 68.1% of NJ&EE students reported large gains on their knowledge of what everyday research work is like in STEM, yet only 16.2% of overall students reported large gains in this area. Students reported similar patterns of impact on their knowledge of how

[8] The outcomes measured in the evaluation study were informed by the following documents:

Committee on STEM Education. (2013*). Federal Science, Technology, Engineering, and Mathematics (STEM) education 5-year strategic plan: A report from the Committee on STEM Education, National Science and Technology Council.* Washington, DC: The White House, Office of Science and Technology Policy.

National Research Council. (2009). Learning Science in Informal Environments: People, Places, and Pursuits. Committee on Learning Science in Informal Environments. Philip Bell, Bruce Lewenstein, Andrew W. Shouse, and Michael A. Feder, Editors. Board on Science Education, Center for Education. Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

President's Council of Advisors on Science and Technology (P-CAST). (February 2012). *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.* Executive Office of the President.

Report of the Academic Competitiveness Council (ACC). (2007). U.S. Department of Education. Available on the Department's Web site at: http://www.ed.gov/about/inits/ed/competitiveness/acc-mathscience/index.html.

scientists and engineers work on real problems in STEM (eCM-N 78.3%; eCM-R 21.9%), and their knowledge of research processes, ethics, and rules for conduct in STEM (eCM-N 79.7%; eCM-R 18.7%).

Table 29N. eCM--NJ&EE Participant Reports of Impact on STEM Knowledge (n = 69)

	No gain	Small gain	Medium gain	Large gain	Response Total
In depth knowledge of a STEM topic(s)	1.4%	4.3%	14.5%	79.7%	
	1	3	10	55	**69**
Knowledge of research conducted in a STEM topic or field	0.0%	2.9%	20.3%	76.8%	
	0	2	14	53	**69**
Knowledge of research processes, ethics, and rules for conduct in STEM	1.4%	2.9%	15.9%	79.7%	
	1	2	11	55	**69**
Knowledge of how scientists and engineers work on real problems in STEM	0.0%	2.9%	18.8%	78.3%	
	0	2	13	54	**69**
Knowledge of what everyday research work is like in STEM	0.0%	2.9%	29.0%	68.1%	
	0	2	20	47	**69**

Table 29R. eCM-Overall Participant Reports of Impact on STEM Knowledge (n = 438)

	No gain	Small gain	Medium gain	Large gain	Response Total
In depth knowledge of a STEM topic(s)	11.6%	31.7%	44.5%	12.1%	
	51	139	195	53	**438**
Knowledge of research conducted in a STEM topic or field	12.1%	29.9%	40.0%	18.0%	
	53	131	175	79	**438**
Knowledge of research processes, ethics, and rules for conduct in STEM	13.2%	29.0%	39.0%	18.7%	
	58	127	171	82	**438**
Knowledge of how scientists and engineers work on real problems in STEM	13.5%	29.5%	35.2%	21.9%	
	59	129	154	96	**438**
Knowledge of what everyday research work is like in STEM	16.0%	29.2%	38.6%	16.2%	
	70	128	169	71	**438**

The Impacts on STEM Knowledge student questionnaire items were combined into a composite variable[9] to test for differences between subgroups of students. Students competing at the NJ&EE level reported significantly higher STEM Knowledge gains than Regional level students[10] (large effect size of d = 0.814). No significant differences were found by SES or race/ethnicity in terms of STEM Knowledge.

Tables 30N and 30R display students' reports of the impact of eCM on their STEM competencies in terms of their science and engineering practices. Over 50% of the responding students reported medium or large gains on all items regardless of competition level with the exception of using computer models of objects or systems to test cause and effect relationships. For this item, only 36.8% of Regional students reported medium to large gains. In all instances, National students reported higher gains than overall/Regional students. For example: communicating about experiments in different ways (eCM-NJ&EE 94.2%; eCM overall 62.1%); supporting an explanation for an observation with data from experiments (eCM-NJ&EE 92.8%; eCM overall 63.9%); using knowledge and creativity to suggest a testable explanation for an observation (eCM-NJ&EE 88.4%; eCM overall 65.1%); and carrying out procedures for an experiment and recording data accurately (eCM-NJ&EE 98.5%; eCM overall 68.7%).

A composite score was also calculated for gains in STEM Competencies – Science and Engineering Practices.[11] This composite was used to assess if the eCM program had differential impacts depending on student group membership. Students competing at the NJ&EE reported significantly higher STEM Competencies compared to overall students[12] (large effect size of d = 0.837). No significant differences were found in terms of STEM Competencies depending on SES or race/ethnicity.

Table 30N. eCM-NJ&EE Participant Gains in their STEM Competencies – Science and Engineering Practices (n =69)

	No gain	Small gain	Medium gain	Large gain	Response Total
Asking a question that can be answered with one or more scientific experiments	2.9%	7.2%	37.7%	52.2%	
	2	5	26	36	**69**
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	1.4%	10.1%	30.4%	58.0%	
	1	7	21	40	**69**
Making a model of an object or system showing its parts and how they work	5.8%	8.7%	26.1%	59.4%	
	4	6	18	41	**69**

[9] The Cronbach's alpha reliability for these 5 items was 0.771.
[10] Two-tailed independent samples t-test: $t(505) = 9.15$, $p < .0001$.
[11] The STEM Competencies composite (11 items) has a Cronbach's alpha reliability of 0.919.
[12] Two-tailed independent samples t-test: $t(505) = 9.40$, $p < .0001$.

Carrying out procedures for an experiment and recording data accurately	0.0%	1.4%	30.4%	68.1%	
	0	1	21	47	**69**
Using computer models of objects or systems to test cause and effect relationships	17.4%	18.8%	31.9%	31.9%	
	12	13	22	22	**69**
Organizing data in charts or graphs to find patterns and relationships	4.3%	10.1%	23.2%	62.3%	
	3	7	16	43	**69**
Considering different interpretations of data when deciding how the data answer a question	1.4%	8.7%	26.1%	63.8%	
	1	6	18	44	**69**
Supporting an explanation for an observation with data from experiments	0.0%	7.2%	23.2%	69.6%	
	0	5	16	48	**69**
Defending an argument that conveys how an explanation best describes an observation	0.0%	7.2%	29.0%	63.8%	
	0	5	20	44	**69**
Integrating information from technical or scientific texts and other media to support your explanation of an observation	1.4%	11.6%	33.3%	53.6%	
	1	8	23	37	**69**
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	1.4%	4.3%	14.5%	79.7%	
	1	3	10	55	**69**

Table 30R. eCM Overall Participant Gains in their STEM Competencies – Science and Engineering Practices (n =438)

	No gain	Small gain	Medium gain	Large gain	Response Total
Asking a question that can be answered with one or more scientific experiments	7.1%	32.4%	40.0%	20.5%	
	31	142	175	90	**438**
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	6.8%	28.1%	43.2%	21.9%	
	30	123	189	96	**438**
Making a model of an object or system showing its parts and how they work	21.5%	24.0%	29.9%	24.7%	
	94	105	131	108	**438**
Carrying out procedures for an experiment and recording data accurately	6.2%	25.1%	41.1%	27.6%	
	27	110	180	121	**438**

Using computer models of objects or systems to test cause and effect relationships	30.6%	32.6%	24.0%	12.8%	
	134	143	105	56	**438**
Organizing data in charts or graphs to find patterns and relationships	11.0%	30.1%	37.4%	21.5%	
	48	132	164	94	**438**
Considering different interpretations of data when deciding how the data answer a question	11.0%	33.8%	37.7%	17.6%	
	48	148	165	77	**438**
Supporting an explanation for an observation with data from experiments	6.8%	29.2%	41.3%	22.6%	
	30	128	181	99	**438**
Defending an argument that conveys how an explanation best describes an observation	13.7%	34.7%	32.6%	18.9%	
	60	152	143	83	**438**
Integrating information from technical or scientific texts and other media to support your explanation of an observation	13.9%	34.2%	34.5%	17.4%	
	61	150	151	76	**438**
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	8.4%	29.5%	36.1%	26.0%	
	37	129	158	114	**438**

The student questionnaire also asked students about the impact of eCM on their 21st Century Skills - a set of knowledge, skills, and habits considered critical for success in the 21st century workplace. Nearly 90% or more of NJ&EE participants reported "medium" or "large" gains on all 21st Century Skills items (see Table 31N). Between 65% and 75% of overall participants reported "medium" or "large" gains on all 21st Century Skills items (see Table 31R). The two areas in which most students reported "medium" or "large" gains were making changes when things did not go as planned (eCM-NJ&EE 94.2%; eCM overall 75.8%), and communicating effectively with others (eCM-NJ&EE 94.2%; eCM overall 73.3%).

Table 31N. eCM-NJ&EE Participant Reports of Impacts on 21st Century Skills (n = 69)

	No gain	Small gain	Medium gain	Large gain	Response Total
Sticking with a task until it is finished	2.9%	7.2%	18.8%	71.0%	
	2	5	13	49	**69**
Making changes when things do not go as planned	1.4%	4.3%	23.2%	71.0%	
	1	3	16	49	**69**
Working well with students from all backgrounds	4.3%	7.2%	20.3%	68.1%	

	3	5	14	47	**69**
Including others' perspectives when making decisions	0.0%	7.2%	23.2%	69.6%	
	0	5	16	48	**69**
Communicating effectively with others	0.0%	5.8%	18.8%	75.4%	
	0	4	13	52	**69**
Viewing failure as an opportunity to learn	0.0%	7.2%	20.3%	72.5%	
	0	5	14	50	**69**

Table 31R. eCM Overall Participant Reports of Impacts on 21st Century Skills (n = 438)

	No gain	Small gain	Medium gain	Large gain	Response Total
Sticking with a task until it is finished	8.9%	18.5%	34.7%	37.9%	
	39	81	152	166	**438**
Making changes when things do not go as planned	5.7%	18.5%	36.8%	39.0%	
	25	81	161	171	**438**
Working well with students from all backgrounds	11.4%	23.3%	32.6%	32.6%	
	50	102	143	143	**438**
Including others' perspectives when making decisions	7.1%	22.1%	37.7%	33.1%	
	31	97	165	145	**438**
Communicating effectively with others	5.9%	20.8%	34.9%	38.4%	
	26	91	153	168	**438**
Viewing failure as an opportunity to learn	10.7%	21.9%	29.7%	37.7%	
	47	96	130	165	**438**

A composite variable of the 6 items focusing on 21st Century Skills[13] was created to test for differences between student subgroups. Students competing at the NJ&EE reported significantly higher gains in 21st Century Skills compared to Regional level students[14] (moderate effect size of d = 0.587). No significant differences were not found between grouped by SES or race/ethnicity.

[13] The 21st Century Skills composite (6 items) had a Cronbach's alpha reliability of .898.
[14] Two-tailed independent samples t-test: $t(505) = 6.59$, $p < .0001$.

STEM Identity and Confidence

A series of items intended to measure the impact of eCM on students' STEM identities were also asked on the student questionnaire. Because students are unlikely to pursue STEM if they do not see themselves as capable of succeeding in STEM[15], deepening students' STEM knowledge and skills is important for increasing the likelihood that they will pursue STEM education and/or careers. Data clearly demonstrate that participating in eCM had a positive impact on the STEM Identity of student participants at the national level (see Table 32N). More than three-quarters of students competing at the NJ&EE reported "medium" or "large" gains for every item. Students at the regional level reported roughly an equal spread across the responses "no gain," "little gain," "medium gain," and "large gain" for all categories (see Table 32R). For example, nearly all NJ&EE students (98.6%) reported "medium" or "large" gains in their sense of accomplishment in a STEM endeavor compared to only 49.3% of Regional students.

Table 32N. eCM-NJ&EE Participant Reports on Impacts on STEM Identity (n = 69)

	No gain	Small gain	Medium gain	Large gain	Response Total
Interest in a new STEM topic	1.4%	4.3%	26.1%	68.1%	
	1	3	18	47	**69**
Deciding on a path to pursue a STEM career	2.9%	17.4%	33.3%	46.4%	
	2	12	23	32	**69**
Sense of accomplishing something in STEM	0.0%	1.4%	26.1%	72.5%	
	0	1	18	50	**69**
Feeling prepared for more challenging STEM activities	0.0%	4.3%	23.2%	72.5%	
	0	3	16	50	**69**
Thinking creatively about a STEM project or activity	0.0%	1.4%	18.8%	79.7%	
	0	1	13	55	**69**
Desire to build relationships with mentors who work in STEM	0.0%	4.3%	21.7%	73.9%	
	0	3	15	51	**69**
Connecting a STEM topic or field to my personal values	1.4%	5.8%	15.9%	76.8%	

[15] Chang, M. J., Sharkness, J., Hurtado, S. and Newman, C. B. (2014), What matters in college for retaining aspiring scientists and engineers from underrepresented racial groups. J. Res. Sci. Teach., 51: 555–580.

	1	4	11	53	**69**

Table 32R. eCM Overall Participant Reports on Impacts on STEM Identity (n = 438)

	No gain	Small gain	Medium gain	Large gain	Response Total
Interest in a new STEM topic	26.9%	32.4%	29.0%	11.6%	
	118	142	127	51	**438**
Deciding on a path to pursue a STEM career	38.4%	28.3%	22.4%	11.0%	
	168	124	98	48	**438**
Sense of accomplishing something in STEM	16.9%	33.8%	30.1%	19.2%	
	74	148	132	84	**438**
Feeling prepared for more challenging STEM activities	19.2%	30.1%	30.8%	19.9%	
	84	132	135	87	**438**
Thinking creatively about a STEM project or activity	15.8%	29.7%	32.9%	21.7%	
	69	130	144	95	**438**
Desire to build relationships with mentors who work in STEM	31.7%	30.4%	25.1%	12.8%	
	139	133	110	56	**438**
Connecting a STEM topic or field to my personal values	26.5%	30.6%	29.2%	13.7%	
	116	134	128	60	**438**

Composite scores were generated for the STEM Identity items[16] to assess whether the eCM program had differential impacts on subgroups of students. Students competing at the NJ&EE reported significantly higher STEM Identity gains than overall students[17] (large effect size of d = 1.12). No significant differences were found by SES or race/ethnicity in terms of reported STEM Identity.

Interest and Future Engagement in STEM

A key goal of the AEOP is to develop a STEM-literate citizenry. As such, students need to be engaged both in and out of school with high-quality STEM activities. The questionnaire asked students to reflect

[16] The Cronbach's alpha reliability for these 7 STEM Identity items was 0.938.
[17] Two-tailed independent samples t-test: $t(505) = 12.53$, $p < .0001$.

on the likelihood that they would engage in STEM activities outside of required school courses changed as a result of their eCM experience. Between 40% and 50% of Regional students (Table 33R) reported "about the same likelihood before and after eCM" to engage in the activities listed, although, on average, 25% reported that they were "more likely" to engage in these activities. In contrast, approximately 70% of National students reported they were "more likely" to engage in all STEM activities listed (Table 33N). Some examples of the discrepancy between National and Regional student responses include the following (students "more likely" or "much more likely"): talk with friends or family about STEM (eCM-NJ&EE 82.6%; eCM overall 28.5%); work on a STEM project in a university or professional setting (eCM-NJ&EE 85.5%; eCM overall 29.4%); and participate in a STEM camp, club, or competition (eCM-NJ&EE 85.5%; eCM overall 24.9%). It is interesting to note that the items with the largest difference between National and Regional results are all "social" activities rather than the more independent activities.

Table 33N. eCM-NJ&EE Impact on Participants' Intent to Engage in STEM Out of School (n = 69)

	Much less likely	Less likely	About the same before and after	More likely	Much more likely	Response Total
Watch or read non-fiction STEM	2.9%	5.8%	37.7%	34.8%	18.8%	
	2	4	26	24	13	**69**
Tinker (play) with a mechanical or electrical device	0.0%	2.9%	18.8%	33.3%	44.9%	
	0	2	13	23	31	**69**
Work on solving mathematical or scientific puzzles	2.9%	1.4%	27.5%	26.1%	42.0%	
	2	1	19	18	29	**69**
Use a computer to design or program something	0.0%	1.4%	30.4%	30.4%	37.7%	
	0	1	21	21	26	**69**
Talk with friends or family about STEM	0.0%	4.3%	13.0%	33.3%	49.3%	
	0	3	9	23	34	**69**
Mentor or teach other students about STEM	0.0%	5.8%	17.4%	31.9%	44.9%	
	0	4	12	22	31	**69**
Help with a community service project related to STEM	0.0%	0.0%	18.8%	20.3%	60.9%	
	0	0	13	14	42	**69**
Participate in a STEM camp, club, or competition	0.0%	1.4%	13.0%	34.8%	50.7%	
	0	1	9	24	35	**69**

Take an elective (not required) STEM class	1.4%	2.9%	18.8%	30.4%	46.4%	
	1	2	13	21	32	**69**
Work on a STEM project or experiment in a university or professional setting	0.0%	2.9%	11.6%	27.5%	58.0%	
	0	2	8	19	40	**69**

Table 33R. eCM Overall Impact on Participants' Intent to Engage in STEM Out of School (n = 438)

	Much less likely	Less likely	About the same before and after	More likely	Much more likely	Response Total
Watch or read non-fiction STEM	14.6%	13.5%	50.7%	16.2%	5.0%	
	64	59	222	71	22	**438**
Tinker (play) with a mechanical or electrical device	10.3%	9.4%	41.6%	28.1%	10.7%	
	45	41	182	123	47	**438**
Work on solving mathematical or scientific puzzles	11.0%	11.9%	46.8%	22.6%	7.8%	
	48	52	205	99	34	**438**
Use a computer to design or program something	11.4%	11.6%	43.6%	22.8%	10.5%	
	50	51	191	100	46	**438**
Talk with friends or family about STEM	13.9%	14.8%	42.7%	18.9%	9.6%	
	61	65	187	83	42	**438**
Mentor or teach other students about STEM	17.1%	14.6%	44.3%	17.6%	6.4%	
	75	64	194	77	28	**438**
Help with a community service project related to STEM	10.7%	11.4%	43.6%	24.7%	9.6%	
	47	50	191	108	42	**438**
Participate in a STEM camp, club, or competition	20.3%	14.2%	40.6%	16.0%	8.9%	
	89	62	178	70	39	**438**
Take an elective (not required) STEM class	16.9%	13.7%	40.0%	19.4%	10.0%	
	74	60	175	85	44	**438**
Work on a STEM project or experiment in a university or professional setting	16.9%	12.3%	41.3%	18.9%	10.5%	
	74	54	181	83	46	**438**

The 10 items comprising students' engagement in STEM outside of required school courses were used to create a composite score[18] to compare subgroups of students. Students competing at the NJ&EE reported significantly higher Intent to Engage in Future STEM Activities compared to Regional students[19] (large effect size of d = 0.970). There were no significant differences between student SES or racial/ethnic subgroups.

The questionnaire also examined student interest level in participating in future AEOP programs. Tables 34N and 34R summarize student responses. If students had heard of the programs, there were few that indicated they were "not at all" interested in the potential future program. While most students reported being at least "Somewhat" to "Very much" interested in all AEOPs, approximately two-thirds of Regional participants reported having "never heard" of each program with the exception of eCM. In contrast, students competing at the NJ&EE were far less likely to report not having heard of programs other than eCM (range of 4.3% to 37.7%). Surprisingly, they were least likely to have heard of JSS (38% had not heard of it), a program for which middle school students are eligible. Students in the NJ&EE focus group credited the alumni panel for some of their familiarity with AEOPs.

Table 34N. eCM-NJ&EE Participant Interest in Future AEOP Programs (n = 69)

	I've never heard of this program	Not at all	A little	Somewhat	Very much	Response Total
Camp Invention	14.5%	4.3%	21.7%	40.6%	18.8%	
	10	3	15	28	13	**69**
eCYBERMISSION	0.0%	2.9%	4.3%	10.1%	82.6%	
	0	2	3	7	57	**69**
Junior Solar Sprint (JSS)	37.7%	5.8%	13.0%	29.0%	14.5%	
	26	4	9	20	10	**69**
Gains in the Education of Mathematics and Science (GEMS)	4.3%	5.8%	26.1%	36.2%	27.5%	
	3	4	18	25	19	**69**
UNITE	8.7%	5.8%	24.6%	30.4%	30.4%	
	6	4	17	21	21	**69**
Junior Science & Humanities Symposium (JSHS)	20.3%	7.2%	24.6%	24.6%	23.2%	
	14	5	17	17	16	**69**

[18] These 10 items for Future STEM Engagement had a Cronbach's alpha reliability of 0.941.
[19] Two-tailed independent samples t-test: $t(505) = 10.90$, $p < .0001$.

Science & Engineering Apprenticeship Program (SEAP)	8.7%	5.8%	14.5%	37.7%	33.3%	
	6	4	10	26	23	**69**
Research & Engineering Apprenticeship Program (REAP)	11.6%	5.8%	18.8%	33.3%	30.4%	
	8	4	13	23	21	**69**
High School Apprenticeship Program (HSAP)	18.8%	4.3%	21.7%	29.0%	26.1%	
	13	3	15	20	18	**69**
College Qualified Leaders (CQL)	36.2%	2.9%	11.6%	23.2%	26.1%	
	25	2	8	16	18	**69**
GEMS Near Peer Mentor Program	20.3%	4.3%	20.3%	31.9%	23.2%	
	14	3	14	22	16	**69**
Undergraduate Research Apprenticeship Program (URAP)	27.5%	7.2%	17.4%	27.5%	20.3%	
	19	5	12	19	14	**69**
SMART College Scholarship	7.2%	1.4%	8.7%	29.0%	53.6%	
	5	1	6	20	37	**69**
National Defense Science & Engineering Graduate (NDSEG) Fellowship	27.5%	4.3%	14.5%	26.1%	27.5%	
	19	3	10	18	19	**69**

Table 34R. eCM Overall Participant Interest in Future AEOP Programs (n = 438)

	I've never heard of this program	Not at all	A little	Somewhat	Very much	Response Total
Camp Invention	60.3%	13.9%	15.3%	5.0%	5.5%	
	264	61	67	22	24	**438**
eCYBERMISSION	3.0%	20.3%	30.6%	20.5%	25.6%	
	13	89	134	90	112	**438**
Junior Solar Sprint (JSS)	66.7%	10.7%	14.4%	4.6%	3.7%	
	292	47	63	20	16	**438**
Gains in the Education of Mathematics and Science (GEMS)	61.0%	11.9%	14.8%	7.5%	4.8%	
	267	52	65	33	21	**438**
UNITE	70.8%	10.5%	10.7%	5.3%	2.7%	
	310	46	47	23	12	**438**
Junior Science & Humanities Symposium	67.6%	9.4%	13.5%	7.1%	2.5%	

(JSHS)	296	41	59	31	11	**438**
Science & Engineering Apprenticeship Program (SEAP)	61.9%	12.1%	13.9%	8.7%	3.4%	
	271	53	61	38	15	**438**
Research & Engineering Apprenticeship Program (REAP)	64.2%	10.5%	13.9%	7.1%	4.3%	
	281	46	61	31	19	**438**
High School Apprenticeship Program (HSAP)	64.2%	10.3%	14.4%	7.8%	3.4%	
	281	45	63	34	15	**438**
College Qualified Leaders (CQL)	67.1%	11.2%	11.0%	5.7%	5.0%	
	294	49	48	25	22	**438**
GEMS Near Peer Mentor Program	67.8%	12.1%	11.2%	6.4%	2.5%	
	297	53	49	28	11	**438**
Undergraduate Research Apprenticeship Program (URAP)	68.7%	10.7%	11.0%	6.8%	2.7%	
	301	47	48	30	12	**438**
SMART College Scholarship	60.3%	9.8%	13.5%	10.3%	6.2%	
	264	43	59	45	27	**438**
National Defense Science & Engineering Graduate (NDSEG) Fellowship	65.1%	11.0%	12.3%	7.1%	4.6%	
	285	48	54	31	20	**438**

Attitudes toward DoD Research

Students were asked their opinions of what DoD researchers do and the value of DoD research more broadly since attitudes about the importance of DoD research are an important prerequisite to continued student interest in the field and to potential DoD STEM involvement in the future. Data indicate that most respondents have favorable opinions about DoD researchers and research regardless of program participation level (see Tables 35N and 35R). A vast majority of NJ&EE students selected "strongly agree" or "agree" for each statement, and most Regional students also selected "strongly agree or agree" with each statement. eCM Regional students reported "neither agree nor disagree" at higher rates than the NJ&EE students however. The two statements with the highest agreement among students were that DoD researchers solve real-world problems (eCM-NJ&EE 94.2%; eCM overall 60.7%); and that DoD research is important to society (eCM-NJ&EE 94.2%; eCM overall 55.9%).

Table 35N. eCM-NJ&EE Participant Opinions about DoD Researchers and Research (n = 69)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Response Total

DoD researchers advance science and engineering fields	0.0%	0.0%	8.7%	29.0%	62.3%	
	0	0	6	20	43	**69**
DoD researchers develop new, cutting edge technologies	1.4%	0.0%	7.2%	23.2%	68.1%	
	1	0	5	16	47	**69**
DoD researchers solve real-world problems	1.4%	0.0%	4.3%	17.4%	76.8%	
	1	0	3	12	53	**69**
DoD research is important to society	1.4%	0.0%	4.3%	21.7%	72.5%	
	1	0	3	15	50	**69**

Table 35R. eCM Overall Participant Opinions about DoD Researchers and Research (n = 438)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Response Total
DoD researchers advance science and engineering fields	4.1%	2.5%	42.9%	38.6%	11.9%	
	18	11	188	169	52	**438**
DoD researchers develop new, cutting edge technologies	2.5%	4.8%	37.2%	40.4%	15.1%	
	11	21	163	177	66	**438**
DoD researchers solve real-world problems	2.3%	3.0%	34.0%	42.2%	18.5%	
	10	13	149	185	81	**438**
DoD research is important to society	3.7%	3.4%	37.0%	37.9%	18.0%	
	16	15	162	166	79	**438**

Education and Career Aspirations

Students were asked about their education aspirations after participating in eCM. As can be seen in Tables 36N and 36R, the vast majority of students expected, at a minimum, to complete a Bachelor's degree. While this is the same across eCM student participation level, there is a difference in educational goals with more Regional students aspiring to a Bachelor's degree as their highest level of education (eCM-NJ&EE 27.54%; eCM overall 50.23%) and more National students aspiring to continue their education after college (eCM-NJ&EE 68.12%; eCM overall 39.73%).

Table 36N. Participant Education Aspirations After eCM-NJ&EE (n = 76)

Choice	Response Percent	Response Total
Graduate from high school	1.45 %	1
Go to a trade or vocational school	1.45 %	1
Go to college for a little while	1.45 %	1
Finish college (get a Bachelor's degree)	27.54 %	19
Get more education after college	68.12 %	47

Table 36R. Participant Education Aspirations After eCM Overall (n = 2,856)

Choice	Response Percent	Response Total
Graduate from high school	3.65 %	16
Go to a trade or vocational school	1.14 %	5
Go to college for a little while	5.25 %	23
Finish college (get a Bachelor's degree)	50.23 %	220
Get more education after college	39.73 %	174

Overall Impact

Students were also asked their opinions about the overall impact of participating in eCM. The responses displayed in Tables 37N and 37R show that students believed eCM had substantial impacts on them. NJ&EE students reported higher impacts on all statements compared to eCM Regional level students. More than half of all students (NJ&EE and Regional) agreed that eCM positively impacted their confidence in STEM knowledge, skills, and abilities (eCM-NJ&EE 91.3%; eCM overall 73.7%); interest in STEM outside of school (eCM-NJ&EE 89.8%; eCM overall 55.3%); interest in taking STEM classes (eCM-NJ&EE 81.2%; eCM overall 51.8%); and appreciation of Army or DoD STEM research (eCM-NJ&EE 95.6%; eCM overall 50.9%). It is noteworthy that about 84% of NJ&EE students indicated that their participation in eCM resulted in an increased interest in pursuing a STEM career with the Army or DoD while only about 33% of Regional students reported this impact. Likewise, nearly all (96%) NJ&EE students reported being more aware of other AEOPs as a result of eCM, only about 50% of Regional students reported this impact.

Overall eCM Impact survey items were combined into a composite variable[20] to assess differences between student subgroups. In terms of Overall eCM Impact, National students reported significantly

[20] The Cronbach's alpha reliability for these 10 Overall eCM Impact items was 0.937.

higher levels in comparison to Regional students[21] (large effect size of d = 1.06). No statistical differences were found between students in terms of SES or race/ethnicity regarding their reported Overall Impact of eCM.

Table 37N. Participant Opinion of eCM-NJ&EE Impacts (n = 69)

	Disagree - This did not happen	Disagree - This happened but not because of eCybermission	Agree - eCybermission somewhat made me feel this way	Agree - eCybermission was primary reason	Response Total
I am more confident in my STEM knowledge, skills, and abilities	0.0%	8.7%	29.0%	62.3%	
	0	6	20	43	**69**
I am more interested in participating in STEM activities outside of school requirements	1.4%	8.7%	36.2%	53.6%	
	1	6	25	37	**69**
I am more aware of other AEOPs	1.4%	2.9%	26.1%	69.6%	
	1	2	18	48	**69**
I am more interested in participating in other AEOPs	2.9%	1.4%	44.9%	50.7%	
	2	1	31	35	**69**
I am more interested in taking STEM classes in school	5.8%	13.0%	34.8%	46.4%	
	4	9	24	32	**69**
I am more interested in earning a STEM degree	4.3%	11.6%	33.3%	50.7%	
	3	8	23	35	**69**
I am more interested in pursuing a career in STEM	1.4%	14.5%	30.4%	53.6%	
	1	10	21	37	**69**
I am more aware of Army or DoD STEM research and careers	1.4%	2.9%	23.2%	72.5%	
	1	2	16	50	**69**
I have a greater appreciation of Army or DoD STEM research	2.9%	1.4%	24.6%	71.0%	
	2	1	17	49	**69**
I am more interested in pursuing	10.1%	5.8%	31.9%	52.2%	

[21] Two-tailed independent samples t-test: $t(505) = 11.96$, $p < .0001$.

a STEM career with the Army or DoD	7	4	22	36	**69**

Table 37R. Participant Opinion of eCM Overall Impacts (n = 438)

	Disagree - This did not happen	Disagree - This happened but not because of eCybermission	Agree - eCybermission somewhat made me feel this way	Agree - eCybermission was primary reason	Response Total
I am more confident in my STEM knowledge, skills, and abilities	12.1%	14.2%	60.5%	13.2%	
	53	62	265	58	**438**
I am more interested in participating in STEM activities outside of school requirements	23.3%	21.5%	42.5%	12.8%	
	102	94	186	56	**438**
I am more aware of other AEOPs	34.5%	15.5%	38.6%	11.4%	
	151	68	169	50	**438**
I am more interested in participating in other AEOPs	37.0%	23.1%	31.1%	8.9%	
	162	101	136	39	**438**
I am more interested in taking STEM classes in school	25.3%	22.8%	39.5%	12.3%	
	111	100	173	54	**438**
I am more interested in earning a STEM degree	30.8%	26.5%	32.4%	10.3%	
	135	116	142	45	**438**
I am more interested in pursuing a career in STEM	33.8%	24.7%	30.8%	10.7%	
	148	108	135	47	**438**
I am more aware of Army or DoD STEM research and careers	33.6%	19.6%	36.5%	10.3%	
	147	86	160	45	**438**
I have a greater appreciation of Army or DoD STEM research	27.4%	21.7%	34.7%	16.2%	
	120	95	152	71	**438**
I am more interested in pursuing a STEM career with the Army or DoD	43.2%	23.7%	24.7%	8.4%	
	189	104	108	37	**438**

An open-ended item on the questionnaire asked students to list the three most important ways they

benefited from eCM. A 33% sample of the 516 responses was taken. Of the 155 responses analyzed, 143 students listed at least one benefit. The two most often-cited benefits by all students were increased knowledge in STEM (mentioned in 53% of responses) and teamwork or collaboration skills (mentioned in 50% of responses). Over a quarter of responses (29%) cited developing research skills as a benefit of eCM, while 23% cited the benefit of examining current issues and finding solutions to real world problems. Many responses also indicated that the opportunity to develop communication skills (22%), gain exposure to STEM careers (20%), manage time (18%), and develop their interest in STEM (14%) were benefits of participating in eCM. Other benefits mentioned by 10% or fewer of respondents included making friends, learning about AEOPs, learning about DoD jobs, building confidence, perseverance, and critical thinking.

Similar benefits were mentioned in student focus groups held at NJ&EE. For example:

> *I think I learned a lot, and it was a lot different from school, because it was a real-world application. We got to be more hands-on than we would be in school* (eCM-NJ&EE Student)

> *I think the whole idea of going on your own as a group and researching something [is a benefit]…In the future, if I'm really interested in something and I say, what if I could do this? Now I know that I can discover it on my own.* (eCM-NJ&EE Student)

> *The thing that this really helped me learn was how to be a part of a team because I'm not really a team person. I like to do things by myself. Doing this really helped me realize that when I'm on a team, I can take a step back and let us all contribute.* (eCM-NJ&EE Student)

> *[A benefit was] having to face so many different problems, guidelines, challenges, and having to complete a very difficult project to get through, that I learned so many skills and gained so many experiences and have a whole new perspective on things.* (eCM-NJ&EE Student)

8 | Findings and Recommendations

Summary of Findings

The FY17 evaluation of JSS collected data about participants; their perceptions of program processes, resources, and activities; and indicators of achievement in outcomes related to AEOP and program objectives. A summary of findings is provided in the following table.

2017 eCM Evaluation Findings	
Participant Profiles	
Participation in eCM increased in FY17	In FY17, 21,277 students participated in eCM, a 3% increase over the 20,607 who participated in FY16.
	As in FY16, student participation by gender was nearly equally distributed between males (49%) and females (51%).
	Students from a variety of backgrounds participated in eCM in FY17. 45% of eCM participants identified as underserved at registration. Nearly half (48%) of participants were White and 10% were Asian, while 10% were Black or African American (an increase from 8% in FY16), and 19% were Hispanic/Latino.
	Students in eCM were enrolled in a variety of school settings, with 41% of students from suburban schools, 28% from urban schools, and 17% from rural schools.
Actionable Program Evaluation	
Students learned about eCM primarily through school contacts or through personal relationships.	About half of responding students learned about eCM from someone who works at the school or university they attend, highlighting the importance of teachers in the student recruitment process. Large proportions of students who competed at the NJ&EE also reported learning about eCM through personal contacts, including friends (39%), family members (24%), and past participants (22%). Fewer regional students reported learning about eCM through these personal contacts (for example 5% learned about eCM through friends and 7% through past participants), however only 262 regional students responded to this question, and of those, nearly a quarter chose not to report how they learned about eCM.

Students are motivated to participate in eCM for a variety of reasons, although students competing at the regional level are more frequently motivated by external factors than students competing at the national level who tend to be motivated by more internal factors.	Regional students reported being primarily motivated by external factors such as teacher or professor encouragement (41%) and an academic requirement or school grade (39%). In contrast, national students reported being motivated by more internal factors such as the desire to learn something new or interesting (41%) and having fun (37%). However, only 251 regional students responded to this question and of those, over a quarter (27%) chose not to report their motivation for participating.
Most student and adult participants were satisfied with the features of eCM they had experienced, although regional students were more likely to express dissatisfaction with some program features than NJ&EE students or adults.	Over half of both regional and NJ&EE students reported being at least somewhat satisfied with most features of eCM including the website (66% and 84% respectively), educational materials (55% and 74%), and the submission process (63% and 88%). Relatively large proportions of students had not experienced resources such as the Cyber Guide live chats (53% regional and 23% NJ&EE) and Cyber Guides feedback (22% regional and 38% NJ&EE). Regional students were more likely to express being "not at all" satisfied with program features such as Mission control phone (13%) and email (12%) response time than were NJ&EE students (1% and 3% reported being not at all satisfied with these features). Students also suggested improvements in program features, commenting, for instance, that the challenge could be more clear and less complex, and that they felt that the website could be improved and the Mission Folder format's usability could be improved.
	The majority of adults were at least somewhat satisfied with all aspects of the program that they had experienced, and very few expressed being "not at all" satisfied with program features. In particular 93% were at least somewhat satisfied with the submission process and 83% were at least somewhat satisfied with the variety of challenges available. Like students, many adults had not experienced resources such as the Cyber Guides forum (54%) and Cyber Guide live chats (56%). Adults suggested a variety of improvements in the program including providing more resources for teachers and examples of completed projects. Adult focus group participants noted that Blackboard can be difficult to use and cannot be accessed at some schools.
Outcomes Evaluation	
eCM student participants reported gains in their STEM knowledge and competencies although students competing at the NJ&EE reported significantly larger gains than students competing at the	Nearly all eCM students responding to the survey reported some level of STEM Knowledge gains as a result of participating in eCM. Students who had competed at the NJ&EE, however, reported significantly greater gains than those who competed at the regional level. Students at the regional level were more likely to report that they had experienced no gains in areas such as their in-depth knowledge of a STEM topic (12% regional versus 1% NJ&EE) and knowledge of what everyday research work is like in STEM (16% regional versus 0% NJ&EE).

regional level.	Over 50% of all students at both the NJ&EE and regional levels reported medium or large gains in nearly all areas of STEM competency. Students who had competed at the NJ&EE reported significantly greater gains than those who competed at the regional level. For example: communicating about experiments in different ways (eCM-NJ&EE 94.2%; eCM overall 62.1%); supporting an explanation for an observation with data from experiments (eCM-NJ&EE 92.8%; eCM overall 63.9%); using knowledge and creativity to suggest a testable explanation for an observation (eCM-NJ&EE 88.4%; eCM overall 65.1%); and carrying out procedures for an experiment and recording data accurately (eCM-NJ&EE 98.5%; eCM overall 68.7%). Students at the regional level were more likely to report that they had experienced no gains in areas such as using computer models of objects or systems to test cause and effect relationships (31% regional versus 17% NJ&EE) and making a model of an object or system showing its parts and how they work (22% regional versus 6% NJ&EE).
	Students reported that increased knowledge in STEM, teamwork or collaboration skills, and the opportunity to develop research skills were benefits of participating in eCM.
	Students at all competition levels reported greater levels of engagement in STEM in their eCM experiences than in their typical school experiences.
	Adults reported that the opportunity for students to focus on real-work problems, work in teams, be involved in their communities, and solve problems are strengths of the eCM program.
eCM had positive impacts on students' perceptions of their 21st Century Skills although students competing at the NJ&EE reported significantly larger gains than students competing at the regional level.	Large majorities of students at all competition levels reported gains in 21st Century skills such as communicating effectively with others and sticking with a task until it is finished. Nearly 90% or more of NJ&EE participants reported "medium" or "large" gains on all 21st Century Skills items. Between 65% and 75% of overall participants reported "medium" or "large" gains on all 21st Century Skills items. Students who had competed at the NJ&EE reported significantly greater gains than those who competed at the regional level, and students at the regional level were more likely to report that they had experienced no gains than students competing at the NJ&EE. For example, 11% of regional students reported that they had not gained in viewing failure as an opportunity to learn and in working well with students from all backgrounds as compared to 0% and 4% of NJ&EE students.
	Adults reported that skills associated with 21st Century skills such as teamwork, communication, problem solving, and perseverance are among the key strengths of eCM.

Students competing at the NJE&E participants were more likely than regional students to report gains in their identity in STEM and interest in engaging in STEM activities in the future.	Like FY16 findings, questionnaire data strongly suggest that the program had a positive impact on students' identity in STEM and likelihood of engaging in STEM activities in the future for students competing at the NJ&EE level. More than three-quarters of students competing at the NJ&EE reported "medium" or "large" gains for every item. Findings for regional level students were mixed. Students at the regional level reported roughly an equal spread across the responses "no gain," "little gain," "medium gain," and "large gain" for all categories (see Table 32R). For example, nearly all NJ&EE students (98.6%) reported "medium" or "large" gains in their sense of accomplishment in a STEM endeavor compared to only 49.3% of Regional students. While nearly all (97%-100%) NJ&EE students reported being more likely to engage in STEM activities in the future after participating in eCM, relatively large percentages (40-51%) of regional students reported that there had been no change in the likelihood that they would engage in future STEM activities outside of regular school classes.
Team advisors used a range of mentoring strategies with students.	A majority of mentors reported using strategies to establish the relevance of learning activities, support the diverse needs of students as learners, support students' development of collaboration and interpersonal skills, support students' engagement in authentic STEM activities, and support students' STEM educational and career pathways.
While most students at all competition levels learned about general careers in STEM, students competing at the NJ&EE level were much more likely to be familiar with DoD STEM jobs or careers.	All NJ&EE students and 66% of regional students had learned about at least 1 STEM job or career during eCM. In contrast, while all NJ&EE students had learned about DoD STEM jobs or careers, less than a third (31%) of regional students had learned about any of these careers. Likewise, while 68% of national students had learned about 5 or more DoD STEM jobs or careers, only 3% of regional students had learned about this number of DoD Stem jobs or careers, suggesting that NJ&EE is a more effective forum for introducing participants to DoD career opportunities than the regional events.
	Adults reported that the most useful resources for exposing students to DoD STEM careers were participation in eCM (76% reported this was at least somewhat useful) and the eCM website (76% reported this was at least somewhat useful). Most adults had not experienced resources such as AEOP on social media (75%), the AEOP brochure (72%), or the AEOP website (58%).
	Over three-quarters (84%) of NJ&EE students indicated that their participation in eCM resulted in an increased interest in pursuing a STEM career with the Army or DoD while only a third of Regional students reported this impact.
	Student focus group participants at the NJE&E reported that the speakers were a key source of information about STEM jobs and careers in the DoD.
eCM participants were likely to express interest in participating in eCM again, however the	Nearly all students (97%) competing at the NJ&EE level, were at least a little interested in competing in eCM again, and 77% of students at the regional level were interested in competing again.

majority of students at the regional level had not heard of other AEOPs.	Findings suggest that students are exposed to other AEOPs at NJ&EE since most NJ&EE students had heard of all other AEOPs and over half expressed being at least somewhat interested in participating in most programs in the future. Students in the NJ&EE focus group credited the alumni panel for some of their familiarity with AEOPs. Surprisingly, NJ&EE students were least likely to have heard of JSS (38% had not heard of it), a program for which middle school students are eligible. Most regional students (60%-71%) had not heard of AEOPs other than eCM and smaller proportions of regional students were interested in future participation.
	Nearly all (96%) NJ&EE students reported being more aware of other AEOPs as a result of eCM, however only 50% of Regional students reported this impact.
	Few adults (1%-9%) reported discussing any other AEOPs with students other than eCM, although over a third (34%) reported that they had discussed AEOP but had not discussed any specific program.
	Adults reported that participating in eCM and the eCM website were the most useful resources for exposing students to AEOPs.
While eCM had positive impact for students competing at all levels, NJ&EE students reported significantly higher levels of impact.	More than half of all students (NJ&EE and Regional) agreed that eCM positively impacted their confidence in STEM knowledge, skills, and abilities (eCM-NJ&EE 91.3%; eCM overall 73.7%); interest in STEM outside of school (eCM-NJ&EE 89.8%; eCM overall 55.3%); interest in taking STEM classes (eCM-NJ&EE 81.2%; eCM overall 51.8%); and appreciation of Army or DoD STEM research (eCM-NJ&EE 95.6%; eCM overall 50.9%).
	Students who competed at the NJ&EE reported statistically significantly higher levels of impact than overall/Regional students. This included items such as confidence in STEM, interest in STEM, awareness of AEOPs, and future interest in STEM education and careers. These findings suggest that attending the NJ&EE event has greater impacts on students than competing at the regional level.

Responsiveness to FY16 Evaluation Recommendations

The primary purpose of the AEOP program evaluation is to serve as a vehicle to inform future programming and continuous improvement efforts with the goal of making progress toward the AEOP priorities. In previous years the timing of the delivery of the annual program evaluation reports has precluded the ability of programs to use the data as a formative assessment tool. However, beginning with the FY16 evaluation, the goal is for programs to be able to leverage the evaluation reports as a means to target specific areas for improvement and growth.

In this report, we will highlight recommendations made in FY16 to programs and summarize efforts and outcomes reflected in the FY17 APR toward these areas.

AEOP Priority: Broaden, deepen, and diversify the pool of STEM talent in support of our Defense

Industry Base

FY16 Finding: The AEOP objective of broadening, deepening, and diversifying the pool of STEM talent continues to be a challenge for eCM. The majority of students participating in the regional competition were White, and proportionally more White and Asian students proceeded to the NJ&EE than Hispanic and Latino/a and Black and African American students. It is recommended for the program to consider doing more to recruit students from schools serving historically underserved groups and to find ways to support these students so that they can potentially progress to the National competition.

Participation in eCM overall declined largely in FY16. Nearly 13% of potential participants were not retained through the registration process. Additionally, there was an 18% decrease in the participants from 2015. Retention/attrition through the registration process is something that should be focused on in FY17. It is recommended that there is a concerted effort in FY17 to increase participation in the program overall.

eCM FY17 Efforts and Outcomes: NSTA developed a new rubric for the Mini-Grant program to target more Title I schools. NSTA addressed some U.S. citizenship issues that tend to arise from the U/U groups. NSTA worked with new AEOP Strategic Outreach Partners to increase the number of students in the U/U population. eCM also attended conferences in states with low registration numbers.

AEOP Priority: Support and empower educators with unique Army research and technology resources

FY16 Finding: Mentors and participants expressed overall satisfaction with the resources available to them through participation in eCM and the eCM website. At the same time, however, both Team Advisors and students reported little familiarity with Army resources such as the AEOP website, the It Starts Here! magazine, and the AEOP brochure. This suggests that participants may not make connections between eCM and some AEOP resources. Interestingly, it was clear in the national student surveys and focus group interviews that the NJ&EE participants recognized the connection between eCM and Army sponsorship – so the lack of familiarity of AEOP resources did not hinder their awareness of eCM being an Army/DoD focused effort. However, better marketing and use of the website, brochure, and other AEOP resources may assist with recruitment for other AEOPs and retention of participants in the AEOP pipeline. Although recent efforts of NSTA to improve the eCM website to make clear the association of eCM with the AEOP, it may be useful to provide AEOP brochures electronically to teams at all state and regional eCM events, and to consider ways in addition to the "Volunteer Spotlight" to communicate a variety of STEM careers available in the DoD, particularly to the state and regional students.

eCM FY17 Efforts and Outcomes: NSTA provided AEOP brochures electronically to all Team Advisors and students through an eblast once they completed registration December 7, 2017. In addition, the AEOP

Brochure can be found on the eCM website. CyberGuide biographies were prevalent on the website and CyberGuide S/E experiences were highlights in CyberGuide Chat promotion to students and parents. U.S. Army Scientists and Engineers were profiled in blogs and through advertorials printed in the Pentagram and DC Military Magazine. This was done to recruit more CyberGuides and Virtual Judges to support students.

AEOP Priority: Develop and implement a cohesive, coordinated and sustainable STEM education outreach infrastructure across the Army

FY16 Finding: Students continue to report having little knowledge of other programs in the AEOP. This is an area of concern due to the overarching goal of creating an AEOP pipeline and retention of participants in additional AEOPs. Although students at the national level and to a lesser extent at the regional level reported gains in their STEM knowledge, confidence and identity, students were largely unaware of programs for which they are or will soon be eligible. Only a quarter of the Team Advisors discussed other AEOP programs with their students. Although NSTA responded appropriately to earlier recommendations by connecting the AEOP logo with the AEOP website and explaining this connection in the video tutorial, the evaluation results suggest that more should be done to make the connection and to inform students of future opportunities in AEOP. In addition, since Team Advisors are an important source of student information, additional efforts should be made to educate Team Advisors about the AEOP and programs for which their students are eligible. One suggestion would be to include a dedicated webinar for Team Advisors and students using the eCM website.

eCM FY17 Efforts and Outcomes: NSTA continued to work with Widmeyer to improve messaging about eCM specifically and AEOP overall. NSTA promoted AEOP STEM efforts at conferences through the distribution of the AEOP Brochure and AEOP rack cards as well as the use of the AEOP Tabletop and new displays, which became available in May. All NSTA staff received training with regards to all AEOP initiatives. NSTA collaborated with RESET to cross-promote AEOP at NSTA's National Conference. NSTA also worked closely with the AEOP Alumni Group to promote AEOP opportunities to eCM Alumni. eCM contributed content to the AEOP blog, was promoted by Widmeyer on AEOP social media, and eCM collaborated with Widmeyer during the AEOP website redesign efforts.

Recommendations for FY18 Program Improvement/Growth

Evaluation findings indicate that FY17 was a success overall for the eCM program. Notable successes for the year include a 3% growth in percentage of participants overall and nearly equivalent participation of male (49%) and female (51%) students. Further, eCM grew the percentage of African American/Black participants by 8% and continued to have good participation from Hispanic/Latinos (19%). Schools and teachers remained the primary mode of recruitment for participation in the program. Participants reported growth in STEM knowledge overall and over 50% at both NJ&EE and regional levels

experienced medium or large gains in nearly all areas of STEM competency. While these successes are commendable, there are some areas that remain with potential for growth and/or improvement.

The evaluation team therefore offers the following recommendations for FY18 and beyond:

AEOP Priority: Support and empower educators with unique Army research and technology resources

Despite NSTA's continued efforts in outreach to the Team Advisors and subsequently students through emails and the eCM website, the results of the survey indicate that, as in FY16 (53% regional; 23% NJ&EE) and few participants use the CyberGuide live chat (22% regional; 38% NJ&EE). NSTA should continue to work to market to participants the value of the use of these important resources to increase the usage.

In FY17, more than a third of regional eCM participants (31%) reported on the evaluation survey they had not learned about any DoD/STEM jobs/careers. Conversely, 68% of NJ&EE participants reported learning about five or more DoD/STEM careers. NSTA should continue to work with regional sites to infuse the learning and connections of the program to the DoD and relevant STEM careers within and outside of the DoD.

AEOP Priority: Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army

Students continue to report having little knowledge of other programs in the AEOP. This is an area of concern due to the overarching goal of creating an AEOP pipeline and retention of participants in additional AEOPs. Over a third (38%) of NJ&EE students had never heard of JSS, indicating two things: 1) eCM is likely their first program in the AEOP pipeline, and 2) eCM may not be marketing this program as frequently as other opportunities. Few Team Advisor/Adults (9%) reported discussing any other AEOPs with students besides eCM, a decrease from 25% in FY16. Most regional participants (60-71%) had not heard of other individual AEOPs. As stated in FY16, the evaluation results suggest that more should be done to make the connection and to inform students of future opportunities in AEOP. In addition, since Team Advisors are an important source of student information, additional efforts should be made to educate Team Advisors about the AEOP and programs for which their students are eligible