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ARMY EDUCATIONAL OUTREACH PROGRAM

2018 Annual Program Evaluation Report
Summative Findings

August 2019

ARMY EDUCATIONAL OUTREACH PROGRAM

1 | AEOP Consortium Contacts

U.S. Army Contacts

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

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

AEOP Cooperative Agreement Manager Organization

Christina Weber
AEOP Cooperative Agreement Manager
U.S. Army Combat Capabilities Development Command (CCDC)
christina.l.weber.civ@mail.mil

Battelle Memorial Institute – Lead

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

Evaluation Team Contacts – NC State University

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

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

Janet B. Walton, Ph.D.
Assistant Director, AEOP CA
jwalton2@ncsu.edu

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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-undergraduate 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, providing a management structure that collectively markets the portfolio among members, leveraging available resources, and providing expertise to ensure the programs provide the greatest return on investment in achieving the Army's STEM priorities and objectives toward a STEM literate citizenry, STEM savvy educators, and sustainable infrastructure.

2018 Portfolio Overview

This report includes a detailed evaluation of the FY18 AEOP activities. A summary of individual program level data is outlined in Table 1 below, which includes applicant and participant data, numbers of Army and DoD S&Es, participating K-12 schools and colleges/universities, and collaborating organizations including Army and DoD laboratories. Overall participant data summarized for youth and adults by program are presented in Table 2. Partner participation is outlined in Table 3 including the numbers of collaborating schools, both K-12 and college/universities, as well as Army and DoD laboratories, and S&Es. Program costs are detailed in Table 4.

In FY18, AEOP initiatives served 30,311 participants, a slight (9%) decrease from FY17 when 32,947 participants were served. However, there was an increase (12%) in the number of adults (9,774) that participated in FY18 AEOP activities, compared to FY17. These adults included 1,919 DoD S&Es and other adults serving in mentor roles for research apprenticeships (CQL, REAP, SEAP, and URAP), judges for competitions (eCM, JSS, and JSHS), and presenters in STEM enrichment activities (GEMS and Unite) as well as in Army/DoD STEM showcases at competitions (eCM and JSHS).

Table 1. 2018 AEOP Initiatives	
Camp Invention Initiative (CII) **Program Administrator: U.S. Army Corps of Engineers – Engineering Research & Development Center (ERDC)**	
Description	One week STEM Enrichment activity for K-6 students
Number of Participants	1,805
Number of Applicants	1,993
Number of Participants	1,805
Number of Teachers & Other Volunteers	153
Number of Sites	22
Number of Army research laboratories	12
Number of K-12 Schools	22
Number of K-12 Schools – Title I	21
Total Cost	$419,750
Cost Per Student Participant	$233
College Qualified Leaders (CQL) **Program Administrator: Academy of Applied Science (AAS)**	
Description	STEM Apprenticeship Program – Summer or school year, at Army laboratories with Army S&E mentors
Participant Population	College undergraduate students
Number of Applicants	574
Number of Participants	214
Placement Rate	37%
Number of Mentors	216
Number of Army S&Es	216
Number of Army Research Laboratories	13
Number of Colleges/Universities	113
Number of HBCU/MIs	17
Total Cost	$1,747,201
AAS Administrative costs	$104,317

Participant Stipends	$1,596,992
Other Operational Costs (Overhead)	$58,136
Cost Per Student Participant	$8,164
eCYBERMISSION (eCM) **Program Administrator: National Science Teachers Association (NSTA)**	
Description	STEM Competition - Nationwide (including DoDEA schools), web-based, including one national event
Participant Population	6th-9th grade students
Number of Student Applicants	22,391
Number of Participants	20,004
Placement Rate	NA (all students who register may participate)
Submission Completion Rate	76%
Number of Adults (Team Advisors and Volunteers – incl. S&Es and Teachers)	3,469
Number of Team Advisors (Predominantly math and science teachers)	869
Number Volunteers (Ambassadors, Cyberguides, Virtual Judges)	2,600
Number of Army S&Es	1,081
Number of Army/DoD Research Laboratories	29
Number of K-12 Teachers (including pre-service teachers)	791
Number of K-12 Schools	572
Number of K-12 Schools – Title I	278
Number of Colleges/Universities	26
Number of HBCU/MSIs	6
Number of DoDEA Students	476
Number of DoDEA Teachers	14
Number of DoDEA Schools	13
Number of Other Collaborating Organizations	12

Total Cost	$3,189,980
Administrative/Overhead & Indirect Costs	$1,436,761
Mini-grants and Savings Bonds	$785,674
National Judging & Educational Event	$351,811
Travel costs – paid for participants and staff	$196,110
Travel costs – paid for S&E's	$47,892
Other Operational Costs	$324,440
Cost Per Student Participant	$159
Gains in the Education of Mathematics & Science (GEMS) **Program Administrator: National Science Teachers Association (NSTA)**	
Description	STEM Enrichment Activity - at Army laboratories, hands-on
Participant Population	5th-12th grade students (secondary audience: college undergraduate near-peer mentors, teachers)
Number of Applicants	5,486
Number of Participants	3,341
Placement Rate	61%
Number of Adults	595
Number of Near-Peer Mentors	152
Number of Army S&Es	366
Number of Army Research Laboratories	18
Number of K-12 Teachers	77
Number of K-12 Schools	1,165
Number of K-12 Schools – Title I	409
Number of Colleges/Universities	67
Number of HBCU/MSIs	2
Other Collaborating Organizations	11
Number of DoDEA Students	1

Number of DoDEA Teachers	0
Number of DoDEA Schools	1
Total Cost	$1,456,996
Administratative/Overhead/Indirect/Procurement Fee Costs	$250,898
Participant Stipends (Students, NPMs & RTs)	$951,772
Supplies/Equipment/Transportation ODCs sent directly to Labs	$191,771
Travel costs – paid for S&E's	$9,107.68
Cost Per Student Participant	$436
High School Apprenticeship Program (HSAP) Program Administrator: Academy of Applied Science (AAS)	
Description	STEM Apprenticeship Program – Summer, in Army-funded laboratories at colleges/universities nationwide, with college/university S&E mentors
Participant Population	11th-12th grade students
Number of Applicants	559
Number of Participants	48
Placement Rate	9%
Number of Adults (Mentors)	53
Number of College/University S&Es	53
Number of K-12 Schools	45
Number of K-12 Schools – Title I	15
Number of Army-Funded College/University Laboratories	33
Number of College/Universities	33
Number of HBCU/MSIs	13
Total Cost	$202,436
Administrative costs	$23,182

Participant Stipends	$143,800
Other Operational Costs (Overhead)	$12,919
Cost Per Student Participant	$4,217
Junior Science & Humanities Symposium (JSHS) **Program Administrator: Academy of Applied Science (AAS)**	
Description	STEM Competition - Nationwide (incl. DoDEA schools), research symposium that includes 47 regional events and one national event
Participant Population	9th-12th grade students
Number of Applicants	4,279
Number of Participants	3,069 Regional Participants (of whom 202 were selected to attend the National JSHS Symposium)
Placement Rate	72%
Number of Adults (Mentors, Regional Directors, Volunteers – incl. Teachers and S&Es)	4,199
Number of Army and DoD S&Es	139
Number of Army/DoD Research Laboratories	48
Number of K-12 Teachers	804
Number of K-12 Schools	1,005
Number of K-12 Schools – Title I	240
Number of DoDEA Students	127
Number of DoDEA Teachers	29
Number College/University Personnel	1,072
Number of Colleges/Universities	119
Number of HBCU/MSIs	7
Number of Other Collaborating Organizations	76
Total Cost	$1,871,919
Administrative/Overhead/Indirect/Cost Share	$314,963
Regional JSHS Support	$730,335

National Program	$328,832
Scholarships and Awards	$420,000
Other Operational Costs	$59,084
Travel costs – paid for S&E's	$18,705
Cost Per Student Participant	$609
Junior Solar Sprint (JSS) **Program Administrator: Technology Student Association (TSA)**	
Description	STEM Competition - Solar car competition regional events at Army laboratories, TSA state events, and a national event hosted in conjunction with the TSA national conference
Participant Population	5th-8th grade students
Number of Applicants/Participants	1,170 total registered applicants; 1,081 participants
Placement Rate	NA (all students who register may participate)
Number of Adults (Mentors and Volunteers – incl. Teachers and Army S&Es)	328
Number of K–12 Teachers (including preservice)	299
Number of Army S&Es	0
Number of Army/DoD Research Laboratories	NA
Number of K-12 Schools	373
Number of K-12 Schools – Title I	96
Number of Other Collaborating Organizations	4
Total Cost	$184,552
Administrative/Overhead & Indirect	$124,918
National Scholarships	$17,701
JSS Solar Panel Kits	$12,296
Other Operational Costs	$29,637
Travel costs – paid for participants and staff	$21,065.00
Cost Per Student Participant	$171

Research & Engineering Apprenticeship Program (REAP) Program Administrator: Academy of Applied Science (AAS)	
Description	STEM Apprenticeship Program – Summer, at colleges/university laboratories, targeting students from groups historically underserved and under-represented in STEM, college/university S&E mentors
Participant Population	Rising 10th, 11th, and 12th grade high school students, rising first-year college students from groups historically underserved and under-represented in STEM
Number of Applicants	949
Number of Participants	138
Placement Rate	15%
Number of Adults (Mentors)	117
Number of College/University S&Es	117
Number of College/Universities	53
Number of HBCU/MSIs	31
Number of K–12 Schools	167
Number of K–12 Schools — Title I	119
Total Cost	$398,640
AAS Administrative Costs	$69,545
Participant Stipends	$298,500
Other Operational Costs (Overhead)	$38,757
Cost Per Student Participant	$2,889
Research Experiences for STEM Educators and Teachers (RESET)	
Description	RESET provides a summer research experience at participating Army Laboratories and on-line for teachers and educators across the nation.
Participant Population	Middle school and high school STEM educators
Number of Applicants/Teachers	27

Number of Participants	20
Placement Rate (percentage)	79%
Number of Adults	25
Number of Army S&Es	5
Number of Army/DoD Research Laboratories	4
Number of K–12 Teachers	20
Number of K–12 Schools	20
Number of K–12 Schools — Title I	7
Number of Colleges/Universities	1
Number of Other Collaborating Organizations	5
Total Cost	$141,964
Administrative Costs (salaries, fringe, indirect, cost share)	$48,505
Teacher Stipends and travel	$79,860
Travel	$5,137
Other costs	$8,462
Cost Per Participant	$7,098
Science & Engineering Apprentice Program (SEAP) **Program Administrator: Academy for Applied Science (AAS)**	
Description	STEM Apprenticeship Program – Summer, at Army laboratories with Army S&E mentors
Participant Population	9th-12th grade students
Number of Applicants	872
Number of Participants	114
Placement Rate	13%
Number of Adults (Mentors)	150
Number of Army S&Es	150
Number of Army Research Laboratories	11

Number of K-12 Schools	76
Number of K-12 Schools – Title I	38
Total Cost	$437,550
AAS Administrative Costs	$57,954
Participant Stipends	$354,100
Other Operational Costs (Overhead)	$32,298
Cost per student participant	$3,838
Unite **Program Administrator: Technology Student Association (TSA)**	
Description	STEM Enrichment Activity - Pre-collegiate, engineering summer program at university host sites, targeting students from groups historically underserved and under-represented in STEM
Participant Population	Rising 9th – 12th grade students from groups historically underserved and under-represented in STEM
Number of Applicants	731
Number of Participants	429
Placement Rate	59%
Number of Adults	401
Number of Army S&Es	27
Adult Volunteers (not Army S&E's or K-12 Teachers)	222
Number of Army DoD Research Laboratories	4
Number of K-12 Teachers & University Educators	49 K-12; 103 university
Number of K-12 Schools	211
Number of K-12 Schools – Title I	84
Number of Colleges/Universities	19
Number of HBCU/MSIs	10
Other Collaborating Organizations	38

Total Cost	$757,752
Administrative/Overhead/Indirect costs	$125,848
Host Site Awards	$602,283
Travel	$14,896
Other costs	$14,725
Cost Per Student Participant	$1,766
Undergraduate Research Apprenticeship Program (URAP) Program Administrator: Academy of Applied Science (AAS)	
Description	STEM Apprenticeship Program – Summer, in Army-funded labs at colleges/universities nationwide, with college/university S&E mentors
Participant Population	College undergraduate students
Number of Applicants	321
Number of Participants	67
Placement Rate	20%
Number of Adults (Mentors)	68
Number of College/University S&Es	68
Number of Army-Funded College/University Laboratories	41
Number of College/Universities	48
Number of HBCU/MSIs	22
Total Cost	$409,561
AAS Administrative Costs	$34,772
Participant Stipends	$296,100
Other Operational Costs (Overhead)	$19,379
Cost Per Student Participant	$6,113

Youth and adult participation data reported by individual programs are presented in Table 2. These are the total participants in programs as reported by the Individual Program Administrators (IPAs). By contrast, in Table 3 the verified and validated data is presented for underserved students in the AEOP

programs for FY18. Table 3 only utilizes data from the Cvent registration system. Therefore, the total number of participants in Table 2 will exceed Table 3 for FY18, as not all sites for all programs fully implemented the use of Cvent to register all participants.

Table 2 breaks out the total 30,311 youth and 9,774 adults who participated in AEOPs in FY18 by program. This represents an 9% decrease in youth participation as compared to FY17 when 32,947 youth participated but a 12% increase in adult participation as compared to the 8,607 adults who participated in FY17. Of the 2017 participants, 604 students and 43 teachers were from DoDEA schools (participating in eCM, GEMS, and JSHS). The majority of adults, including Army S&Es and K-12 teachers, volunteered with the eCM (3,5904 adults) and JSHS (4,199 adults) competitions. Youth participation increased in 5 programs (CII, GEMS, REAP, SEAP Unite, and URAP) while youth participation in other programs declined slightly (CQL, eCM, HSAP, JSHS, and JSS).

Table 2. 2018 AEOP Participation by Youth and Adults Reported by Programs

		Youth	Adults
CII	Camp Invention Initiative	1,805	153
CQL	College Qualified Leaders	214	216
eCM	eCYBERMISSION	20,004	3,469
GEMS	Gains in the Education of Mathematics & Science	3,341	595
HSAP	High School Apprenticeship Program	48	53
JSHS	Junior Science & Humanities Symposium	3,069	4,199
JSS	Junior Solar Sprint	1,081	328
REAP	Research & Engineering Apprenticeship Program	139	117
RESET*	Research Experiences for STEM Educators and Teachers	0	25
SEAP	Science & Engineering Apprentice Program	114	150
Unite	Unite	429	401
URAP	Undergraduate Research Apprenticeship Program	67	68
	Total 2018 AEOP Participants	**30,311**	**9,774**

*Note – RESET participants are teachers, therefore has no youth participants.

Table 3 takes a closer look at youth participant demographics and underserved status (U2). In FY 18, the percentage of U2 student participants increased by 7% to 45% overall, compared to 38% for FY17 (in FY17 the programs reported data, not verified by the evaluation team). The AEOP definition of underserved and underrepresented is that participants who possess at least two of the following criteria are considered U2: attend a rural, urban, or frontier/tribal school; identify as female, identify as racial/ethnic minority, receive free or reduced lunch price at school; speak a language other than English as their primary language; or have no parents who have attended college. Overall, 45.5% of FY18 AEOP youth participants were classified as U2.

HSAP, REAP, Unite, and eCM reached a population of students that was comprised of over 50% U2 participants. JSHS, GEMS, and JSS had less than 40% participation. Three apprenticeship programs included less than 30% U2 students (URAP, CQL, SEAP).

Table 3. 2018 AEOP Youth Participant Underrepresented (U2) Data by Program							
Program	**School – Rural, Urban, Frontier**	**Female**	**Racial/ Ethnic Minority**	**FARMS**	**ELL**	**College First Generation**	**U2**
CQL (n=214)	NA	97 (45.3%)	41 (19.2%)	NA	7 (3.3%)	35 (16.4%)	**43 (20.1%)**
HSAP (n=48)	19 (39.6%)	29 (60.4%)	15 (31.3%)	8 (16.7%)	5 (10.4%)	4 (8.3%)	**26 (54.2%)**
REAP (n=138)	76 (55.1%)	85 (61.6%)	94 (68.1%)	76 (55.1%)	37 (26.8%)	49 (35.5%)	**133 (96.4%)**
SEAP (n=114)	31 (27.2%)	60 (48.0%)	19 (16.7%)	10 (8.8%)	6 (5.3%)	2 (1.8%)	**31 (27.2%)**
Unite (n=429)	329 (76.3%)	266 (61.7%)	314 (72.9%)	305 (70.1%)	79 (18.3%)	220 (51.0%)	**399 (92.6%)**
URAP (n=67)	NA	26 (38.8%)	13 (19.4%)	NA	4 (6.0%)	10 (14.9%)	**12 (17.9%)**
eCM (n=19,860)	8,074 (40.7%)	10,060 (50.7%)	6,486 (32.7%)	5,598 (28.2%)	2,531 (12.7%)	2,588 (13.0%)	**10,248 (51.6%)**
NJ&EE (n=78)	27 (34.6%)	48 (61.5%)	6 (7.7%)	8 (10.3%)	12 (15.4%)	2 (2.6%)	**25 (32.1%)**
R-JSHS (n=2,955)	1,074 (36.3%)	1,712 (57.9%)	344 (11.6%)	323 (10.9%)	223 (7.5%)	235 (8.0%)	**1,088 (36.8%)**
N-JSHS (n=202)	81 (40.1%)	120 (59.4%)	14 (6.9%)	13 (6.4%)	10 (5.0%)	12 (5.9%)	**77 (38.1)**
JSS (n=1,081)	429 (39.7%)	399 (36.9%)	227 (21.0%)	184 (17.0%)	64 (5.9%)	112 (10.4%)	**368 (34.0%)**
GEMS (n=3,251)	540 (16.6%)	1,521 (46.8%)	1,077 (33.1%)	447 (14.7%)	163 (5.0%)	287 (8.8%)	**1,122 (34.5%)**
Total (N=28,437)	10,680 (37.9%)	13,860 (48.7%)	9,308 (32.7%)	6,591 (23.4%)	3,025 (10.6%)	3,556 (12.5%)	**12,940 (45.5%)**

Note - Data for some programs must be interpreted with caution as there was a considerable amount of missing/choose not to respond demographic data in registration files which introduces measurement error in determining U2 status. Additionally, many participants shared no demographic data which makes it impossible to determine U2 status. Specifics for individual program analyses are as follows:

- **CQL**: 0%-3.3% missing individual demographics; all participant U2 calculated
- **HSAP**: 0%-4.2% missing individual demographics; all participant U2 calculated
- **REAP**: 0%-4.3% missing individual demographics; all participant U2 calculated
- **SEAP**: 0%-8.8% missing individual demographics; all participant U2 calculated
- **Unite**: 0%-5.6% missing individual demographics; all participant U2 calculated
- **URAP**: 1.5%-7.5% missing individual demographics; all participant U2 calculated
- **eCM**: 47.1%-53.2% missing individual demographics; 333(1.7%) participant U2 not calculated
- **NJ&EE**: 34.7%-43.1% missing individual demographics; 3(3.8%) participant U2 not calculated
- **JSHS**: 1.6%-33.1% missing individual demographics; 33(1.1%) participant U2 not calculated
- **N-JSHS:** 0.5%-19.8% missing individual demographics; all participant U2 calculated
- **JSS:** 2.4%-39.4% missing individual demographics; 1(0.1%) participant U2 not calculated
- **GEMS**: 0.2%-48.5% missing individual demographics; all participant U2 calculated; results based on unique participants as 80 students participated in more than 1 GEMS program (90 lines of students) and duplicates were removed

Collaboration with other organizations and the involvement of adult participants who serve as mentors, judges, team advisors, and in various other roles are key assets of the AEOP (Table 4). In particular, AEOP initiatives are distinguished from other STEM outreach programs by the AEOP's ability to leverage Army and DoD S&Es and Army and DoD laboratories in its programs. The 9,875 adults who served as mentors, judges, presenters, and other volunteers within AEOP apprenticeships, competitions, and STEM programs across the country represented DoD/Army laboratories, K-12 schools, and college/universities. In 2018, 1,984 adult participants were Army/DoD S&Es and 238 were college or university S&Es. Of these, 604 served as mentors to student apprentices in CQL, HSAP, REAP, SEAP, and URAP. Another 1,081 Army/DoD S&Es participated in eCM as judges and in other roles (i.e. Cyberguides and ambassadors), 366 participated in GEMS, 139 served as judges and presenters in JSHS, 5 as mentors for teachers in RESET, and 27 as presenters in Unite. This is a decrease in Army/DoD S&E participation as compared to FY17 when 2,137 Army and DoD S&Es participated in AEOPs. Four of the 12 AEOP initiatives (GEMS, SEAP, RESET and CQL) took place at Army laboratories. HSAP and URAP apprentices were placed in 74 Army-funded laboratories at colleges and universities around the country, with 121 college/university S&Es serving as mentors to HSAP and URAP apprentices.

The AEOP also actively engaged K-12 participants both nationally and internationally (from DoDEA schools) in FY18 programs. Youth and teachers from 3,656 K-12 schools (1,518 with Title I status) participated in AEOPs in 2018. K-12 teachers are frequently a source of information about AEOPs for their students and are especially critical to the success of the eCM, JSS, and JSHS competitions, often engaging entire classrooms of students in the programs and serving as team advisors or mentors. In 2018, 791 K-12 teachers participated in eCM, 299 in JSS, and 804 in JSHS.

Colleges and universities are also key collaborators for AEOP programming. College and university S&Es, students, and other staff actively participated in AEOP initiatives such as HSAP, URAP, Unite, and GEMS in 2018. Colleges and universities across the U.S. acted as host sites for JSHS regional symposia (46), the Unite summer program (19), and the HSAP (33) and URAP (48) apprenticeship programs. The total number of colleges, universities, and laboratories are not totaled in Table 4 due to the fact that many of these partners engage with more than one AEOP program.

Table 4. Number of 2018 Collaborating Schools, Laboratories, Army/DoD S&Es, and Other Organizations

Program	K-12 Schools		Colleges/Universities (represented by participants or serving as host sites)		Army and DoD Research Labs/ Army Agencies	Army-Funded University Labs	Army and DoD Scientists & Engineers (S&Es)	Other Collaborating Organizations
	Total	Title I	Total	HBCU/ MIs				

Camp Invention (CII)	22	21	NA	NA	12	NA	NA	NA
College Qualified Leaders (CQL)	NA	NA	113	7	13	NA	216	NA
eCYBERMISSION (eCM)	572	278	26	6	29	NA	1,081	12
Gains in the Education of Mathematics and Science (GEMS)	1,165	409	67	2	18	NA	366	11
High School Apprenticeship Program (HSAP)	45	15	33	13	NA	33	NA	NA
Junior Science and Humanities Symposium (JSHS)	1,005	240	119	7	48	NA	139	76
Junior Solar Sprint (JSS)	373	96	NA	NA	NA	NA	0	4
Research and Engineering Apprenticeship Program (REAP)	167	119	53	31	NA	NA	NA	NA
Research Experiences for STEM Educators (RESET)	20	7	1	0	4	NA	5	5
Science and Engineering Apprentice Program (SEAP)	76	38	NA	NA	11	NA	150	NA
Unite	211	84	19	10	4	NA	27	38
University Research Apprenticeship Program (URAP)	NA	NA	48	22	NA	41	NA	NA

Total	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**1,984**	**NA**

Costs associated with the implementation of the FY18 AEOP portfolio of programs are detailed in Table 5. The portfolio is broken into four categories of programming: competitions, STEM enrichment programs, apprenticeships, and STEM educator programs. As in previous years, the apprenticeship programs and the STEM educator program (RESET) had the highest costs per participant while the competitions were the least costly of the AEOPs on a per student basis. The cost of AEOP competitions (eCM, JSS, and JSHS) in FY17 ranged from $159 per student (eCM) to $609 per student (JSHS). The cost of STEM enrichment programs (CII, GEMS, Unite) ranged from $233 per student for CII, typically a 1-week summer STEM experience, to $1,766 for Unite, a 4-6-week summer STEM experience for students from historically underserved and under-represented groups. Apprenticeship program (CQL, HSAP, REAP, SEAP, URAP) costs ranged from $2,889 per apprentice (REAP) to $7,463 per apprentice (CQL), with cost variations reflecting the duration of the program and academic level of apprentices. RESET is currently the only STEM educator program in the AEOP and cost $7,098 per participant in 2018.

Two programs, GEMS and Unite, had slightly lower costs per student participant in FY18 as compared to FY17. All other programs experienced slight increases in cost per student in FY18 as compared to FY17.

Table 5. 2018 AEOP Costs

	Program Type	Program Cost	Cost Per Participant	Average Stipend Per Participant
CII	STEM Enrichment Program (grades K-6)	$419,750	$233	NA
CQL	STEM Apprenticeship Program (undergraduate/graduate)	$1,747,201	$8,164	$7,463
eCM	STEM Competition (grades 6-9)	$3,189,980	$159	NA
GEMS	STEM Enrichment Program (grades 5-12)	$1,447,889	$433	$268*
HSAP	STEM Apprenticeship Program (grades 9-12)	$202,436	$4,217	$2,996
JSHS	STEM Competition (grades 9-12)	$1,871,919	$609	NA
JSS	STEM Competition (grades 5-8)	$184,552	$171	NA
REAP	STEM Apprenticeship Program (grades 9-12)	$398,640	$2,889	$2,147
RESET	STEM Educator Program	$141,964	$7,098	$3,993

SEAP	STEM Apprenticeship Program (grades 9-12)	$437,550	$3,838	$3,106
Unite	STEM Enrichment Program (grades 9-12)	$757,752	$1,766	NA
URAP	STEM Apprenticeship Program (undergraduate)	$409,561	$6,113	$4,419

* Average stipend for GEMS program includes stipends for student participants (3,341), NPMs (151), and RTs (68)

4 | Evaluation Strategy

The 2018 AEOP portfolio evaluation was conducted by Purdue University, the lead for AEOP evaluation, 2015-2025. The evaluation was comprised of a two-pronged strategy. The first and primary focus of the evaluation was to assess current program year effectiveness for each of eleven AEOP elements: CQL, eCM, GEMS, HSAP, JSHS, JSS, REAP, RESET, SEAP, Unite, and URAP. The secondary focus of the evaluation, beginning in FY16, was a long-term alumni study. This component includes an examination of the mid to long-term outcomes of the AEOP.

The evaluation team conducted all data collection for FY18 including questionnaire data for programs and alumni, site visits for selected programs, 21st Century Skill assessments, and focus group/individual interviews with selected program participants (both current and alumni). Purdue University conducted all data analysis and prepared all AEOP FY18 evaluation reports with the exception of the Camp Invention Initiative (CII). Purdue University assessed and evaluated eleven of the AEOP elements in collaboration with AEOP CA consortium members,[1] individual program administrators (IPAs), the Army Cooperative Agreement Managers (CAMs), and personnel responsible for implementing programs at specific sites (Command Level Coordinators, Lab Coordinators, Regional Directors, etc.). The 2018 AEOP evaluation was standardized across all programs, with the exception of RESET, to allow for the reporting of consistent information about program quality and impacts. Because of the small number of RESET participants, a formative approach consisting of interviews with participants and information provided by the IPA was utilized to evaluate the program. Elements of the data available through Camp Invention that were aligned with the overall AEOP portfolio evaluation are included for reference in this report.

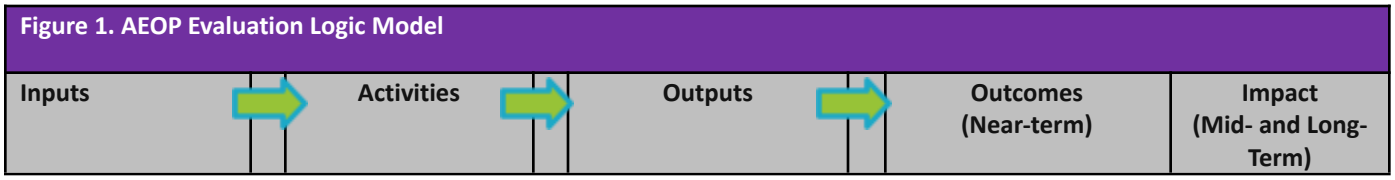
[1] The 2018 AEOP consortium members included the Academy of Applied Science (AAS; JSHS, Apprenticeship Programs), the Technology Student Association (TSA; JSS, Unite), the National Science Teachers Association (NSTA: eCM, GEMS), NC State University (Evaluation Lead); Metriks Amerique (Alumni Management); Widmeyer (Communications and Marketing); Battelle Memorial Institute (Lead Organization).

The 2018 evaluation was informed by AEOP priorities and by the objectives of individual AEOP elements. Evaluation studies were carried out using a logic model that proposes a pathway of influence for the AEOP, ultimately linking AEOP inputs and activities to intended outcomes that align with AEOP priorities and objectives as well as federal requirements for reporting on federal STEM investments. The logic model provides a framework for the near- and long-term AEOP evaluation plan, ensuring that evaluation questions yield information that is valuable to the AEOP and that evaluation assessments include appropriate measures of intended outputs and outcomes that align with the AEOP's priorities and objectives and federal requirements.

Table 6. AEOP Priorities and Objectives (2018)
PRIORITY ONE: STEM Literate Citizenry
Broaden, deepen, and diversify the pool of STEM talent in support of our defense industry base.
Objectives
● Encourage and reward student participation in STEM opportunities.
● Inspire students to excel in science and mathematics.
● Increase participation of underserved populations in the AEOP.
● Expand the involvement of students in ongoing DoD research.
● Increase awareness of DoD STEM career opportunities.
PRIORITY TWO: STEM Savvy Educators
Support and empower educators with unique Army research and technology resources.
Objectives
● Partner with schools and teachers at local and state educational agencies for shared standards in science and mathematics.
● Use incentives to promote teacher participation in the AEOP.
● Provide online resources for educators to share best practices.
● Provide and expand mentor capacity of the Army's highly qualified scientists and engineers.
PRIORITY THREE: Sustainable Infrastructure
Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.
Objectives
● Develop and implement cohesive program metrics for each individual program and across all of the AEOP.
● Provide STEM educational opportunities for students at all stages of their K-12 education.
● Integrate programs in a central branding scheme, inclusive of a centralized website, for a strategic and comprehensive marketing strategy.
● Establish a competitive process for funding new STEM investments that align to the overall program strategy.

In 2018, the AEOP evaluation studies focused predominantly on assessing the quality of AEOP programs as well as near- and mid-term impacts. Thus, data collection included questions about the benefits of participation to participants, program strengths and challenges, and overall effectiveness in meeting AEOP and program objectives. In addition, each program evaluation noted which recommendations from previous evaluations had been implemented (evidence-based change). Figure 1 provides a simple graphic depiction of the AEOP Evaluation logic model.

Figure 1. AEOP Evaluation Logic Model



• US Army sponsorship • Broad roster of AEOP initiatives available for student engagement • IPAs providing coordination and oversight of programs • Operations conducted at Army/DoD research facilities, universities, schools, and local/regional and national competitions • Army/DoD and university S&Es, local and DoDEA/DoDDS educators, and other volunteers serving as STEM "mentors" • Online and on-site curricular resources • Stipends and awards for students and educator participants • Centralized branding and comprehensive marketing • Centralized evaluation and annual reporting		• Engagement in "authentic" STEM experiences through: • Curriculum-driven summer programs at Army research institutions and universities • Summer and academic year apprenticeship programs at Army research institutions and universities • Local/regional and national STEM competitions		• Increasing numbers and diversity of student participants • Increasing numbers and diversity of mentor participants • Increasing numbers and diversity of Army/DoD scientists and engineers engaged in programs • Increasing numbers of K-college schools served through participant engagement • Increasing number of curricular resources distributed through websites and program participation • Students, mentors, site coordinators, and IPAs contributing to evaluation		• Increased student interest and engagement in STEM (formal and informal) • Increased participant STEM skills, knowledge, abilities, and confidence • Increased participant knowledge of other AEOP opportunities • Increased participant knowledge of Army/DoD STEM research and careers • Implementation of evidence-based recommendations to improve programs	• Increased student participation in other AEOP opportunities and DoD scholarship/ fellowship programs • Increased student interest in and pursuit of STEM coursework in secondary and post-secondary schooling • Increased student interest in and pursuit of STEM degrees • Increased student interest in and pursuit of STEM careers • Increased student interest in and pursuit of Army/DoD STEM careers • Continuous improvement and sustainability of the AEOP

The 2018 AEOP evaluation plan is summarized by program in Table 7. In short, most evaluations utilized participant questionnaires, as well as focus groups or interviews with the youth participants (herein called students and apprentices) and adult participants who led educational activities or supervised research (herein called mentors).

Table 7. 2018 AEOP Evaluation Strategy

AEOP Element	Assessment Tools	Program-Level Objectives
CQL	<u>Program Evaluation:</u> ● Apprentice questionnaire ● Mentor questionnaire ● Apprentice focus groups ● Mentor focus groups ● 21st Century Skills Assessment	● To nurture interest and provide research experience in STEM for college students. ● To provide opportunities for continued association with the DoD laboratories and STEM enrichment of previous SEAP, GEMS, and other AEOP program participants as well as allow new college students the opportunity to engage with DoD laboratories. ● To outreach to participants inclusive of youth from groups historically under-represented and underserved in STEM. ● To increase participant knowledge in targeted STEM areas and develop their research and laboratory skills as evidenced by mentor evaluation and the completion of presentations of research (poster, paper, oral presentation, etc.). ● To educate participants about careers in STEM fields with a particular focus on STEM careers in DoD laboratories. ● To acquaint participants with the activities of DoD laboratories in a way that encourages a positive image and supportive attitude towards our defense community. ● To provide information to participants about opportunities for STEM enrichment and ways they can mentor younger STEM students through GEMS, eCYBERMISSION, and other AEOP opportunities.
eCM	<u>Program Evaluation:</u> ● Student questionnaire ● Mentor questionnaire ● Student focus groups ● Mentor focus group ● NJ&EE observation	● Increase number of student and Team Advisor registrants and folder submissions. ● Increase the number of participants from Title I schools. ● Increase the number of volunteers and Army volunteers. ● Increase Team Advisor retention rate and implement programs to exceed our target rate. ● Increase number of classroom integrated programs. ● Increase number of students from DoDEA schools. ● Increase participants' awareness of other AEOP and DoD STEM opportunities and Army/DoD technologies and increase student interest in STEM learning and pursuit of STEM-related degrees.
GEMS	<u>Program Evaluation:</u> ● Student questionnaire ● Mentor questionnaire ● Student focus groups ● Mentor focus groups ● Site observations	● To nurture interest and excitement in STEM for middle and high school participants. ● To nurture interest and excitement in STEM for mentor participants. ● To implement STEM enrichment experiences through hands-on, inquiry-based educational modules that enhance in-school learning.

		• To increase participant knowledge in targeted STEM areas and laboratory skills. • To increase the number of outreach participants inclusive of youth from groups historically under-represented and underserved in STEM. • To encourage participants to pursue secondary and post-secondary education in STEM. • To educate participants about careers in STEM fields with a particular focus on STEM careers in Army laboratories. • To provide information to participants about opportunities for STEM enrichment through advancing levels of GEMS as well as other AEOP initiatives.
HSAP	<u>Program Evaluation:</u> • Apprentice questionnaire • Mentor questionnaire • Apprentice interviews • Mentor interviews • 21st Century Skills Assessment	• Expand apprenticeship opportunities for underserved populations in cooperation with HBCUs/MSIs and other affinity groups, and in cooperation with recruitment objectives of LPCs by disseminating program information to a broader and a more diverse audience. • Expand cross marketing and outreach of apprenticeship programs to include other AEOP programs to mentors and LPCs. • Encourage apprentices to continue pursuit of AEOP STEM/Army STEM careers • Encourage more students already in the AEOP pipeline to continue with an apprenticeship program • Increase participant's knowledge of other AEOP programs and STEM careers • Improve the overall participant and mentor apprenticeship experience.
JSHS	<u>Regional Symposia Evaluation:</u> • Student questionnaire • Mentor questionnaire <u>National Symposium Evaluation:</u> • Student questionnaire • Mentor questionnaire[2] • Student focus groups • Mentor focus group	• To promote research and experimentation in STEM at the high school level. • To recognize the significance of research in human affairs and the importance of humane and ethical principles in the application of research results. • To search out talented youth and their teachers, recognize their accomplishments at symposia, and encourage their continued interest and participation in the sciences, mathematics, and engineering. • To recognize innovative and independent research projects of youth in regional and national symposia. • To expose students to academic and career opportunities in STEM and to the skills required for successful pursuit of STEM. • To expose students to STEM careers in Army and/or DoD laboratories.

[2] A single mentor questionnaire was administered to all mentors, regardless of whether their student was selected for the National Symposium.

		• To increase the future pool of talent capable of contributing to the nation's scientific and technological workforce.
JSS	<u>Program Evaluation:</u> • Student questionnaire • Mentor questionnaire • Student focus groups • Mentor focus groups	• Increase outreach to populations that are historically underserved and underserved in STEM. • Increase participants' awareness of Army/DoD STEM careers. • Increase participants' awareness of other AEOP opportunities. • To create a national infrastructure to manage local, regional, and national JSS events and increase participation. • To enhance training opportunities and resources for teachers/mentors. • To coordinate tracking and evaluation opportunities for student and teacher participation in JSS. • To leverage AEOP through cross-program marketing efforts.
REAP	<u>Program Evaluation:</u> • Apprentice questionnaire • Mentor questionnaire • Apprentice interviews • Mentor interviews • 21st Century Skills Assessment	• To provide high school students from groups historically under-represented and underserved in STEM, including alumni of the AEOP's Unite program, with an authentic science and engineering research experience. • To introduce students to the Army's interest in science and engineering research and the associated opportunities offered through the AEOP. • To provide participants with mentorship from a scientists or engineer for professional and academic development purposes. • To develop participants' skills to prepare them for competitive entry into science and engineering undergraduate programs.
RESET	<u>Program Evaluation:</u> • Participant interviews	• To increase teacher knowledge and access to research • To create digital professional learning community (D-PLC) for educators and mentors to share best practices. • To prepare teacher participants to create Legacy Cycle lessons based on DoD research and careers.
SEAP	<u>Program Evaluation:</u> • Apprentice questionnaire • Mentor questionnaire • Apprentice focus groups • Mentor focus groups • 21st Century Skills Assessment	• To acquaint qualified high school students with activities of DoD laboratories through summer research and engineering experiences. • To provide students with opportunities and exposure to scientific and engineering practices and personnel not available in their school environments. • To expose those students to DoD research and engineering activities and goals in a way that encourages a positive image and supportive attitude toward our defense community.

		● To establish a pool of students preparing for careers in science and engineering with a view toward potential government service. ● To prepare these students to serve as positive role models for their peers thereby encouraging other high school students to take more science and math courses. ● To involve a larger percentage of students from previously under-represented segments of our population, such as women, African-Americans and Hispanics, in pursuing science and engineering careers.
Unite	<u>Program Evaluation:</u> ● Student questionnaire ● Mentor questionnaire ● 21st Century Skills Assessment	● To effectively show participants the real word applications of math and science. ● To raise participant confidence in the ability to participate in engineering activities. ● To inspire participants to consider engineering majors in college. ● To remove social barriers and negative attitudes about engineering. ● To promote collaboration and problem solving in a team environment. ● To expose participants to STEM careers in the Army and DoD. ● To increase the number of STEM graduates to fill the projected shortfall of scientists and engineers in national and DoD careers.
URAP	<u>Program Evaluation:</u> ● Apprentice questionnaire ● Mentor questionnaire ● Apprentice interviews ● Mentor interviews ● 21st Century Skills Assessment	● Expand apprenticeship opportunities for underserved populations in cooperation with HBCUs/MSIs and other affinity groups, and in cooperation with recruitment objectives of LPCs by disseminating program information to a broader and a more diverse audience. ● Expand cross marketing and outreach of apprenticeship programs to include other AEOP programs to mentors and LPCs. ● Encourage apprentices to continue pursuit of AEOP STEM/Army STEM careers ● Encourage more students already in the AEOP pipeline to continue with an apprenticeship program ● Increase participant's knowledge of other AEOP programs and STEM careers ● Improve the overall participant and mentor apprenticeship experience.

Evaluation instruments were iteratively reviewed and revised by individual program administrators (IPAs), the Army Cooperative Agreement Managers (CAMs), and evaluators. All instruments and protocols were approved by Purdue University's Institutional Review Board (IRB) for the protection of

human research subjects. Additional details about Purdue University's measures and sampling, data collection and analyses, and reporting and dissemination are provided in Appendix A.

5 | Study Sample

The FY18 AEOP evaluation included an analysis of participation in questionnaires, the primary data collection method. Response rates and associated margins of error at the 95% confidence level for each sample were computed (see Table 8). As was the case in FY17, most of the margins of error for individual programs do not fall within the acceptable range (2-5%). This can be partially attributed to the fact that random sampling is not used for participation in the surveys. The large margin of error can indicate potential for response bias (that those who chose to respond to the questionnaire may not be representative of the entire population) and, consequently, results from questionnaire data should be viewed as preliminary indicators of program quality and impact and not as conclusive.

There were some programs that had less than 20 participants in the participant and/or mentor questionnaires (CQL, HSAP, JSS). Overall, only eCM secured a participation rate of over 40% for their NJ&EE on-site administration of the survey.

Table 8. 2018 AEOP Program Participant Questionnaire Participation

Program	2017 Questionnaire	Sample	Population	Participation Rate	Margin of Error @ 95% Confidence[3]
CQL	Apprentice	58	214	27.1%	±11.01%
	Mentor	17	216	7.9%	±22.87%
eCM	Overall Participants	686	20,004	3.43%	±3.68%
	NJ&EE Participants	72	78	92.31%	±3.22%
	Team Advisor	274	869	31.53%	±4.90%
GEMS	Student	1,806	3,251	56%	±1.54%
	Mentor (incl. NPM, RT, S&Es)	26	595	4%	±18.81%
HSAP	Apprentice	17	48	35%	±19.3%
	Mentor	4	53	8%	±47.57%
JSHS	Regional Symposia Student	429	4600	9.32%	±4.51%
	National Symposium Student	28	240	11.67%	± 17.44%
	Mentor	165	4199	3.93%	± 7.48%
JSS	Student	86	1081	7.96%	±10.14%
	Mentor	4	328	1.22%	±48.77%

[3] "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.

REAP	Apprentice	66	138	48%	±8.75%
	Mentor	67	117	57%	±7.86%
SEAP	Apprentice	35	114	31%	±13.85%
	Mentor	20	150	13%	±20.47%
Unite	Student	296	429	69.0%	±3.18%
	Mentor	103	401	25.7%	±8.33%
URAP	Apprentice	34	67	51%	±11.88%
	Mentor	27	68	40%	±18.81%
Alumni Study		290	2,500	11.6%	±5.41%
Total AEOP Questionnaire Participation		**4,610**	**39,760**	**11.6%**	**±1.36%**

Focus groups or interviews were conducted with participants and mentors from each of the programs. Purposive sampling was used for assembling diverse focus groups when larger populations were available at a site, and convenience sampling was employed when small numbers of participants were available at a site. In total, 308 students, apprentices, and mentors participated in focus groups and interviews. Interviews were conducted with 41 individual AEOP participants, and focus groups were conducted with 267 students, apprentices, and mentors. Table 9 summarizes focus group and interview participation.

The FY18 AEOP evaluation included an alumni survey and an alumnus focus group session at JSHS. There were three participants in the JSHS alumni focus group.

Table 9. 2018 AEOP Program Participant Focus Group and Interview Participation

Program	2018 Focus Group and Interview	Focus Group Sample	Interview Sample
CQL	Apprentice	6	
	Mentor	7	
eCM	NJ&EE Student	23	
	NJ&EE Team Advisor	23	
GEMS	Student	57	
	Mentor	27	
HSAP	Apprentice		6
	Mentor		5
JSHS	Regional and National Symposium Participants	15	
	Competition Advisor/Mentor	2	
JSS	Student	69	
	Mentor	12	
REAP	Apprentice		9
	Mentor		4
RESET	Teacher participants		7
SEAP	Apprentice	13	
	Mentor	13	
Unite	Student	0	
	Mentor	0	
URAP	Apprentice		6
	Mentor		4
Total AEOP Focus Group/Interview Participation		**267**	**41**

The FY18 evaluation also included a mid to long-term study of AEOP alumni. The alumni respondent profile is included in Table 10.

Table 10. Alumni Respondent Profile (Longitudinal FY18 participants)		
Demographic Category	**Questionnaire Respondents**	
Gender (*n*=282)		
Female	156	55%
Male	118	42%
Choose not to report	8	3%
Race/Ethnicity (*n*=282)		
Asian	45	16%
Black or African American	38	14%
Hispanic or Latino	32	11%
Native American or Alaska Native	3	1%
Native Hawaiian or Other Pacific Islander	2	<1%
White	144	51%
Other race or ethnicity (specify):[†]	16	6%
Choose not to report	2	<1%
Program Year (*n*=282)		
2018	143	51%
2017	76	27%
2016	39	14%
2015	13	5%
2014	3	1%
2013	3	1%
2012	5	2%
High School Graduation Year (*n*=282)		
Before 2012	57	20%

2012	2	<1%
2013	2	<1%
2014	6	2%
2015	11	4%
2016	14	5%
2017	6	2%
2018	16	6%
2019	30	11%
2020	31	11%
2021	89	32%
Choose not to report	18	6%

Participant in several programs were observed by their mentors using the 21st Century Skills Assessment (Johnson & Sondergeld, 2016). This was done to objectively assess actual growth in skills in addition to self-reported impacts of the AEOPs on participants. A pre/post assessment was completed for apprentices in CQL, SEAP, HSAP, REAP, URAP, and for participants in Unite for FY18. Pre-assessment was completed in the first days of the program. Post-assessment was completed at the end of the program. Participants were rated on the six domains of 21st Century Skills:

1. Creativity and Innovation
2. Critical Thinking and Problem Solving
3. Communication, Collaboration, Social, and Cross-Cultural Skills
4. Information, Media, & Technological Literacy
5. Flexibility, Adaptability, Initiative, and Self-Direction
6. Productivity, Accountability, Leadership, and Responsibility

On each of the six domains AEOP participants were rated by their mentors on a scale of 0 – 3 with 0 = Did Not Observe; 1 = Needs Improvement; 2 = Progressing; and 3 = Demonstrates Mastery.

To be included in analysis, both a pre- and post-assessment needed to be completed for each participant. Completion rates for FY18 were less than desired for individual programs, with the exception of eCM which a pilot and Unite was who had an outstanding participation rate of more than 50%. All program types across the AEOP participated including STEM competitions (eCM), STEM programs (Unite), and STEM apprenticeship programs (all). eCM mini-grant teachers were invited to include their students as participants in the assessment. Approximately half of Unite participants were observed at both pre- and post-observation (53%), and thus included in analysis. For apprenticeship programs, pre-

and post-assessments were conducted for a total of 34 students, which led to approximately 6% of apprentices being included in this analysis. See Table 11 for sample information by program.

Table 11. Pre-Post Assessment Participation by Program

Program	Pre-Assessment	Post-Assessment	Included Matched Pre-Post Assessments
CQL (n=214)	22	7	4
eCM (n=11,952)	261	261	261
HSAP (n=48)	36	8	6
REAP (n=138)	33	23	11
SEAP (n=114)	11	9	6
UNITE (n=429)	331	309	226
URAP (n=67)	46	12	7
Total	**740**	**629**	**521**

6 | Evaluation Findings

The FY18 AEOP evaluation findings are organized within the three AEOP priorities and associated research questions to provide insight into portfolio progress toward achieving the desired outcomes of the AEOP. The priorities and research questions for the near-term (annually) are found in Table 12 and the mid to long-term (multiple years) research questions are detailed in Table 13.

Table 12. AEOP Priorities and Near-Term Research Questions (2018)
PRIORITY ONE: STEM Literate Citizenry
Broaden, deepen, and diversify the pool of STEM talent in support of our defense industry base.
Research Question #1 - To what extent do participants report growth in interest and engagement in STEM?

Research Question #2a - To what extent do participants report increased STEM competencies, 21st Century/STEM skills, STEM knowledge, STEM abilities, and STEM confidence?
Research Question #2b – To what extent do participants demonstrate use of and growth in 21st Century skills? **(NEW for FY17)**
Research Question #3 - To what extent do participants and mentors report increased participant interest in STEM research and careers?
Research Question #4 - To what extent do participants and mentors report increased awareness of and interest in Army/DoD STEM research and careers?
Research Question #5 - To what extent do participants report increased enrollment, achievement, and completion of STEM degree programs?
PRIORITY TWO: STEM Savvy Educators
Support and empower educators with unique Army research and technology resources.
Research Question #6 - What is the impact of Scientists and Engineers (S&E) Mentors on AEOP participants?
Research Question #7 - To what extent do teacher participants report increased use of new approaches to teaching research concepts within STEM practices, and infusion of careers?
PRIORITY THREE: Sustainable Infrastructure
Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.
Research Question #8 - To what extent do participants report growth in awareness of and/or interest in AEOP opportunities?

Table 13. AEOP Priorities and Mid to Long Term Research Questions (2018)
PRIORITY ONE: STEM Literate Citizenry
Broaden, deepen, and diversify the pool of STEM talent in support of our defense industry base.
Research Question #1 - To what extent do alumni report positive, sustained interest and engagement in STEM?
Research Question #2 - To what extent do alumni report positive attitudes toward STEM, and particularly Army/DoD STEM?
Research Question #3 - To what extent do alumni report pursuit of and achievement in STEM courses in secondary school, post-secondary STEM degrees, STEM careers, and Army/DoD STEM careers?
Research Question #4 - To what extent do alumni report awareness of and interest in STEM research and careers overall and for the Army/DoD specifically?
Research Question #5 – To what extent do alumni report an increase in STEM career participation and success overall, as well as within the Army/DoD specifically?
PRIORITY TWO: STEM Savvy Educators
Support and empower educators with unique Army research and technology resources.
Research Question #6 - What is the impact of scientist and engineer (S&E) mentors on AEOP alumni?

Research Question #7 – Are there measurable changes in teacher approaches to teaching research concepts within STEM practices, and careers after participation in AEOP (RESET)?
PRIORITY THREE: Sustainable Infrastructure
Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.
Research Question #8 - To what extent do alumni report increased awareness of and/or interest in AEOP opportunities?
Research Question #9 - To what extent do alumni report participation in an AEOP program multiple times, in other AEOP elements, or in other DoD workforce development programs?

Near-Term Evaluation – Findings for FY18 AEOPs

Priority One: STEM Literate Citizenry

Findings from the FY18 AEOP evaluation reveal progress toward achieving a STEM Literate Citizenry with some continued challenges. Major trends that support the achievement of this AEOP priority along with evidence from assessment data that inform the findings are presented below by associated research question(s).

Research Question #1 - To what extent do participants report growth in interest and engagement in STEM?

AEOPs continued to engage a strong pool of diverse future STEM talent – over 31,000 participants, including 45% underserved students. The AEOP portfolio consisted of STEM programs designed to nurture students' STEM interests and aspirations throughout their educational careers. AEOPs include STEM competitions (eCM, JSHS, and JSS), STEM enrichment activities (CII, GEMS, and Unite), and STEM apprenticeship programs (CQL, HSAP, REAP, SEAP, and URAP). The GEMS Near-Peer Mentor (NPM) program also provided opportunities for undergraduate student scientists and engineers (S&Es)-in-training, to lead educational activities for youth in the GEMS program, and RESET provided professional development experiences for STEM educators by offering on-line learning and on-site research experiences.

In FY18, the AEOP engaged 30,334 participants in STEM programming, which is a slight 9% decrease from FY17 when 32,947 participants were served. This decrease reverses the growth in enrollment observed in FY17 and reflects a total enrollment of slightly lower than that in 2016, resuming a downward trend in participation from FY14 (41,802 youth participants) to FY16 (30,973 youth participants). eCM, the AEOP that serves the greatest number of students, experienced a decline of 6% in participation in FY18 as compared to FY17 (21,277 participants) and a 3% decline compared to FY16 (20,607 participants). JSS enrollment continued to grow, however, and served 17% more students than in FY17 (893 participants). After the substantially increased interest in apprenticeship programs in FY17, the number of applicants across the AEOP apprenticeship portfolio declined slightly to 3,275 (a 3% decrease from FY 17), although this is a 33% increase as compared to FY16 (2,184 applications).

AEOP youth application numbers and placement rates for FY18 are detailed in Table 14. The various AEOPs received a total of 39,325 applications in FY18, an 23% decrease from the 48,419 applications

received in FY17, but an increase of 5% over the 37,399 applications received in FY16. These application rates indicate that there is strong student interest in AEOPs, although the current number of applications reflects a downward trend since FY14 when 49,686 applications were received. There continues to be considerably higher demand for many programs than spaces available, however.

The overall placement rate across AEOPs for FY18 was 77% as compared to 68% in FY17. Several programs had decreases in placement rates as compared to prior years. CQL placed 37% of applicants in FY18 compared with 41% FY17 and 51% in FY16; REAP placed 15% of applicants in FY18 as compared with 17% in FY17 and 25% in FY16; URAP placed 20% of applicants in FY18 as compared to 9% of applicants in FY17 as compared to 29% in FY16. Other programs showed growth in placement rates, however, and JSHS served 72% of applicants in FY18 as compared to 65% in FY17, Unite placed 59% of applicants in FY18 as compared to 45% in FY17 and URAP placed 20% of applicants as compared with 9% in FY17. Placement rates in GEMS (61%) HSAP (9%), and SEAP (13%) remained unchanged since FY17.

More than 2,000 K-12 teachers and nearly 2,000 Army and DoD S&Es engaged in AEOP programs, leading educational activities, supervising research, or serving as competition advisors, judges, event hosts or other volunteers. These numbers do not capture numerous others who may have been impacted within the organizations of those participating in AEOPs, nor do they reflect the potentially broader and undetermined impact of the AEOP's online educational resources made freely available through eCM and JSS, or those resources available to GEMS NPMs and GEMS resource teachers.

Registration data indicate that many AEOPs were filled to capacity while others had capacity for more participants but were unable to fill slots due to limited interest, funding limitations, or lack of adequate programmatic support (e.g., mentors, volunteers). eCM, a web-based STEM competition for 6^{th}-9^{th} grade students, continues to enroll the largest number of participants among AEOPs, enrolling 66% of the total number of AEOP participants in FY18. JSS, another STEM competition, was similarly open to all those who met registration qualifications and increased actual participation by 17% from FY17 to FY18.

Because of individual program capacities and varying levels of interest in AEOPs, placement rates vary across the AEOP. Apprenticeship programs (CQL, HSAP, REAP, SEAP, and URAP) continued to be particularly competitive, with placement rates ranging from 9% (HSAP) to 37% (CQL). A total of 3,275 applications to apprenticeship programs were received in FY18, a slight decrease (3%) compared to the 3,384 applications received in FY17 and an increase of 33% over the 2,184 applications received in FY16. Of those applying for apprenticeships in FY18, 585 were selected for participation. The placement rate for apprentices in FY18 (18%) is similar to that in FY17, a substantial decrease compared to the 27% of applicants who were placed in apprenticeships in FY16 and the 684, or 33% of students, who were selected for apprenticeship sin FY15. The apprenticeships serving high school students (HSAP, REAP, and SEAP) were most competitive, and had a combined placement rate of only 11% (301 apprentices placed out of 2,380 applicants. This is a decrease in placement rate as compared to FY17 (13%), however it should be noted that in FY17, fewer apprentices were placed (285) out of a smaller pool of applicants (2,190). Nevertheless, this represents a substantial decrease from the 25% placement rate in FY16 and the 17% placement rate for these programs in FY15 and FY14. The placement in undergraduate apprenticeships (CQL and URAP) rose to 32% (284 apprentices placed out of 895 applicants) as

compared to the placement rate of 24% in FY17, however it should be noted only 4 more apprentices were placed from a larger applicant pool in FY17 (288 apprentices placed out of 1,194 applicants). This represents a trend in decreasing placement rates for undergraduate apprenticeships during the past several years (45% in FY16; 72% in FY15; and 57% in FY14). Overall enrollment in apprenticeship program declined by 2% in FY18 (585) as compared to FY17 (573).

Table 14. 2018 AEOP Number of Youth Applications and Placement Rates					
		Youth Applicants	**Youth Participants**	**Placement Rate**	**Change in Youth Participants, FY18 vs. FY17**
CII	STEM Enrichment Activity	1,993	1,805	NA†	21%
CQL	STEM Apprenticeship Program (undergrad)	574	214	37%	-6%
eCM	STEM Competition	22,391	20,004	NA†	-6%
GEMS	STEM Enrichment Activity	5,486	3,341	61%	15%
HSAP	STEM Apprenticeship Program (high school)	559	48	9%	-13%
JSHS	STEM Competition	4,279	3,069	72%	-82%
JSS	STEM Competition	1,170	1,081	NA†	17%
REAP	STEM Apprenticeship Program (high school)	949	139	15%	15%
SEAP	STEM Apprenticeship Program (high school)	872	114	13%	1%
Unite	STEM Enrichment Activity	731	429	59%	17%
URAP	STEM Apprenticeship Program (undergrad)	321	67	20%	12%
	Total	**39,325**	**30,311**	**77%**	**-9%**

† *In 2018, all youth who met registration requirements for CII, eCM and JSS were able to participate.*

The AEOP continued to make progress toward its goal of serving groups underserved in STEM, as mentioned previously, with a 45% U2 population for FY18. AEOP's definition of underserved includes at least two of the following: low-income students; students belonging to race and ethnic minorities that are historically underrepresented in STEM; students who speak English as a second language;

first-generation college students; students in rural, frontier, or other federally targeted outreach schools; students who receive free and reduced-price school meals (FARMS) and females in certain STEM fields.

Table 15 summarizes demographics collected through the evaluation questionnaires and the resulting participation group is reflective of the overall student registrations in FY 18 AEOP programs. Participation of females in the evaluation, a group historically underserved in some STEM fields, varied widely among programs (range of 26%-65%). Female participation increased over FY16 levels for 5 programs (eCM, eCM-NJ&EE, JSHS, REAP, URAP), while female participation decreased in 6 (CQL, GEMS, HSAP, JSS, SEAP, Unite). The proportion of students identifying with racial and ethnic groups other than White or Asian has not remained constant over time for most programs on the evaluation questionnaire (range of 12%-74%) except for CQL. Programs such as eCM, HSAP, JSS, and REAP had more racial/ethnic minorities participate in the evaluation in 2018 compared to 2017. While the opposite trend was found for the following programs: eCM-NJ&EE, GEMS, JSHS, SEAP, and Unite. The proportions of students who reported that they were eligible for free or reduced-price lunch also varied greatly between programs (3%-70%) and fluctuated by year.

In 2018, demographic data were collected from evaluation participants on school location (10%-76% rural/urban/frontier), ELL status (2%-29%), and first-generation status (1%-65%). These student demographic variables were used to calculate underrepresented student classification (U2) by program (21%-91%). A few programs had half or more of their evaluation participants classified as U2 students (JSHS, REAP, Unite), while most had less than half (JSS, HSAP, SEAP, eCM, URAP, GEMS, eCM-NJ&EE, CQL).

Table 15. Evaluation Questionnaire Respondent Demographics

Program	Females		Racial & Ethnic Minorities		FARMS		School: Rural/Urban /Frontier		ELL		College 1st Generation		U2	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
CQL	49%	43%	17%	17%	NA††	NA††	---	NA††	---	2%	---	17%	---	21%
eCM	50%	51%	21%	42%	20%	36%	---	43%	---	13%	---	9%	---	28%
eCM-NJ &EE	56%	66%	16%	12%	13%	11%	---	28%	---	17%	---	1%	---	21%
GEMS	48%	35%	37%	22%	19%	9%	---	10%	---	3%	---	6%	---	23%
HSAP	48%	41%	28%	35%	---†	3%	---	32%	---	14%	---	3%	---	43%
JSHS	60%	63%	18%	14%	14%	14%	---	47%	---	6%	---	13%	---	55%
JSS	46%	26%	29%	33%	---†	12%	---	27%	---	2%	---	7%	---	48%
REAP	61%	65%	53%	66%	49%	47%	---	50%	---	29%	---	65%	---	75%
SEAP	58%	51%	18%	12%	8%	11%	---	23%	---	3%	---	0%	---	29%
Unite	52%	42%	82%	74%	64%	70%	---	76%	---	26%	---	52%	---	91%
URAP	42%	59%	32%	26%	NA††	NA††	---	NA††	---	3%	---	18%	---	24%

† Data were not provided/collected from the specified program.

†† Not applicable – college program.

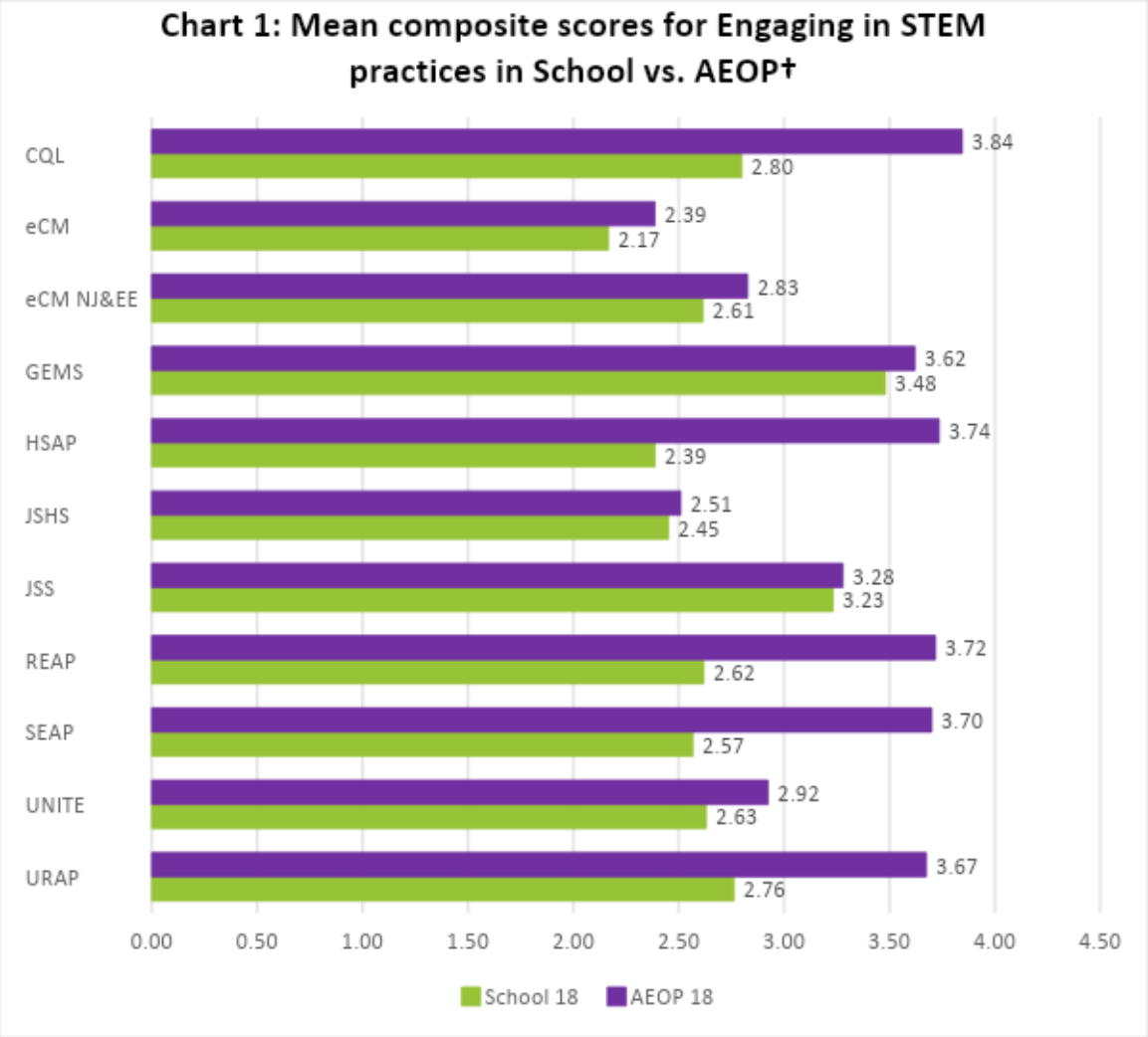
Most programs in the AEOP portfolio continued to provide participants with more frequent exposure to real world, hands-on, and collaborative STEM activities than students are exposed to through typical in-school experiences. Participants were asked about how frequently they engaged in STEM practices in

their AEOP experiences as compared to in-school experiences. These items were combined into a composite variable; items used to formulate the composite variables are shown in Table 16.

Table 16. Items that Form the Engaging in STEM Practices in School and Engaging in STEM Practices in AEOP Composites
1. Work with a STEM researcher or company on a real-world STEM research project
2. Work with a STEM researcher on a research project of your own choosing
3. Design my own research or investigation based on my own question(s)
4. Present my STEM research to a panel of judges from industry or the military
5. Interact with STEM researchers
6. Use laboratory procedures and tools
7. Identify questions or problems to investigate
8. Design and carry out an investigation
9. Analyze data or information and draw conclusions
10. Work collaboratively as part of a team
11. Build or make a computer model
12. Solve real world problems

Mean composite scores for participant engagement in STEM practices for programs in FY18 are provided in Chart 1. Apprentices and students reported engaging in STEM practices significantly more in their AEOP programs compared to typical school experiences for each program except JSS and JSHS. Significant differences ranged from small to large in effect sizes.[4] Large effect sizes were found for these differences in all programs that noted significant differences except for GEMS. Large effect sizes indicate that programs offered participants STEM engagement experiences that were substantially more intense and interactive than their typical in-school experiences. It is important to note that teachers may use competition programs (eCM, JSS, and JSHS) as part of students' in-school learning experiences, and students in these programs may not easily distinguish between their engagement in STEM practices in AEOP and in school.

[4] Effect sizes: CQL, d = 2.15 standard deviations; R-ECM, d = 0.82 standard deviations; N-ECM = 0.86 standard deviations; GEMS, d = 0.48 standard deviations; HSAP, d = 2.88 standard deviations; REAP, d = 2.79 standard deviations; SEAP, d = 2.15 standard deviations; Unite, d = 0.96 standard deviations; and URAP, d = 1.87 standard deviations.



† *Response options for the items forming this composite were: 1 – Not at all, 2 – At least once, 3 – Monthly, 4 – Weekly, 5 – Every day.*

Evaluation findings indicated that AEOPs consistently provided opportunities for participants to engage in authentic STEM activities that are more intensive than those they experience in their typical school settings. This was reflected in both participants' questionnaire responses and in comments made in focus groups and interviews. Participants' comments included the following:

> *"[CQL] gives [apprentices] a lot of experience in the real world with real world equipment, real world problems, real world presentations. They attend meetings of the branch, teams and so forth. It gives them a lot of good practical experience."* (CQL Mentor)

> *"I love eCYBER because it helps me solve REAL problems in my community, helps me feel like I am giving back, and gets me into stem fields more than any science class at school ever would. I think it is incredible."* (eCM-NJ&EE Student)

"I've gotten a deeper understanding of some topics that we haven't gone through in the school yet or we unable to touch the surface on." (GEMS Student)

"[In HSAP] you have to follow your intuition and you have to really put yourself out there in order to find the results that you're getting. At times you might not know what you're getting into, or exactly what you're doing. You can use the science concepts and the math concepts in order to get those results. It's more intuitive and you think past what procedures that you're given in school." (HSAP Apprentice)

"[JSHS was] very fun and it's an interesting experience being with military personnel. talking with my academic peers is fascinating, and somewhat of a new experience for me, which I thoroughly enjoyed." (N-JSHS Student)

"[In JSS] there's a goal that we're trying to reach and we take different steps to that goal, instead of school where we have a curriculum and we learn things as step by step…[In school], you know how to solve a math problem, but it really doesn't affect you. [In JSS] when you reach the goal, it's like you've accomplished something." (JSS National Student)

"I enjoyed participating in this program because it gave me a good idea on how research occurs in the real world. I didn't have any background on what we were researching. So I had to learn a bit of programming, new software, and a lot about epilepsy." (REAP Apprentice)

"Being exposed to all of the technology and the things that the Army Research Labs are doing has been very eye-opening. It's allowed me to bring those experiences back to my classroom to my students. It has greatly benefited me both professionally in my classroom and me as a professional educator." (RESET Level III Participant)

"At school, most of what we're taught is theoretical. You don't actually get to apply it to anything. Here, it's a lot more hands on. You get the actual experience that goes along with the theories that you're learning at school." (SEAP Apprentice)

"High school curriculum is not keeping pace with state-of-the-art STEM, and students are capable of much more than is usually expected of them. I got to help students and teachers master computer vision and graphic processing tools that they were able to apply to create valuable software that other people will use. I believe this program has inspired them to continue STEM projects and bring these topics back to the classroom." (Unite Mentor)

"In undergrad, a lot of times we're coddled, we're hand held and things are done for us. [My mentor] has done an amazing job with saying, 'This is what I want you to do. You can figure out whatever way you want to do it, but I need you to get it done.'" (URAP Apprentice)

Research Question #2a - To what extent do participants report increased STEM competencies STEM skills, STEM knowledge, abilities, and confidence?

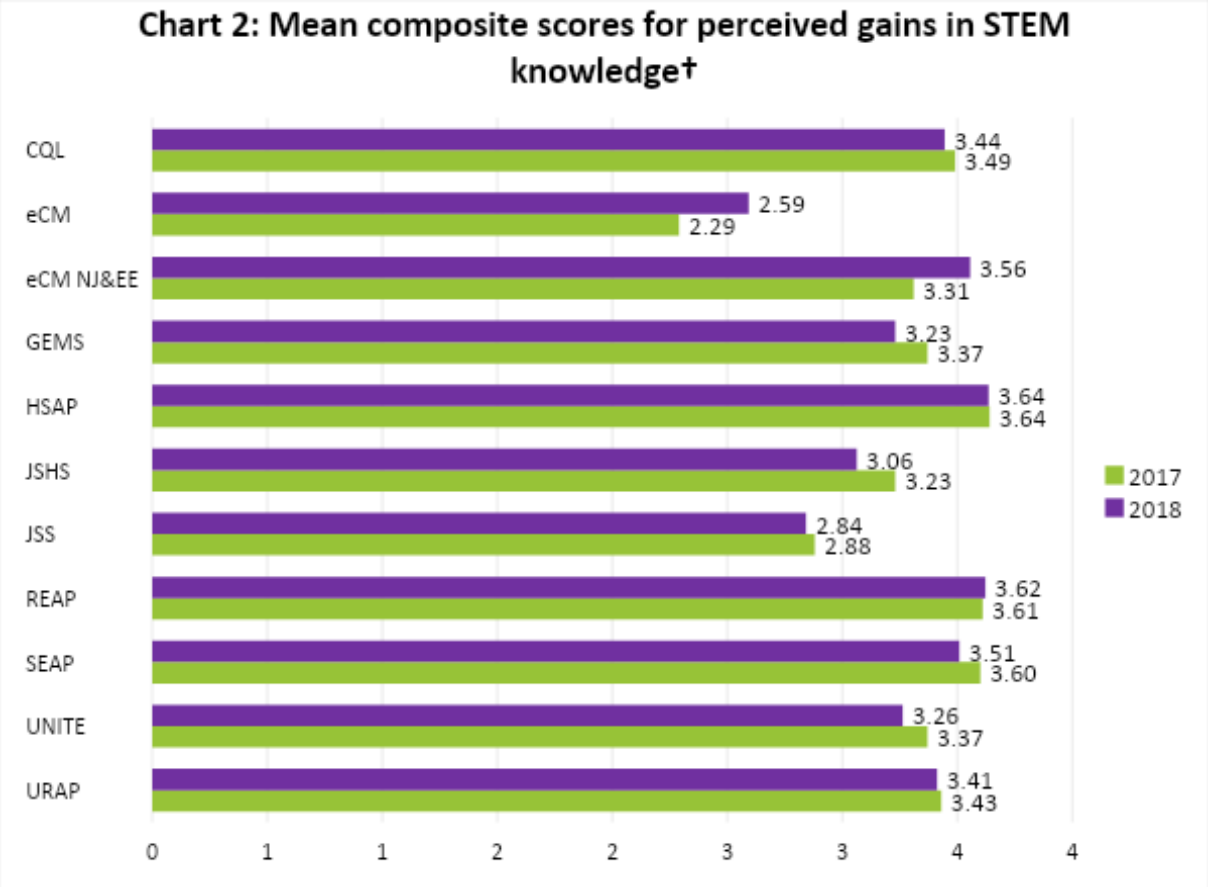
Participants reported that their AEOP experiences improved their STEM-specific and 21st Century STEM skills competencies. They also reported gains in their abilities to use the science and engineering practices described in the Next Generation Science Standards (NGSS), and reported gains in their STEM confidence and identity.

AEOP aims to develop participants' STEM knowledge, skills, and abilities, their 21st Century Skills and their abilities to appropriately apply these skills. Because deepening students' and apprentices' STEM knowledge and skills are key factors in increasing the likelihood that they will pursue STEM further in their education and/or careers, the FY18 evaluation examined students' and apprentices' perceptions of gains in their STEM-specific and 21st Century STEM Skills as a result of participating in AEOPs, as well as the impacts of participation on their confidence in STEM and on their STEM identities.[5]

Participants' gains in STEM knowledge were assessed by five questionnaire items shown in Table 17. A 4-point scale ranging from "no gain" to "large gain" was used for participants to rate these items. Results indicate that participants from all programs reported gains in their STEM knowledge after participating in AEOPs (Chart 2). All programs averaged between "some" and "large" gains except for eCM and JSS which averaged in slightly lower ranges ("a little" to "some" gains).

Table 17. Items that form the Perceived Gains in STEM Knowledge Composite
1. Knowledge of how scientists and engineers work on real problems in STEM
2. In depth knowledge of a STEM topic(s)
3. Knowledge of research conducted on a STEM topic or field
4. Knowledge of research processes, ethics, and rules for conduct in STEM
5. Knowledge of what everyday research work is like in STEM

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



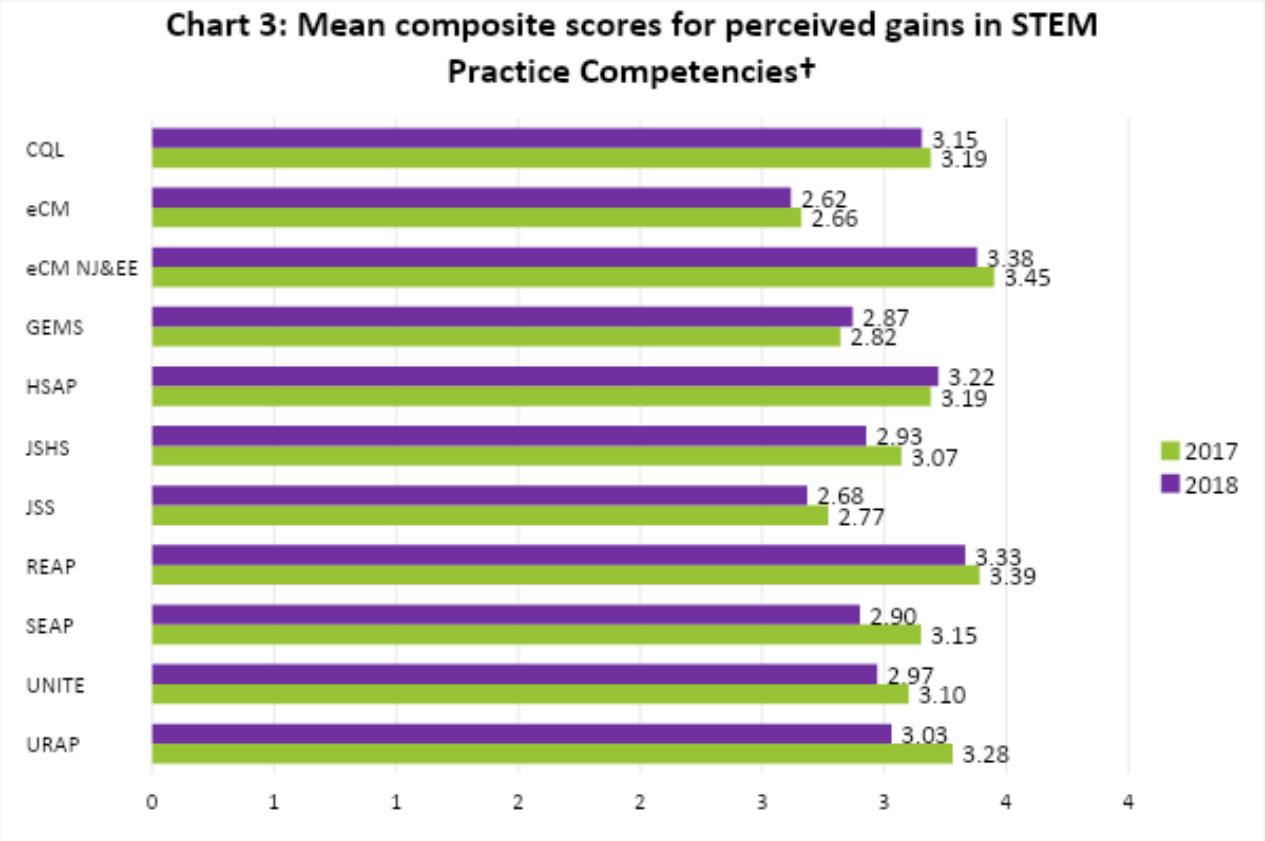
† *Response options for the items forming this composite were: 1 – No gain, 2 – A little gain, 3 – Some gain, 4 – Large gain.*

A goal of AEOP initiatives is to not only increase students' knowledge in STEM, but to give them opportunities to apply and improve their skills in STEM. The FY18 evaluation therefore investigated the impact of AEOPs on participants' abilities to use the STEM practices (i.e., their STEM competencies) described in the Next Generation Science Standards (NGSS)[6]. Table 18 lists the questionnaire items used to assess participants' gains in STEM competencies. Chart 3 presents findings for 2017 and 2018. Students and apprentices in all programs reported gains in their STEM competencies. Chart 3 shows that FY18 gains were slightly lower than those reported in FY17 for all programs except for GEMS and HSAP which reported slight increases.

Table 18. Items that form the Perceived Gains in STEM Practices Composite
1. Asking a question that can be answered with one or more scientific experiments
2. Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation
3. Considering different interpretations of data when deciding how the data answer a question

[6] http://www.nextgenscience.org/sites/default/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf

4.	Supporting an explanation for an observation with data from experiments
5.	Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge
6.	Identifying the strengths and limitation of explanations in terms of how well they describe or predict observations
7.	Defending an argument that conveys how an explanation best decribes an observation
8.	Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts
9.	Integrating information from technical or scientific texts and other media to support your explanation of an observation
10.	Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics

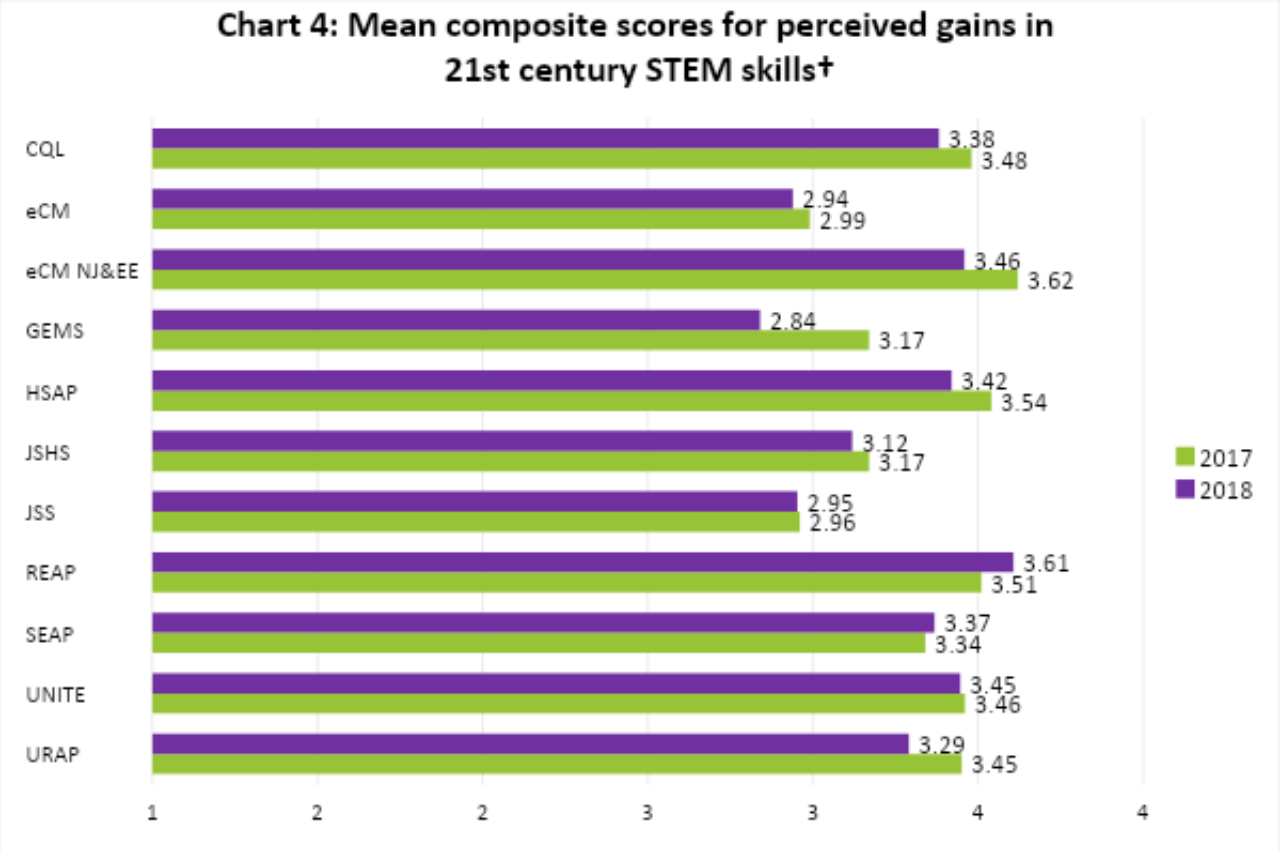


† *Response options for the items forming this composite were: 1 – No gain, 2 – A little gain, 3 – Some gain, 4 – Large gain.*

21st Century Skills are skills such as collaboration, communication, perseverance, and problem solving that are necessary across a wide variety of fields. Participants were asked about the impact of their AEOP participation on these 21st Century Skills (Table 19). Items making up the perceived gains in 21st Century Skills composite are provided in Table 18. Findings displayed in Chart 4 show that participants in each program reported gains in their 21st Century Skills. However, most programs reported slightly less gains in FY18 compared to FY17 except for REAP and SEAP which reported slightly greater gains.

Table 19. Items that form the Perceived Gains in 21st Century STEM Skills Composite
1. Learning to work independently†
2. Setting goals and reflecting on performance†
3. Sticking with a task until it is finished
4. Making changes when things do not go as planned
5. Working well with students from all backgrounds
6. Including others' perspectives when making decisions
7. Communicating effectively with others
8. Viewing failure as an opportunity to learn

† *These two items were not included on the GEMS, JSS, and Unite versions of the survey.*



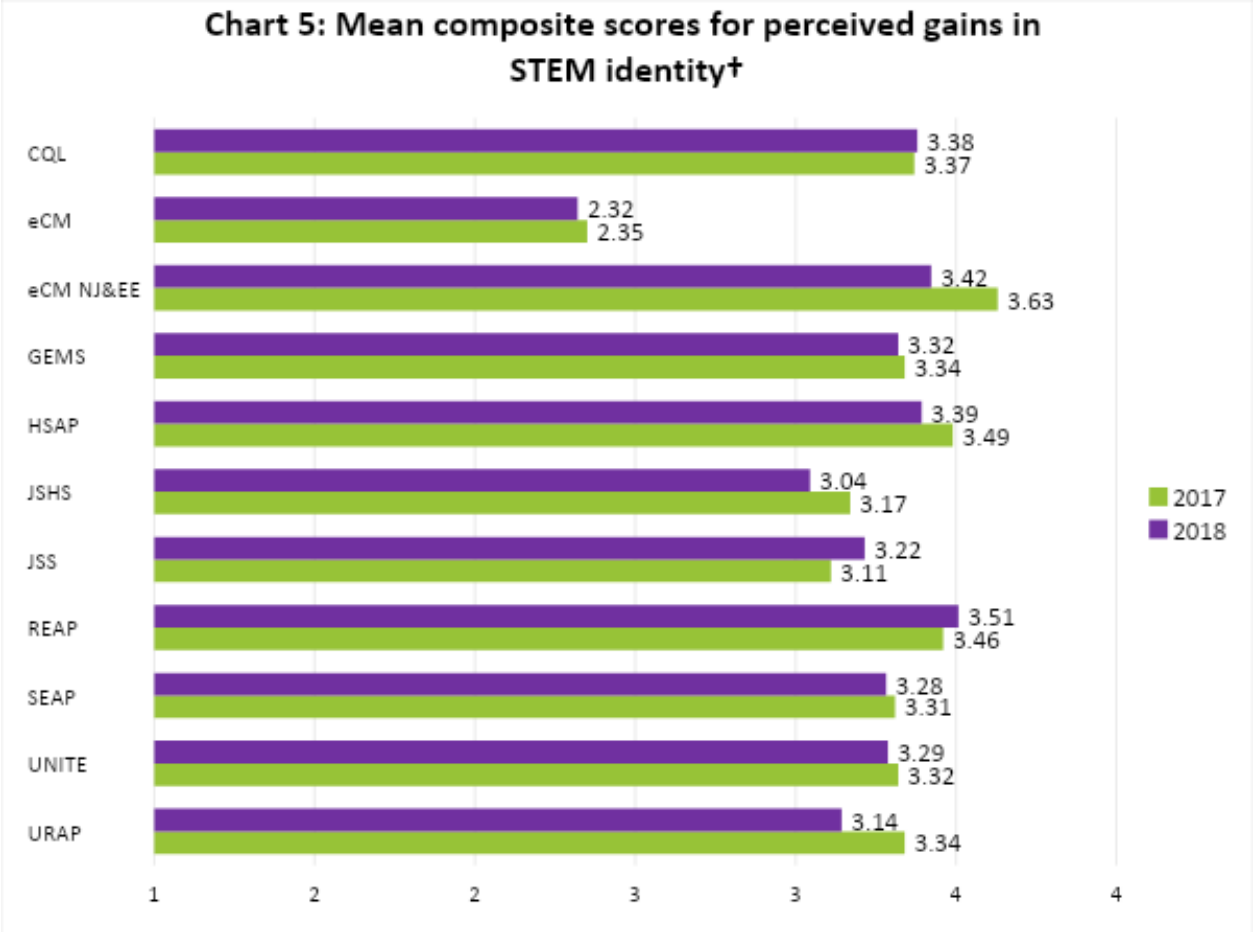
† *Response options for the items forming this composite were: 1 – No gain, 2 – A little gain, 3 – Some gain, 4 – Large gain.*

Participants were also asked to consider the effect of their AEOP participation on their STEM identities. STEM identity is a construct similar to self-confidence or self-efficacy that is associated with interest in STEM fields and careers. Participants were asked about gains in their STEM Identity as a result of participating in AEOP through a series of items that comprise the perceived gains in STEM Identity composite (Table 20). Chart 5 shows that participants in all programs reported some level of gains in their STEM identity. However, only CQL, JSS, and REAP reported larger gains in FY18 compared to FY17.

Table 20. Items that form the Perceived Gains in STEM Identity Composite
1. Interest in a new STEM topic
2. Deciding on a path to pursue a STEM career
3. Sense of accomplishing something in STEM
4. Feeling prepared for more challenging STEM activities
5. Confidence to try out new ideas or procedures on my own in a STEM project

6.	Patience for the slow pace of STEM research
7.	Desire to build relationships with mentors who work in STEM
8.	Connecting a STEM topic or field to my personal values

† *Not included on the CQL, JSHS, REAP, SEAP, URAP, HSAP versions of the survey*



† *Response options for the items forming this composite were: 1 – No gain, 2 – A little gain, 3 – Some gain, 4 – Large gain.*

Students and apprentices were asked to rate the extent of their agreement with items describing program impacts related to their STEM confidence and interest in STEM. These items asked about interest in taking additional STEM classes in school, pursuing STEM activities outside of school, and participants' confidence in their STEM knowledge, skills, and abilities. Table 21 presents results for these items from FY17 and FY18. For all programs except eCM and JSHS, more than half of participants agreed their AEOP program contributed to their increased confidence and interest in each question. Confidence in participants' STEM knowledge, skills, and abilities was ranked consistently highest (range of 65%-100% agreement).

Table 21. Students Agreeing that the Program Contributed to their STEM Confidence and Interest												
	Year	CQL	eCM	eCM NJ&EE	GEMS	HSAP	JSHS	JSS	REAP	SEAP	Unite	URAP
I am more confident in my STEM knowledge, skills, and abilities.	2017	90%	74%	91%	93%	100%	78%	76%	93%	93%	92%	88%
	2018	***91%***	***65%***	***96%***	***82%***	***100%***	***89%***	***79%***	***95%***	***97%***	***90%***	***94%***
I am more interested in participating in STEM activities outside of school requirements.	2017	79%	55%	90%	82%	90%	72%	76%	85%	77%	85%	84%
	2018	***81%***	***47%***	***90%***	***80%***	***90%***	***82%***	***76%***	***87%***	***86%***	***87%***	***71%***
I am more interested in taking STEM classes in school.	2017	66%	52%	81%	79%	74%	61%	78%	78%	67%	83%	69%
	2018	***64%***	***48%***	***76%***	***78%***	***74%***	***44%***	***73%***	***70%***	***71%***	***82%***	***50%***

Students and apprentices in all programs reported that, as a result of their AEOP participation, they had improved their STEM-specific skills and competencies and their 21st Century skills. Participants reported gains in their science and engineering practices as described in the NGSS and reported gains in participants' STEM identities and confidence in their STEM abilities. Again, these gains were apparent in participants' questionnaire responses as well as comments made by both youth participants and mentors during interviews and focus groups. For example:

> *"Overall, my experience as a research apprentice under CQL was amazing. I am continuing to collaborate with my team during the academic year on a volunteer basis as I am now a SMART Scholarship recipient and will be working full time with [the lab] upon completion of my degree. The research experiences I have had and continue to have at [this lab] have equipped me with the skills and experience necessary to pursue a PhD…Overall, this program has greatly improved my life and allowed me to pursue my dreams."* (CQL Apprentice)

> *"I believe eCYBERMISSION was a great experience, not only helping me learn about STEM, but also making me a better team player, as well as helping me solve real world problems. I know more about the world around me, and can hopefully one day use my newfound knowledge to make something important."* (eCM-R Student)

> *"I am very satisfied with this program for the overall benefit of being able to participate in the STEM field, and getting to learn about new and different career choices. It has gotten me more interested into the STEM field, and possibly a job later on. I would recommend this program to anyone who want to further their knowledge into the STEM field, and have fun while doing it."* (GEMS Student)

"The connections I had made with my mentor, the other interns, and the other people in the lab group made the summer a fulfilling experience. I learned to be more persistent, creative, and inquisitive because research does not come easily. At the end of the program, I learned more about what researchers do, made great friendships, gained a lot of respect for researchers and was able to reflect on my growth. I am glad that I applied and am highly satisfied with my HSAP experience!" (HSAP Apprentice)

"I enjoyed JSHS a lot. It was extremely interesting to get to see other students' research, as well as inspiring. It strengthened my drive to continue research and gave me more confidence in what I am doing as a high school student." (R-JSHS Student)

"I had a blast with my team and it was fun to see how much adversity we overcame as a team." (JSS National Student)

"It was a good experience and allowed me to enhance my lab skills, and work with equipment that I might have to use in college or the future. I got to meet other interns with different backgrounds, and hear about many different experiences yet relate to them while going through this new experience." (REAP Apprentice)

"This program, overall, far exceeded my expectations. To be able to work in a real engineering laboratory on important and viable projects helped me to more fully realize what exactly being an engineer or scientist means. This program made sure that I had all of the assistance needed to enable my success, and much equipment and resources were made available to me for my project. The benefits of this program will continue to help me in my coming years, and I now eagerly await the opportunity to perform future STEM research." (SEAP Apprentice)

"[Unite] opened my mind in engineering knowledge and the disciplines that follow into it. Along with that, it has allowed me to learn of the values and traits that is required for a task to be successful in the end." (Unite Student)

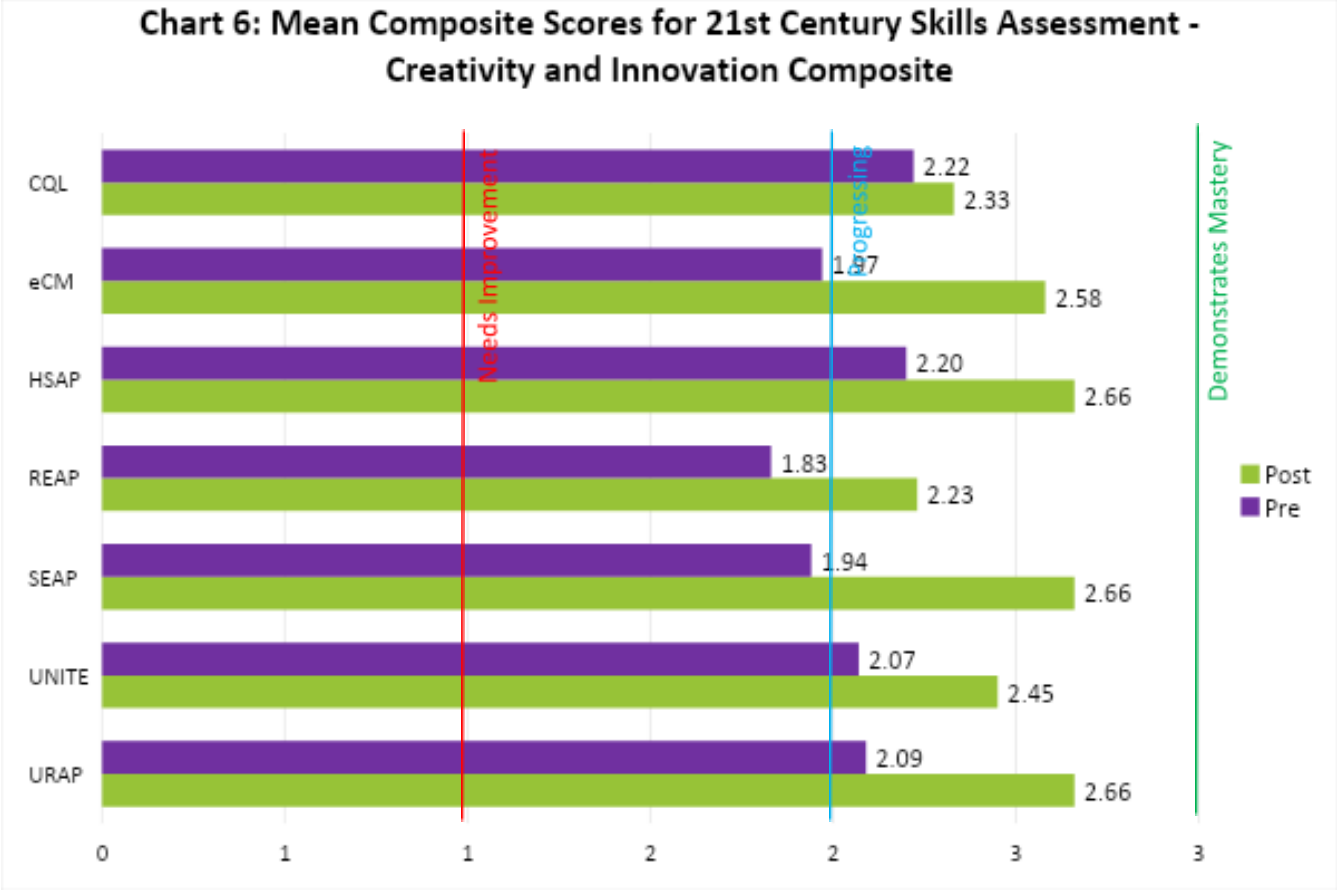
"This program has been invaluable for me in professional development and basic research techniques. [My mentor] spent a lot of time investing in not only the education but giving us advice that translates to many facets of life. He also exposed me to areas of science that I did not know existed. Meeting Mrs. Jennifer Ardouin was a great experience as well. As a black woman in science, it is not so common to see women like me in higher places. It was very refreshing to speak with her…I would highly recommend this experience to anyone." (URAP Apprentice)

Research Question #2b – To what extent do participants demonstrate use of and growth in 21st Century skills?

AEOP Apprentices and Unite participants demonstrated growth toward mastery of the 21st Century Skills as assessed by their mentor/teacher(s).

Creativity & Innovation. Across all AEOPs, there was an increase in participant growth in terms of creativity and innovation skills. For all programs except CQL, this increase was statistically significant ($p<.05$). CQL is a college-level program and students came in somewhat higher than others (.02-.39) at the Progressing level to start the program. See Table 22 for items rated in this skill set. Overall, participants began their program rated near the Progressing level and grew to an approaching Demonstrates Mastery level (see Chart 6). While all AEOPs showed a significant increase in this area, SEAP (+0.72) and eCM (+0.61) participants saw the greatest increases.

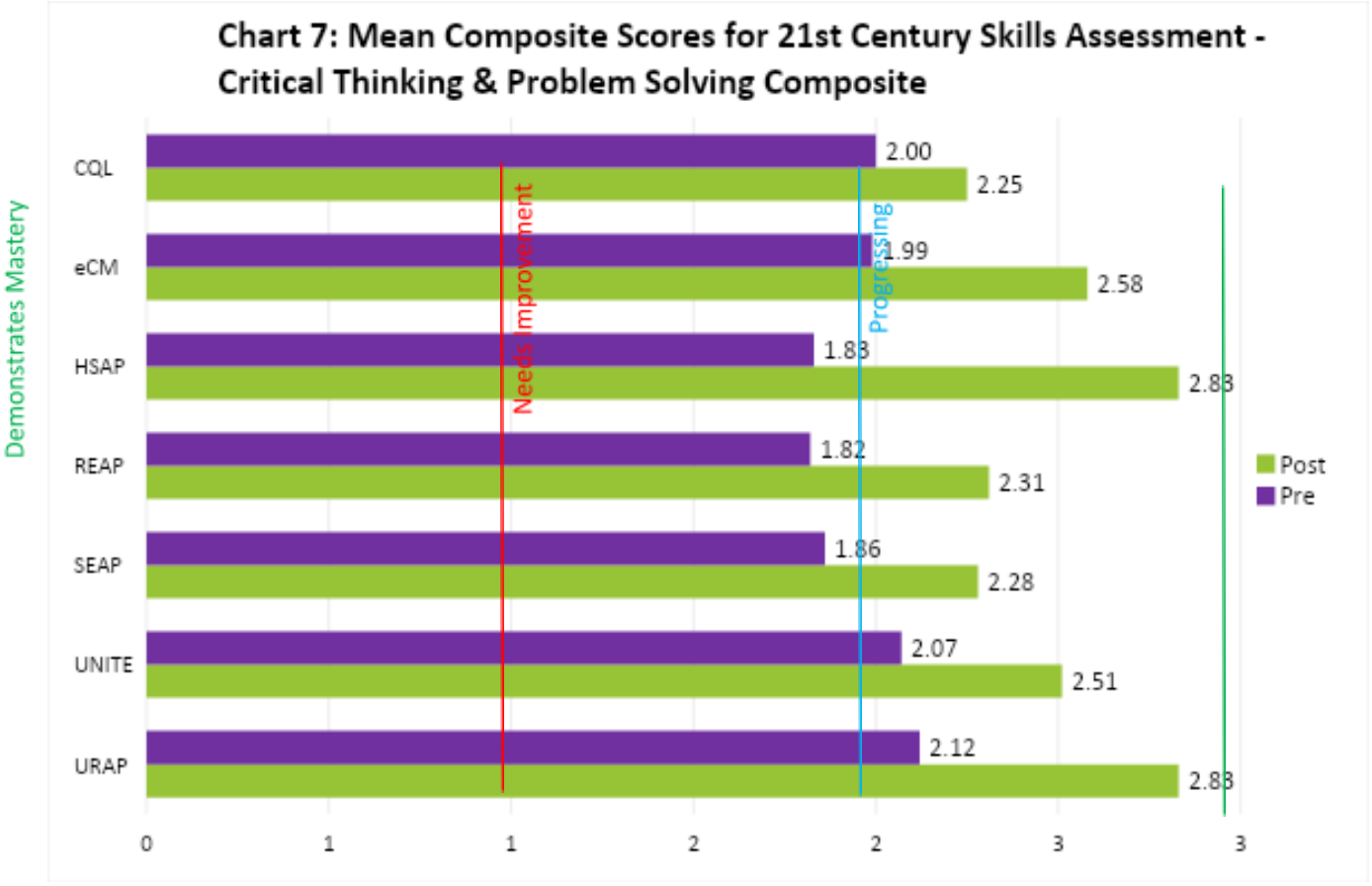
Table 22. Items that form the 21st Century Skills Assessment Subscale Composite of Creativity and Innovation
1. Think creatively
2. Work creatively with others
3. Implement innovations



Critical Thinking & Problem Solving. Significant growth in participant skills related to critical thinking and problem solving were observed by mentors ($p<.01$) for all programs except CQL and SEAP. Table 23 lists items rated in this skill set. Across AEOPs, participants began their program rated at approaching

Progressing or slightly above this level. By the post-assessment, participants grew to an average level between Progressing and Demonstrates Mastery (see Chart 7). HSAP (+1.00) and URAP (+0.71) participants saw the greatest increases in this area and ended with the highest average ratings (2.83 – approaching Demonstrates Mastery).

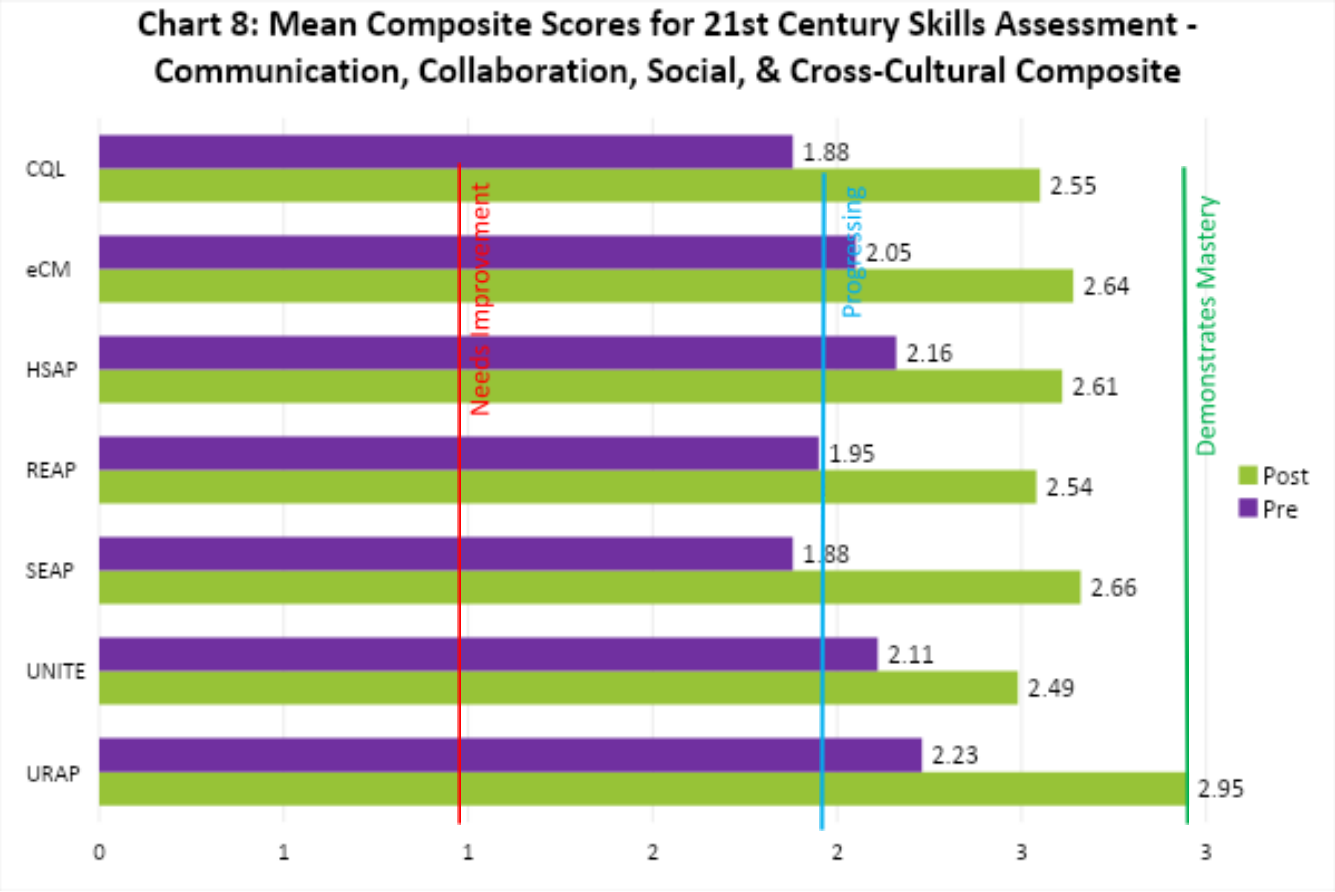
Table 23. Items that form the 21st Century Skills Assessment Subscale Composite of Critical Thinking & Problem Solving
1. Reason effectively
2. Use systems thinking
3. Make judgments and decisions
4. Solve problems



Communication, Collaboration, Social & Cross-Cultural. Statistically significant growth in communication, collaboration, social, and cross-cultural skills was demonstrated from pre- to post-assessment for all AEOPs ($p<.05$). Table 24 provides items rated in this skill set. Regardless of program, participants were rated relatively high on these skills at the pre-assessment averaging near or

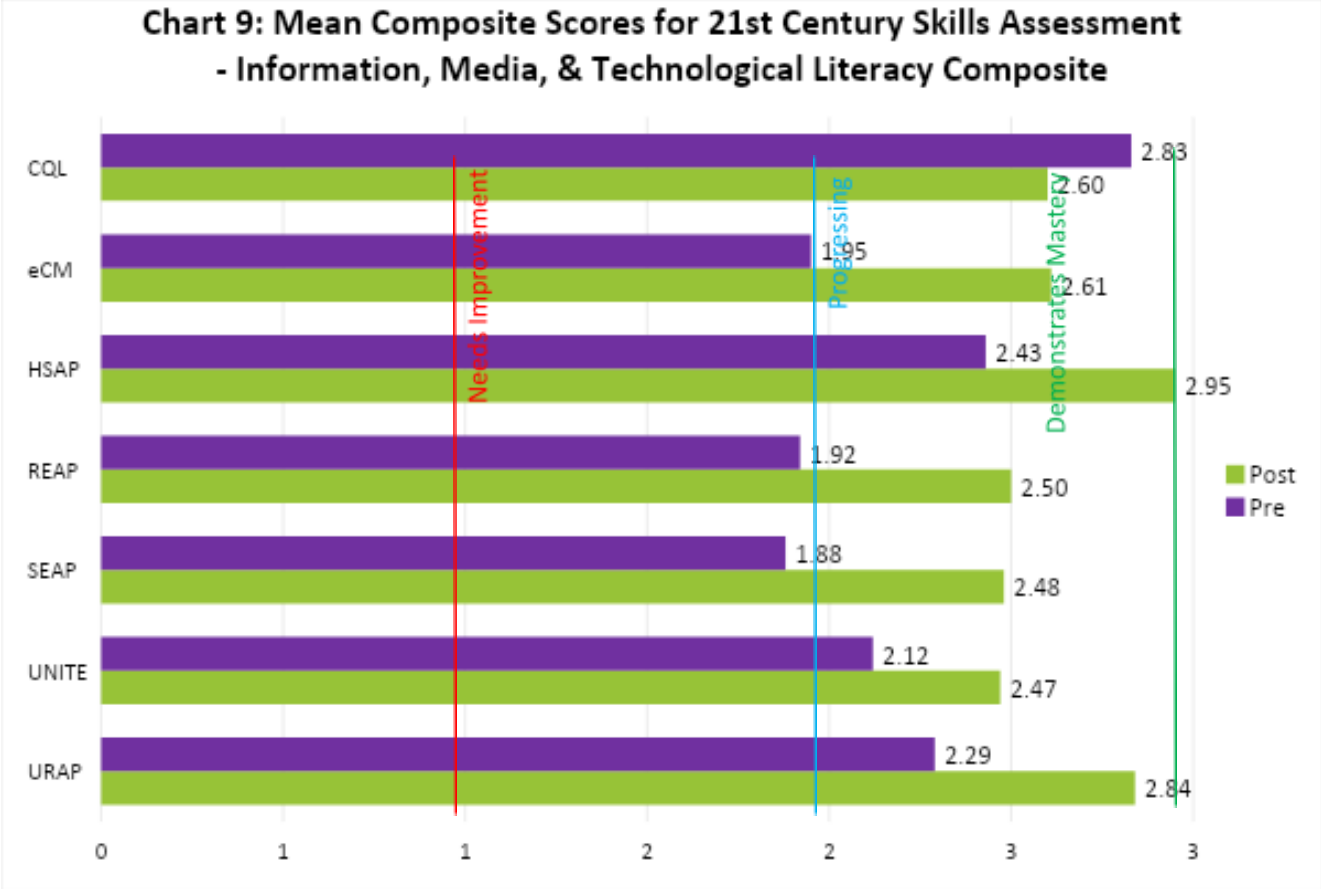
over the Progressing level benchmark of 2.0. By the post-rating, participants grew to an approaching Demonstrates Mastery level (see Chart 8). SEAP (+0.78) and URAP (+0.71) apprentices had the greatest average growth in this area.

Table 24. Items that form the 21st Century Skills Assessment Subscale Composite of Communication, Collaboration, Social, & Cross-Cultural
1. Communicate clearly
2. Communicate with others
3. Interact effectively with others



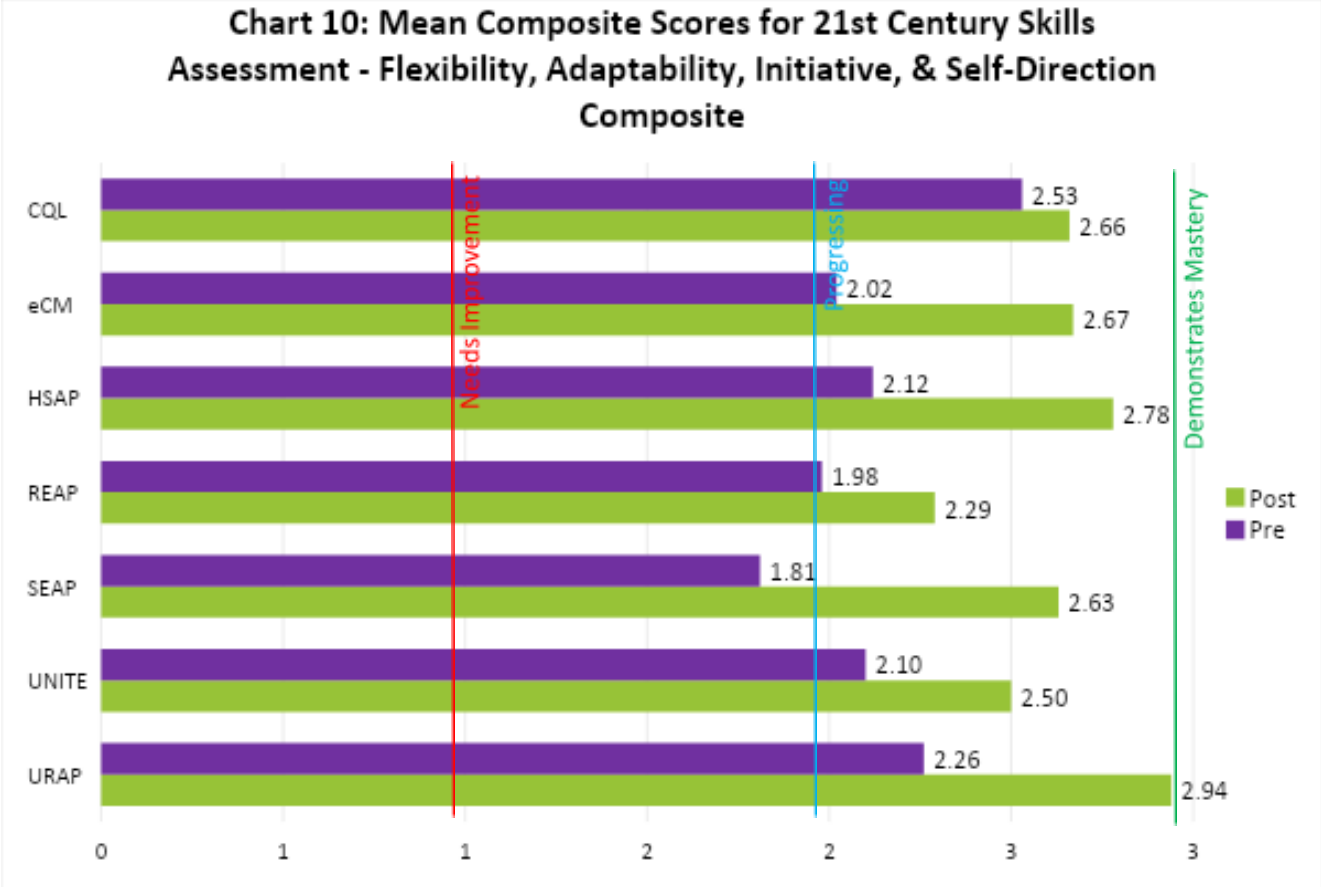
Information, Media, & Technological Literacy. Participants from all AEOPs (except CQL) averaged significantly positive growth in their information, media, and technological literacy skills ($p<.05$). Table 25 shows items rated in this skill set. CQL students actually demonstrated a decrease from pre- to post- though still rating at Progressing (see Chart 9). eCM (+0.66) and SEAP (+0.60) students showed the greatest growth in this area.

Table 25. Items that form the 21st Century Skills Assessment Subscale Composite of Information, Media, & Technological Literacy
1. Access and evaluate information
2. Use and manage information
3. Analyze media
4. Create media products
5. Apply technology effectively



Flexibility, Adaptability, Initiative, & Self-Direction. Growth in flexibility, adaptability, initiative, and self-direction was found in all AEOPs from pre- to post-assessment, and this growth was statistically significant ($p<.05$) for all programs except CQL. CQL is a college-level program and students came in somewhat higher than others (.27-.72) at the Progressing level to start the program. See Table 26 for items rated in this skill set. SEAP apprentices demonstrated the greatest increase in this area (+0.82) as they had the most room to grow compared to the other programs (see Chart 10).

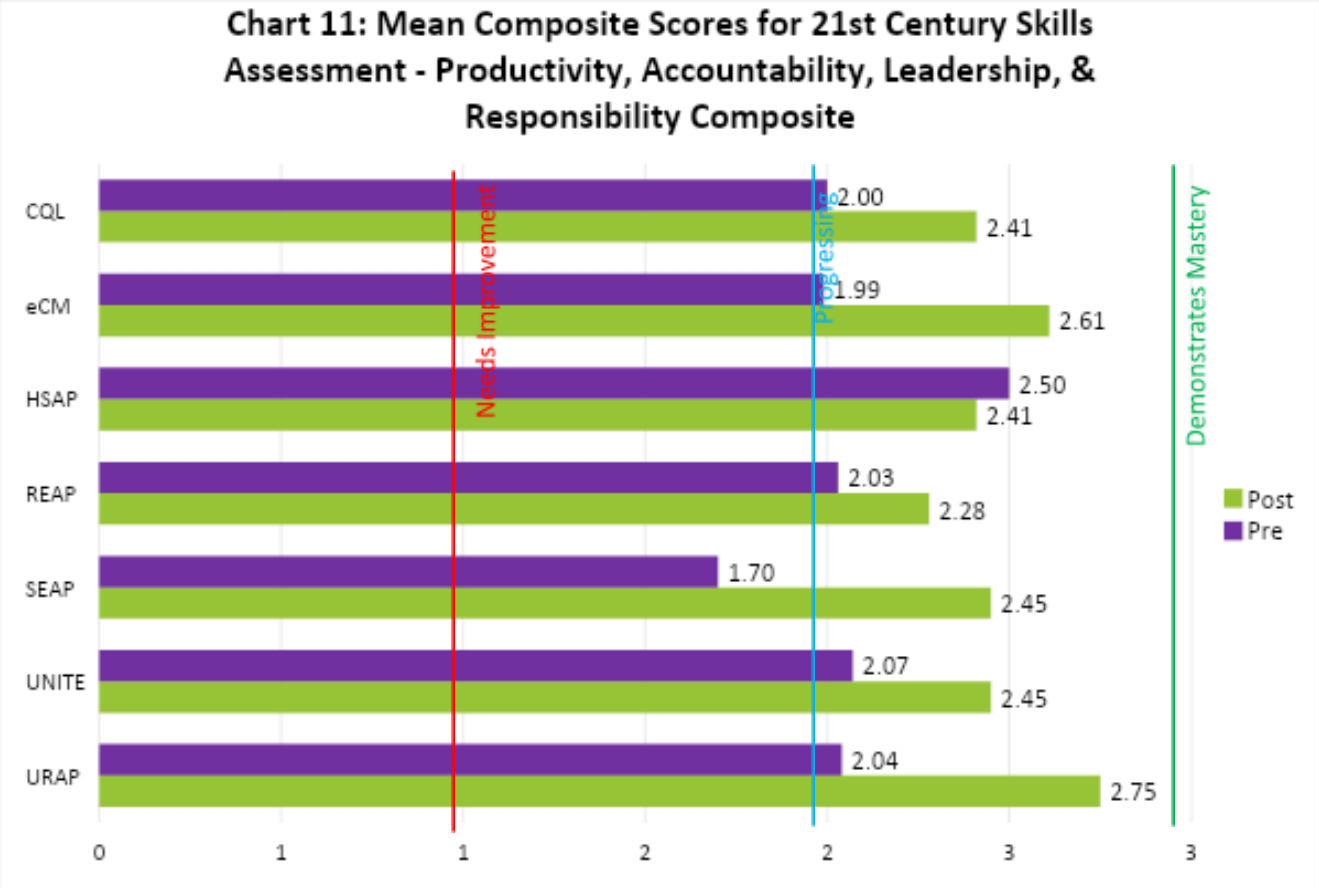
Table 26. Items that form the 21st Century Skills Assessment Subscale Composite of Flexibility, Adaptability, Initiative, & Self-Direction
1. Adapt to change
2. Be flexible
3. Manage goals and time
4. Work independently
5. Be a self-directed learner



Productivity, Accountability, Leadership, & Responsibility. Growth in productivity, accountability, leadership, and responsibility skills were found from pre- to post-assessment for all programs except HSAP, which started the program at a higher rating than any other programs (2.50). Table 27 presents items rated in this skill set and Chart 11 graphically depicts findings. HSAP apprentices were initially rated higher than some of the programs finished (i.e., CQL, REAP, SEAP, Unite). As such, HSAP apprentice final

ratings regressed toward the mean and were slightly lower than they were at pre-assessment. SEAP (+0.75) and URAP (+0.70) had the most improvement in this area.

Table 27. Items that form the 21st Century Skills Assessment Subscale Composite of Productivity, Accountability, Leadership, & Responsibility
1. Manage projects
2. Produce results
3. Guide and lead others
4. Be responsible to others



Although results slightly varied across programs, the skill sets of Creativity and Innovation as well as Critical Thinking and Problem Solving were areas where participants showed the great improvement over the duration of their program. Participants from SEAP and REAP generally had the lowest pre-assessment scores and also demonstrated large amounts of growth. While CQL students demonstrated growth in all domains except Information, Media, & Technological Literacy, there was little significant improvement identified due to the extremely small sample size (*n*=3) for this program.

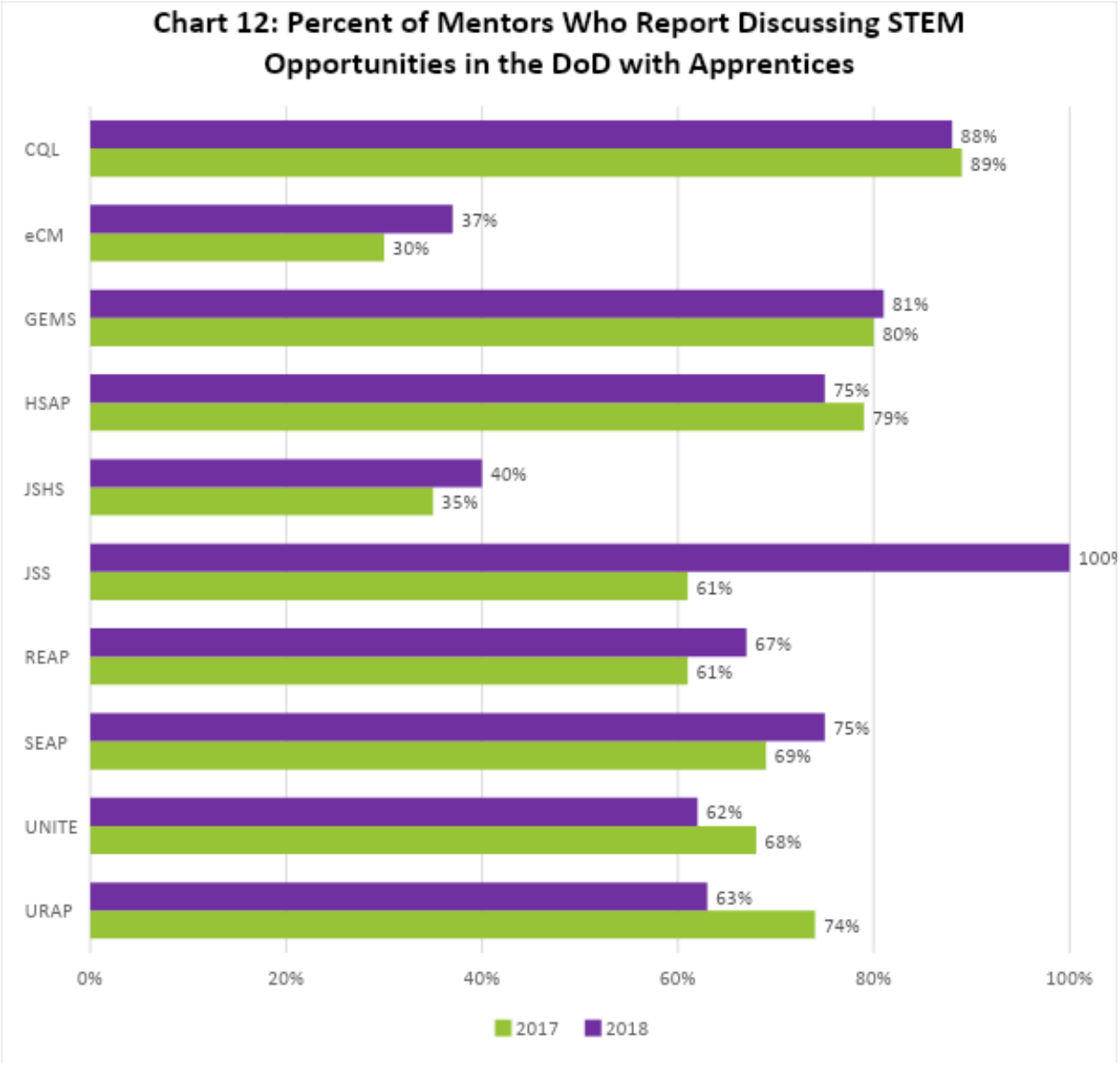
Research Question #4 - To what extent do participants and mentors report increased awareness of and interest in Army/DoD STEM research and careers?

The AEOP's efforts to engage students in and/or expose them to DoD research continues to be a challenge met with mixed results. While students reported positive attitudes toward DoD STEM research and researchers, findings related to mentors discussing DoD STEM research and STEM opportunities in the DoD with apprentices and students varied widely across programs. In FY18 the AEOP continued to highlight DoD STEM research through program activities that engage participants in or provide meaningful exposure to DoD research. Table 28 summarizes some of these efforts.

Table 28. 2017 Participant Engagement in and Exposure to DoD Research	
AEOP	**Engagement in DoD Research**
CQL, SEAP	**328** high school and undergraduate participants (**114 for SEAP, 214 for CQL**) serving as apprentices on DoD research projects at Army or DoD research laboratories.
HSAP, URAP	**115** (48 **for HSAP, 67 for URAP**) high school and undergraduate participants serving as apprentices on Army research projects at college/university research laboratories.
GEMS	**3,341** elementary, middle and high school participants, **151** NPMs and **68** K-12 teachers were engaged in DoD research through GEMS activities hosted by Army research laboratories.
AEOP	**Exposure to DoD Research**
eCM	**78** participants and their **22** team advisors (in-service teachers) were exposed to DoD research through the National Judging & Educational Event activities. **367** students participated in Cyberguides live chats.
JSHS	**240** participants and their teachers were exposed to DoD research through the National Symposium activities. National JSHS programming included DoD S&Es, who served as national judges, speakers and presenters who highlighted DoD research. **4,600** students were exposed to DoD research through DoD S&Es who engage at regional JSHS symposia.
Unite	**429** high school participants and **401** program mentors participated in experiences including field trips and speakers about the work of DoD STEM personnel and/or DoD research facilities.
JSS	**1,081** participants in regional competitions and **263** participants in the national competition were exposed to DoD research through JSS activities.

Although AEOPs vary in their focus and objectives, all programs share a goal of exposing participants to Army/DoD research and careers. Apprenticeship programs, including CQL, HSAP, SEAP, and URAP, actively engage participants in DoD research projects by providing apprentices opportunities to work alongside Army S&Es make meaningful contributions to research. STEM enrichment activities provide students with hands-on, interactive experiences that are relevant to nearby Army labs. In GEMS, for example, DoD S&Es, or NPMs under the mentorship of S&Es, translate DoD research into grade-level appropriate educational activities, allowing GEMS participants to engage in real-world research through the questions and problems addressed by DoD researchers and their research. A number of AEOP programs also incorporate DoD STEM-expos, laboratory tours, expert panels, and professional development activities linking school curricular topics in efforts to expose participants to the DoD STEM research and careers.

Mentors provide students and apprentices with valuable information about the DoD and STEM research in the DoD. In recognition of this key mentor role, the mentor questionnaire asked mentors to report whether they discussed STEM opportunities in the DoD and other government agencies with apprentices and students in order to support their STEM educational and career pathways. Chart 12 provides results for this item in FY17 and FY18. There continues to be substantial variation in mentor responses to this item across programs and across program years. While less than half of eCM mentors (37%) and JSHS mentors (40%) discussed STEM opportunities in the DoD with students, approximately two-thirds or more of mentors in all other programs (range of 61%-100%) discussed these opportunities with their students or apprentices. Mentors in six programs (eCM, GEMS, JSHS, JSS, REAP, SEAP) discussed these opportunities at slightly greater rates than in FY17.



Students and apprentices were presented with several positive statements about DoD research and researchers and were asked to indicate their level of agreement. Participant responses indicate that attitudes toward Army/DoD research and researchers remain consistently positive. The proportion of respondents who agreed with the statements in FY17 and FY18 are provided in Table 29. With the exception of eCM on one item, a majority of participants in all programs agreed that Army/DoD research and researchers advance science and engineering fields (range of 48%-97%), develop new cutting-edge technologies (range of 52%-93%), that DoD researchers solve real-world problems (range of 56%-97%), and that DoD research is valuable to society (range of 56%-95%). These responses are similar to those from 2017.

Across the items, the highest rates of agreement with these statements (averaging 90% or higher) continues to be from participants at programs hosted at DoD research laboratories (CQL and SEAP) and DoD-sponsored college/university laboratories (HSAP and URAP). Participants at programs hosted by non-DoD affiliated college/university laboratories and settings (REAP and Unite) had positive, but somewhat lower, rates of agreement. Further, competition programs (eCM, JSHS, and JSS) had the lowest rates of agreement averaging below three-quarters (53%-73%). It is interesting to note that eCM NJ&EE averaged 92% agreement across these items. Overall, these findings suggest that experiences at DoD research laboratories and DoD-sponsored college/university laboratories generated greater understandings of and positive attitudes toward DoD research than those hosted in non-DoD affiliated university laboratories and other settings. While the nature of programs precludes all students from being physically present at DoD research labs or DoD-sponsored college/university labs, strategies and experiences utilized by these DoD laboratory-affiliated programs should be examined and, where possible, scaled up and used with other AEOP initiatives to strengthen participant knowledge of DoD STEM research.

Table 29. AEOP Participants' Agreeing with Various Statements about DoD STEM Research

	Year	CQL	eCM	eCM NJ&EE	GEMS	HSAP	JSHS	JSS	REAP	SEAP	Unite	URAP
DoD researchers advance science and engineering fields	2017	94%	51%	91%	80%	97%	68%	67%	87%	92%	74%	88%
	2018	***97%***	***48%***	***90%***	***76%***	***90%***	***73%***	***65%***	***87%***	***97%***	***75%***	***91%***
DoD researchers develop new, cutting edge technologies	2017	94%	56%	91%	81%	97%	67%	64%	87%	92%	75%	84%
	2018	***93%***	***52%***	***92%***	***87%***	***90%***	***72%***	***64%***	***88%***	***89%***	***75%***	***88%***
DoD researchers solve	2017	94%	61%	94%	85%	94%	71%	69%	87%	95%	76%	88%

real-world problems	***2018***	***97%***	***56%***	***93%***	***87%***	***95%***	***74%***	***67%***	***87%***	***97%***	***78%***	***91%***
DoD research is valuable to society	2017	95%	56%	94%	84%	94%	68%	69%	89%	98%	77%	91%
	2018	***95%***	***56%***	***93%***	***79%***	***90%***	***73%***	***65%***	***83%***	***94%***	***78%***	***91%***

Research Question #3 - To what extent do participants and mentors report increased participant interest in STEM research and careers?

Participants reported increased interest in STEM research and careers after participation in FY18 AEOPs. Evaluation findings indicated that the AEOP exposed students and apprentices to STEM careers generally and to Army and DoD STEM careers, and that participating in these programs increased their interest in pursuing STEM careers.

Students and apprentices were asked to indicate the number of STEM careers generally, and the number of STEM careers in the Army/DoD specifically, they learned about during their AEOP experiences. Chart 13 displays results for participants who reported learning about 3 or more general STEM careers (range of 32%-91%). In all programs except eCM, JSS, and URAP a majority of participants reported learning about 3 or more STEM careers during their AEOP participation. A somewhat larger proportion of students had learned about 3 or more STEM careers in FY18 as compared to FY17 in CQL, eCM, JSHS, JSS, SEAP, and URAP.

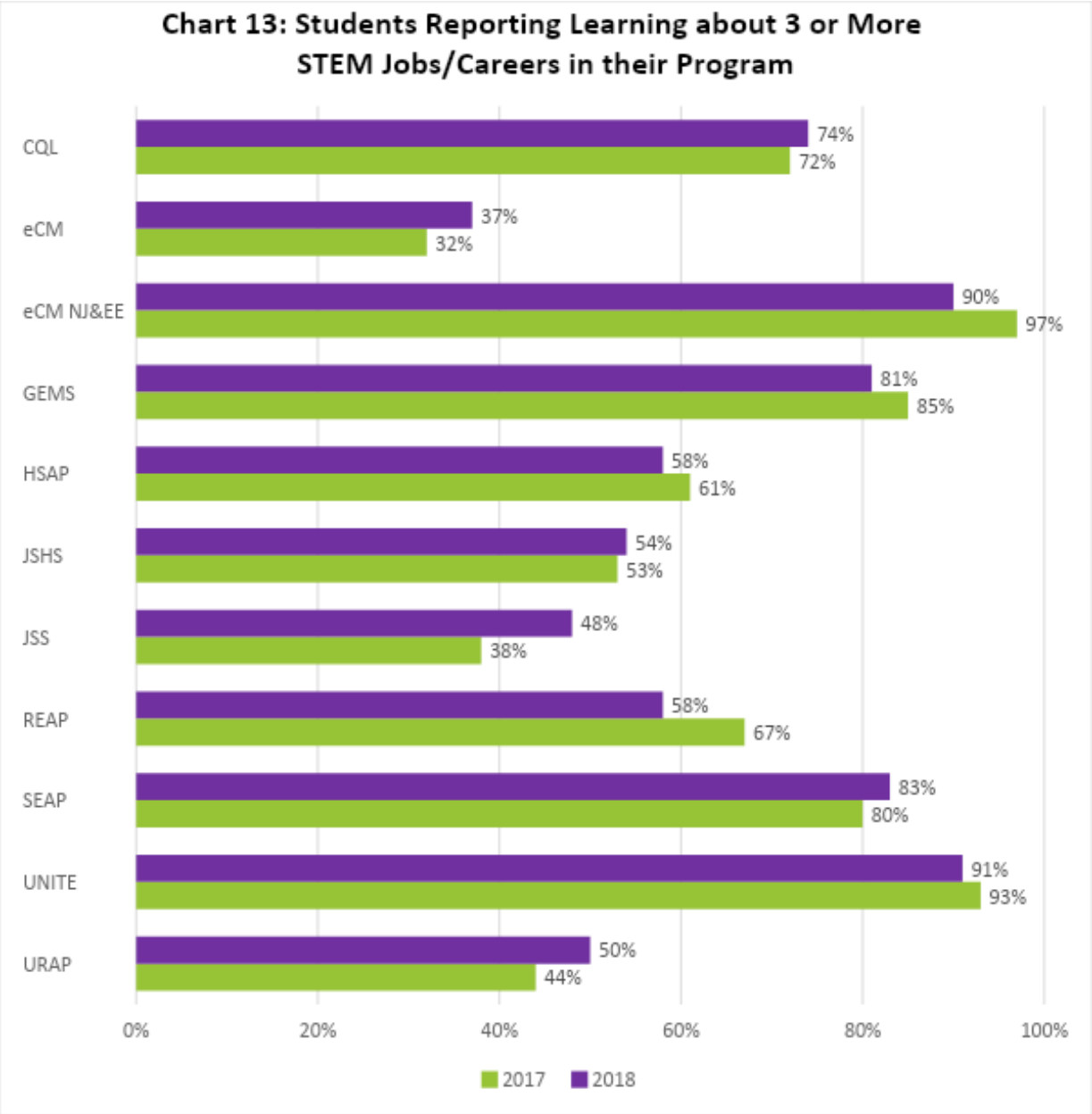
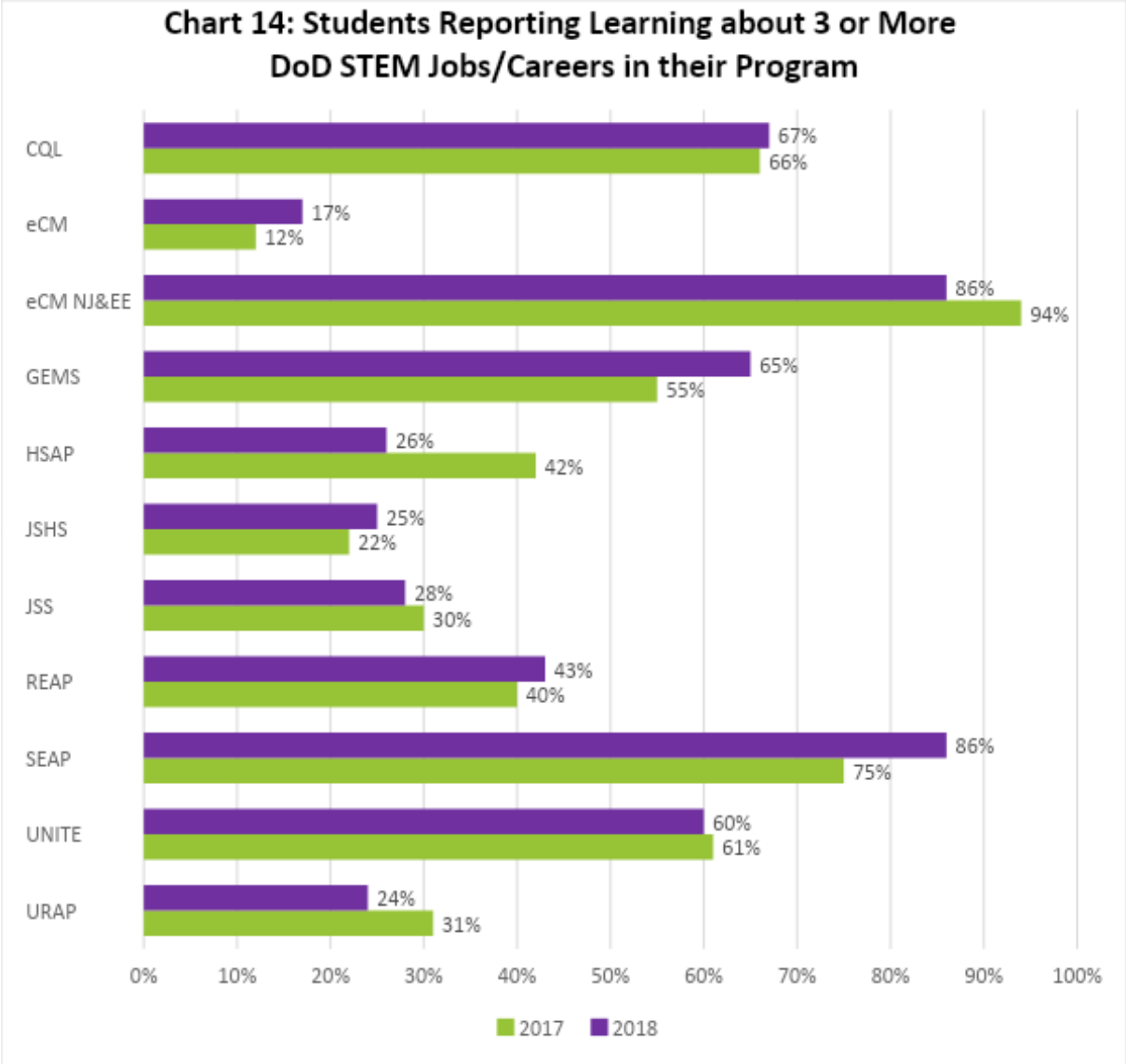


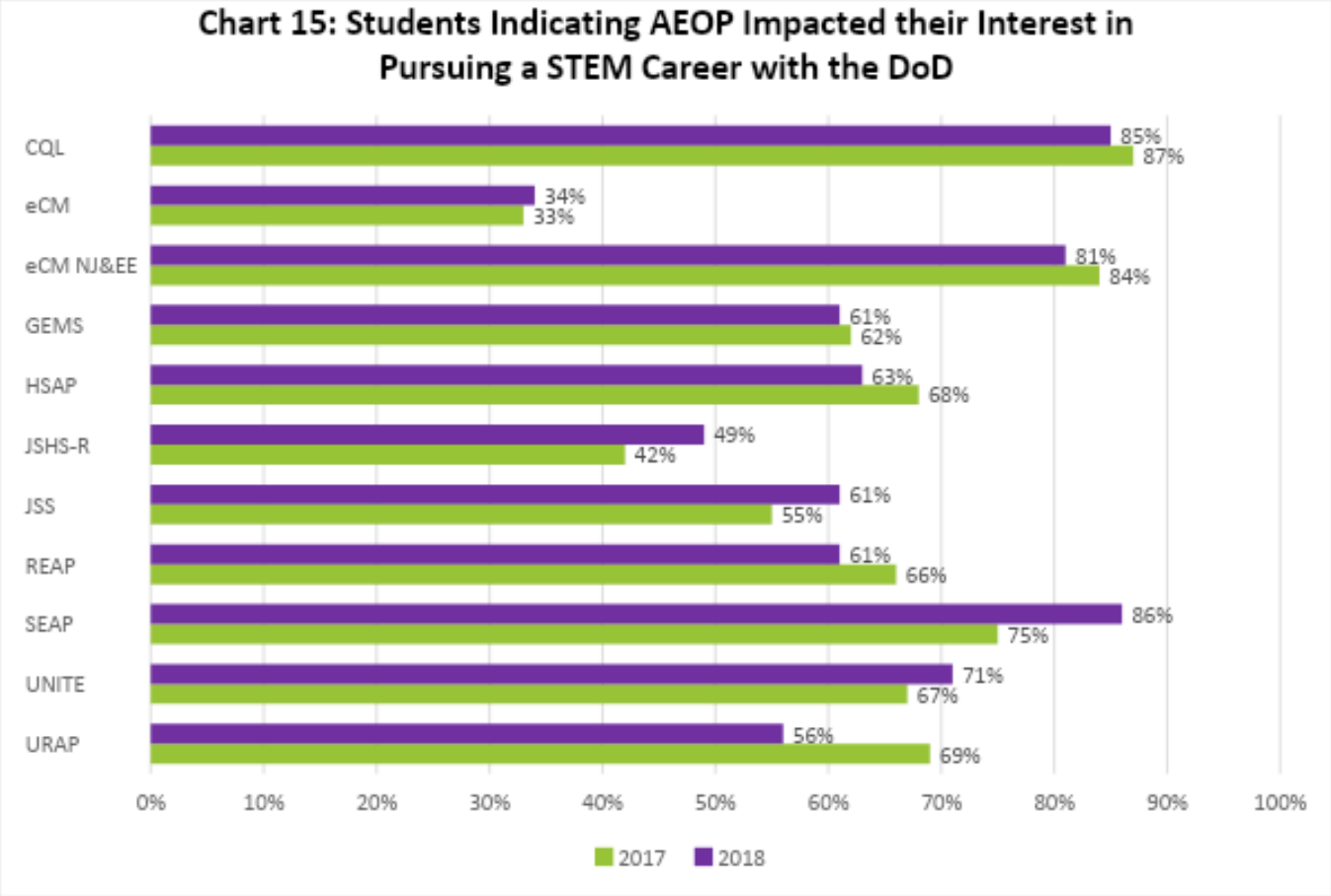
Chart 14 displays findings for students who learned about 3 or more STEM careers within the Army or DoD. A smaller percentage of students (range of 17%-86%) had learned about these careers as compared with STEM careers more generally (Chart 13). A majority of students (range of 60%-86%) in CQL, eCM National, GEMS, SEAP, and Unite had learned about 3 or more DoD STEM careers. In FY18 a greater percentage of participants than in FY17 learned about these jobs in the following programs: CQL, eCM, GEMS, JSHS, REAP, and SEAP. As in previous years, comparisons of participants participating in AEOPs held at Army research laboratories (CQL, GEMS, and SEAP), with participants at Army-sponsored university labs (HSAP and URAP), and non-Army affiliated settings (eCM Regional, JSHS, REAP, and Unite) reveal that, overall, these participants learned about more DoD STEM careers. It is noteworthy, however,

that an overwhelming majority (86%) of eCM National students and more than half of Unite students (60%) reported learning about 3 or more DoD STEM careers although they participated in programs in non-Army affiliated settings. It may be useful, therefore, to examine the practices used by these programs to determine their suitability for implementation in other programs hosted in non-Army affiliated settings.



Participants were also asked about the extent to which their AEOP participation impacted their interest in pursuing STEM careers in the Army or DoD (Chart 15). As in past years, participants in some programs reported that their AEOP experiences were more impactful in this area (e.g., CQL, SEAP, and national eCM,) than did participants in programs such as regional e-CM and JSHS. Because the programs for which participants tend to report the greatest impact in this area are those in which participants have exposure to Army and DoD STEM researchers and/or facilities during program activities, this suggests that this type of direct engagement is especially useful for informing participants about specific jobs and

careers within the DoD. Mentors in many programs were unaware of AEOP electronic and print resources and therefore these had limited usefulness in exposing apprentices and students to STEM DoD careers, although findings suggest that these resources are used differently across programs.



Participants were also asked to rate their agreement with a number of statements about their interest in and awareness of STEM careers, both generally and within the DoD (Table 30). A majority of students (range of 67%-90%) in all programs except for eCM Regional (39%) were more interested in pursuing STEM careers after their AEOP participation. Somewhat smaller percentages of participants in most programs (range of 34%-86%) indicated that their AEOP participation resulted in an increased interest in DoD STEM careers, with the exception of CQL, eCM NJ&EE, and SEAP whose participants reported higher interest in DoD STEM careers compared to STEM careers in general. A majority of participants (63%-96%) in all programs except eCM Regional (47%) reported being more aware of DoD STEM research and careers after their AEOP experiences. A majority of participants (52%-100%) had a greater appreciation of Army or DoD STEM research after their AEOP experiences. There was substantially greater agreement with these statements in FY18 as compared to FY17 for JSHS, JSS, and SEAP.

Table 30. Students Agreeing AEOP Affected Their Attitudes Toward STEM Careers

	Year	CQL	eCM	eCM NJ&EE	GEMS	HSAP	JSHS	JSS	REAP	SEAP	Unite	URAP
I am more interested in pursuing a career in STEM	2017	69%	42%	84%	75%	81%	64%	64%	78%	69%	80%	63%
	2018	***76%***	***39%***	***72%***	***90%***	***79%***	***67%***	***72%***	***82%***	***83%***	***79%***	***68%***
I am more aware of DoD STEM research and careers	2017	92%	47%	96%	80%	97%	53%	61%	77%	89%	85%	72%
	2018	***95%***	***47%***	***96%***	***87%***	***84%***	***63%***	***72%***	***78%***	***94%***	***83%***	***82%***
I have a greater appreciation of Army or DoD STEM research	2017	93%	51%	96%	84%	97%	56%	70%	78%	93%	77%	84%
	2018	***88%***	***52%***	***94%***	***88%***	***95%***	***65%***	***76%***	***86%***	***100%***	***84%***	***85%***
I am more interested in pursuing a STEM career with the DoD	2017	87%	33%	84%	62%	68%	42%	55%	66%	75%	67%	69%
	2018	***85%***	***34%***	***81%***	***61%***	***63%***	***51%***	***61%***	***62%***	***86%***	***71%***	***56%***

Findings for apprentice interest in pursuing DoD STEM careers is displayed in Table 31. More than half of responding apprentices reported interest in DoD STEM careers in FY18 (range of 56%-86%), findings slightly lower than those for FY17 (range of 66%-87%). SEAP was the only program to show an upward trend from FY17 (75%) to FY18 (86%).

Table 31. Apprentices' Interest in DoD STEM Careers 2017 - 2018

Program	2017	2018
CQL	87%	85%
HSAP	68%	63%
REAP	66%	62%
SEAP	75%	86%
URAP	69%	56%

In all programs, youth and adult participants reported that AEOP participation afforded students opportunities to refine, explore, and/or advance their STEM education and career interests. In open-ended questionnaire responses, focus groups, and interviews, students and apprentices indicated that participating in AEOPs affirmed or increased their interest in STEM careers. Likewise, mentors commented that participation in AEOPs provides participants with valuable career information, both in STEM fields generally and in Army/DoD STEM careers more specifically. For example, participants said:

> *"[A benefit of CQL is] getting more experience with STEM related work in general because I don't know what I want to do as a career. Having this opportunity to explore the STEM world a little bit and find out about some of the opportunities that are available to me, that was really valuable."* (CQL Apprentice)

"Prior to doing eCYBERMISSION, I never thought about [a career in STEM with the Army or DoD]. After hearing the presentations and all of the benefits, I think it would actually be a smart choice…I'm definitely considering it." (eCM-NJ&EE student)

"I learned more about what I wanted to do specifically when I got older." (GEMS Student)

"I too have been able to talk to scientists and engineers about their field and what they do, and get an idea for what I want to do in the future." (GEMS NPM)

"This program was so valuable to me in learning that I would like to further pursue research in college and potentially beyond. I got a lot of totally new exposure to fields I never knew about, and learned so much about what it's like to work on university research like this." (HSAP Apprentice)

"I think meeting new people and DOD scientists opened my eyes to the level of research being done. I had a newfound appreciation for what the DOD does and the career, life advice were mostly helpful." (N-JSHS Student)

"I think it's cool how people are starting to make the movement towards more efficient and longer lasting energy sources." (JSS National Student)

"[REAP] was very good and helped me learn more about research and careers in STEM. The mentors were very helpful and easy to work with and the other participants were also fun to be around. Overall the experience was great and I learned a lot from my research and interacting with other people and made me learn more about careers." (REAP Apprentice)

I've already started recruiting students to do some authentic research, plug them into eCYBERMISSION, plug them into the Junior [Science and] Humanities Symposium; In my district, no one's really heard of AEOP or RESET, and so [I'm] going out there and talking to teachers, saying, "Hey, do you have time this summer? Is this something you would like to do?" (RESET Level II Participant)

"I feel I've gotten a lot of experience in the lab and trying to figure out if this is what to do in the future." (SEAP Apprentice)

"My participation in Unite has helped to broaden my perspective on the STEM field, specifically the range of jobs and complexities of certain fields." (Unite Student)

"There's a very strong effort from the HSAP and URAP program leaders to let the students know what the opportunities are in the Army and other DoD agencies." (URAP Mentor)

Because mentors play a key role in providing information to program participants, the AEOP has focused since 2014 on supporting mentors with resources to expose participants to DoD STEM careers. Mentors were asked, as part of the FY18 evaluation, to rate the usefulness of various resources for this purpose. Table 32 demonstrates that across all programs simply participating in the program was chosen most

frequently as useful for exposing participants to DoD STEM careers (a range of 65%-100%). Mentors' perceptions of the usefulness of other AEOP resources varied across programs. For example, while 100% of HSAP mentors found the AEOP website useful, only 15% of JSHS mentors reported that the website was a useful resource. Additionally, while 68% of JSS mentors found the AEOP brochure useful, only 5% of SEAP mentors and 12% of CQL mentors believed the brochure helped them to expose apprentices to DoD STEM careers. With the exception of SEAP, CQL, and eCM, a majority of mentors in all other programs found the program administrator or site coordinator to be useful.

Table 32. Resources that Mentors Found Useful for Exposing Apprentices and Students to DoD STEM Careers

Resource	Year	CQL	eCM	GEMS	HSAP	JSHS	JSS	REAP	SEAP	Unite	URAP
Program Administrator Website (TSA, ASEE, AAS, etc.)	2017	NA	87%	NA	63%	15%	78%	NA	NA	39%	56%
	2018	***NA***	***87%***	***NA***	***75%***	***11%***	***100%***	***NA***	***NA***	***41%***	***48%***
AEOP website	2017	22%	38%	48%	83%	10%	48%	54%	17%	67%	71%
	2018	***41%***	***38%***	***50%***	***100%***	***15%***	***68%***	***60%***	***20%***	***56%***	***56%***
AEOP social media	2017	2%	21%	17%	25%	3%	17%	19%	3%	33%	18%
	2018	***6%***	***16%***	***35%***	***0%***	***3%***	***33%***	***24%***	***5%***	***31%***	***15%***
AEOP brochure	2017	9%	25%	54%	58%	13%	22%	46%	6%	68%	47%
	2018	***12%***	***20%***	***46%***	***50%***	***15%***	***68%***	***51%***	***5%***	***49%***	***33%***
Program administrator or site coordinator	2017	48%	51%	89%	92%	76%	22%	69%	54%	80%	71%
	2018	***41%***	***41%***	***89%***	***75%***	***65%***	***100%***	***72%***	***35%***	***70%***	***56%***
Invited speakers or "career" events	2017	22%	28%	76%	38%	49%	9%	29%	17%	78%	44%
	2018	***65%***	***20%***	***65%***	***25%***	***34%***	***0%***	***NA***	***50%***	***66%***	***26%***
Participation in program	2017	78%	94%	93%	100%	93%	74%	80%	69%	93%	91%
	2018	***82%***	***83%***	***85%***	***75%***	***80%***	***100%***	***87%***	***65%***	***75%***	***78%***

Evaluation findings suggest that AEOP mentors in some programs have limited awareness of Army and DoD STEM careers themselves and are therefore unable to effectively share information with student participants. These mentors often report lack of awareness of available resources about these careers and about the range of AEOPs. As a result, some mentors have limited capacity to educate participants about Army and DoD STEM careers and other AEOPs.

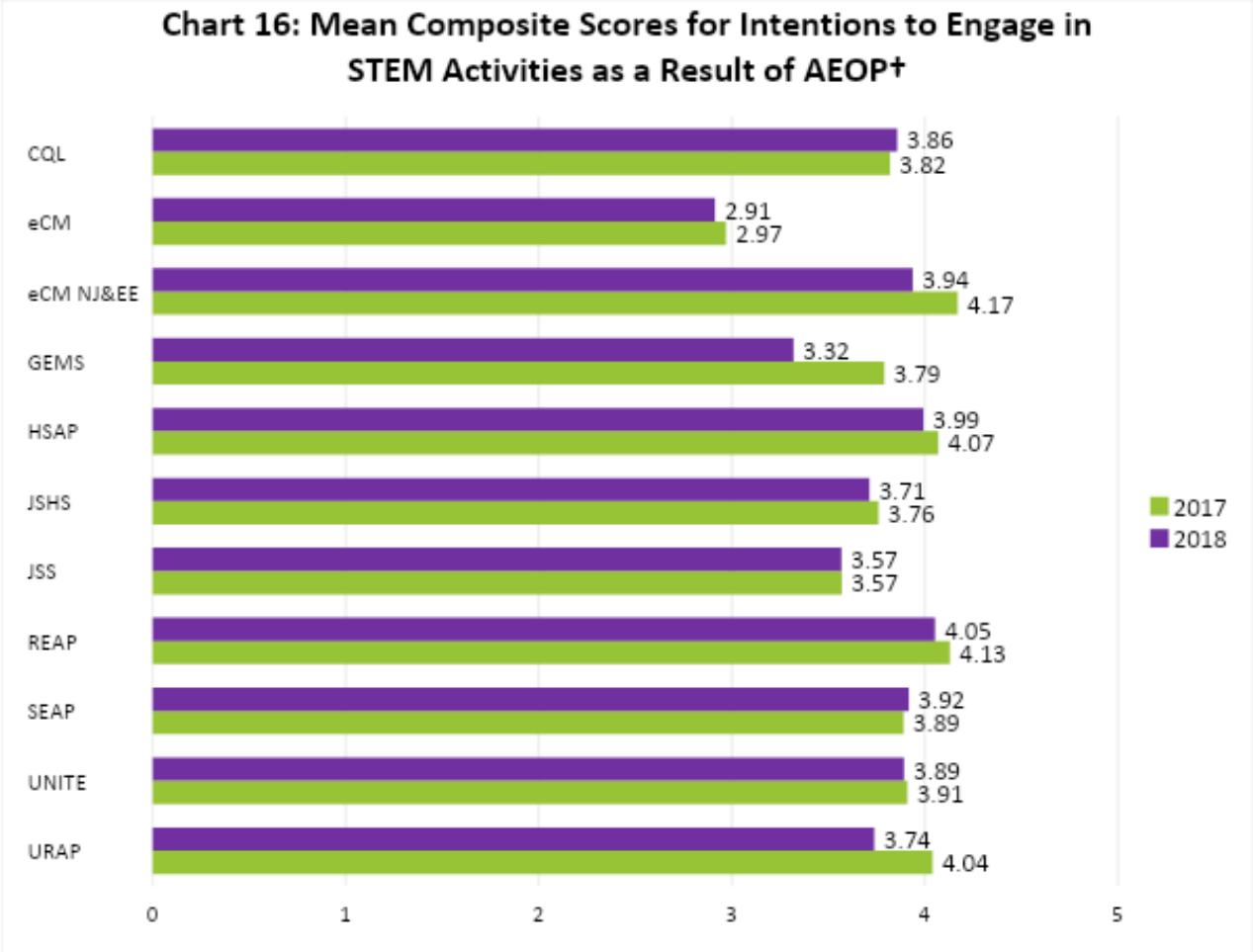
Research Question #5 - To what extent do participants report increased enrollment, achievement, and completion of STEM degree programs?

FY18 AEOP programs served to sustain existing STEM educational and career aspirations of participants and to inspire intentions to pursue post-baccalaureate education. In addition, participants reported gains in interest in pursuing DoD STEM careers as a result of their AEOP participation, although the magnitude of these effects varied across programs.

In order to understand how AEOP participation influenced participants' intentions to engage in STEM activities in the future, the evaluation asked AEOP participants to rate the likelihood that they would

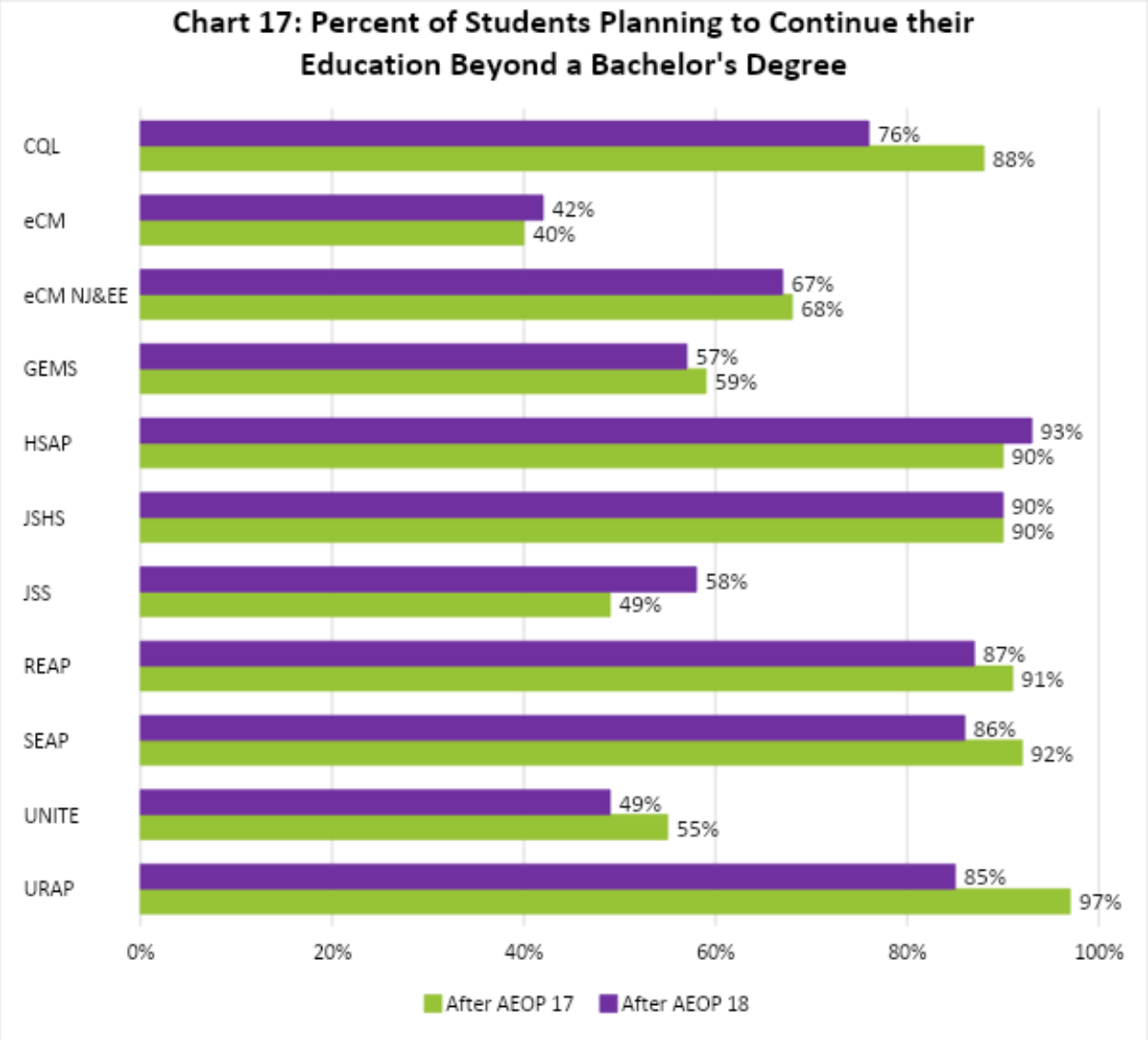
engage in STEM activities outside of AEOP or scheduled school classes. The Intentions to Engage in STEM Activities composite items (Table 33) included activities participants may do at home, with family, in clubs, in the community, and in other settings. Findings suggest that participants in all AEOP programs were somewhat more likely to engage in these types of activities after participating in the AEOP (Chart 16). The largest impact on participants' intentions to engage in STEM in the future occurred in REAP (4.05), HSAP (3.99), eCM NJ&EE (3.94), and SEAP (3.92).

Table 33. Items that form the Intentions to Engage in STEM Activity Composite
1. Watch or read non-fiction STEM
2. Tinker (play) with a mechanical or electrical device
3. Work on solving mathematical or scientific puzzles
4. Use a computer to design or program something
5. Talk with friends or family about STEM
6. Mentor or teach other students about STEM
7. Help with a community service project that relates to STEM
8. Participate in a STEM camp, club, or competition
9. Take an elective (not required) STEM class
10. Work on a STEM project or experiment in a university or professional setting



† *Response options for the items forming this composite were: 1 – Much less likely, 2 – Less likely, 3 – About the same before and after, 4 – More likely, 5 – Much more likely.*

Students and apprentices were asked to indicate their educational aspirations after their AEOP experiences. Data for participants planning to continue their education beyond a bachelor's degree for FY17 and FY18 are presented in Chart 17. A large majority of participants in all programs indicated wanting to at least earn a bachelor's degree, and a majority of participants (57%-93%) in all programs, with the exception of eCM regional (42%) and Unite (49%), indicated that they planned to continue their education beyond a bachelor's degree. Comparing FY17 findings to FY18, there was a slight decrease in the percentage of participants with these educational aspirations for several programs (CQL, eCM NJ&EE, GEMS, REAP, SEAP, Unite, URAP), although the percentage of apprentices with these post-bachelor's aspirations grew for eCM, HSAP, and JSS.



Priority Two: STEM Savvy Educators

Mentors play a critical role in the AEOP program, designing and facilitating learning activities, delivering content through instruction, supervising and supporting collaboration and teamwork, providing one-on-one support, chaperoning, advising on educational and career paths, and generally serving as STEM role models. The 2018 AEOP evaluation examined the extent to which adults serving in these capacities used research-based strategies for mentoring, as well as the extent to which apprentices and students were satisfied with their mentors.

Research Question #6 - What is the impact of Scientists and Engineers (S&E) Mentors on AEOP participants?

Most AEOP mentors reported using a range of effective mentoring strategies in FY18, including establishing the relevance of learning activities, supporting the diverse needs of students as learners, supporting student development of interpersonal and collaboration skills, supporting student engagement in authentic STEM activities, and supporting student STEM educational and career pathways. Use of mentoring strategies varied across programs, although a majority of mentors in each program indicated using each of the mentoring strategies about which they were asked. Mentors across programs were most likely to report using strategies to engage students in authentic STEM activities (range of 76%-100%) and to support the development of collaboration and interpersonal skills (78%-96%). Mentors were least likely to report using strategies to support their students' STEM educational and career pathways (range of 50%-88%).

Since mentors play a key role in AEOPs, inspiring and sustaining students' and apprentices' interest in STEM and STEM careers, the nature and quality of mentoring provided is an important factor in participants' AEOP experiences. Mentors were therefore asked as a part of the FY18 evaluation to report on their use mentoring strategies with participants. These strategies comprised five main areas of effective mentoring:[7]

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.

Each area of mentoring was composed of items that were combined into a composite variable. Items making up the Establishing the Relevance of Learning Activities composite are shown in Table 34 and mean composite scores for this variable are shown in Chart 18. A majority of mentors across all programs (range of 71%-93%) reported using these strategies. Overall, the proportion of mentors using these strategies is similar to FY17 (range of 71%-89%). In FY18, slightly more mentors in eCM, GEMS, REAP, Unite, and URAP reported using these strategies as compared to FY17 (see Table 35).

Table 34. Items that form the Establishing the Relevance of Learning Activities Composite
1. Become familiar with my student(s) background and interests at the beginning of the program
2. Giving students real-life problems to investigate or solve

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

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.

3. Selecting readings or activities that relate to students' backgrounds
4. Encouraging students to suggest new readings, activities, or projects
5. Helping students become aware of the role(s) STEM plays in their everyday lives
6. Helping students understand how STEM can help them improve their community
7. Asking students to relate real-life events or activities to topics covered in the program

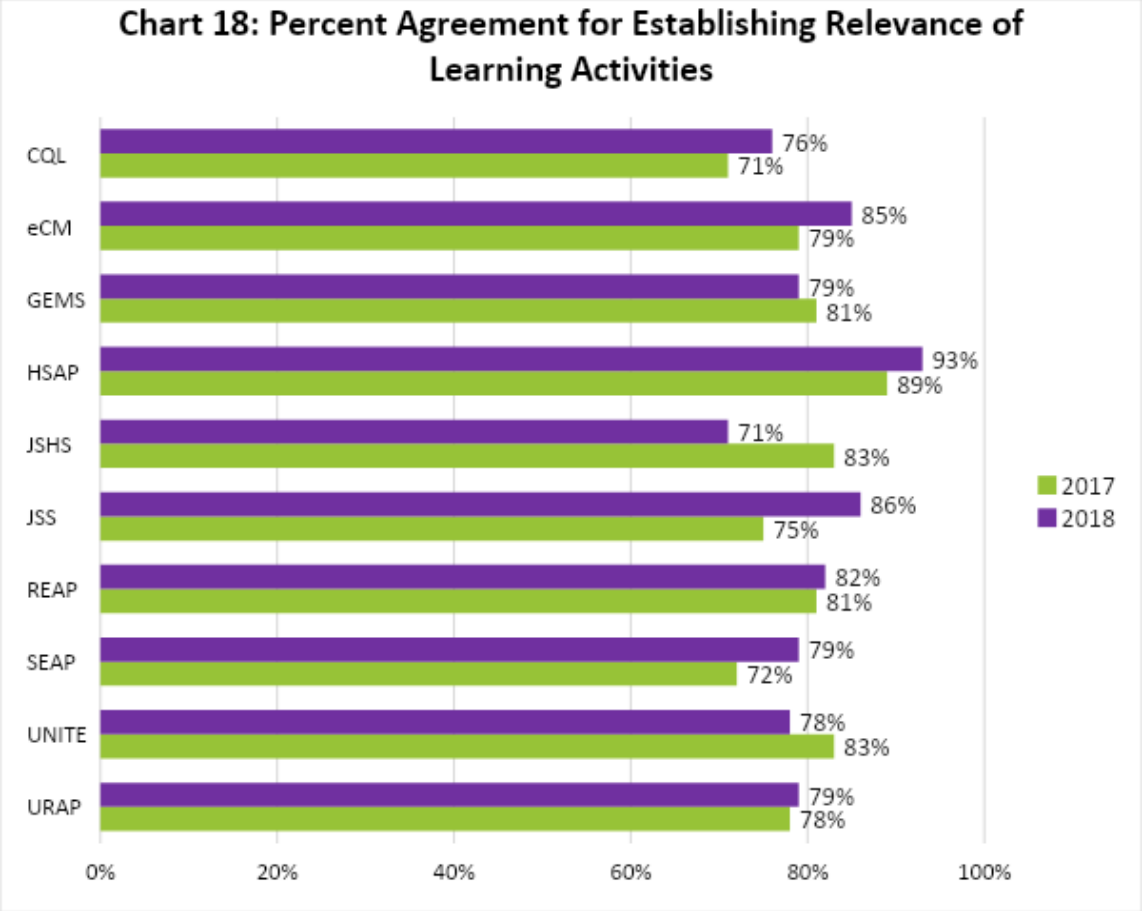


Table 35. Mentor Overall Percent Agreement for Establishing the Relevance of Learning Activities		
Program	**2017 Composite % Agreement**	**2018 Composite % Agreement**
CQL	71%	76%
eCM	79%	85%
GEMS	81%	79%
HSAP	89%	93%
JSHS	83%	71%

JSS	75%	86%
REAP	81%	82%
SEAP	72%	79%
Unite	83%	78%
URAP	78%	79%

Similarly, the items comprising the Supporting the Diverse Needs of Students as Learners composite are shown in Table 36, and mean composite scores are shown in Chart 19 and Table 36. A majority of all mentors (range of 65%-93%) reported using these mentoring strategies. In comparison to FY17, there was a slight decline in the use of these strategies in FY18 for all programs except for CQL, eCM, and REAP where reported usage slightly increased.

Table 36. Items that form the Supporting the Diverse Needs of Students as Learners Composite
1. Identify the different learning styles that my student(s) may have at the beginning of their program
2. Interact with students and other personnel the same way regardless of their background
3. Use a variety of teaching and/or mentoring activities to meet the needs of all students
4. Integrating ideas from education literature to teach/mentor students from groups underserved in STEM
5. Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills
6. Directing students to other individuals or programs for additional support as needed
7. Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM

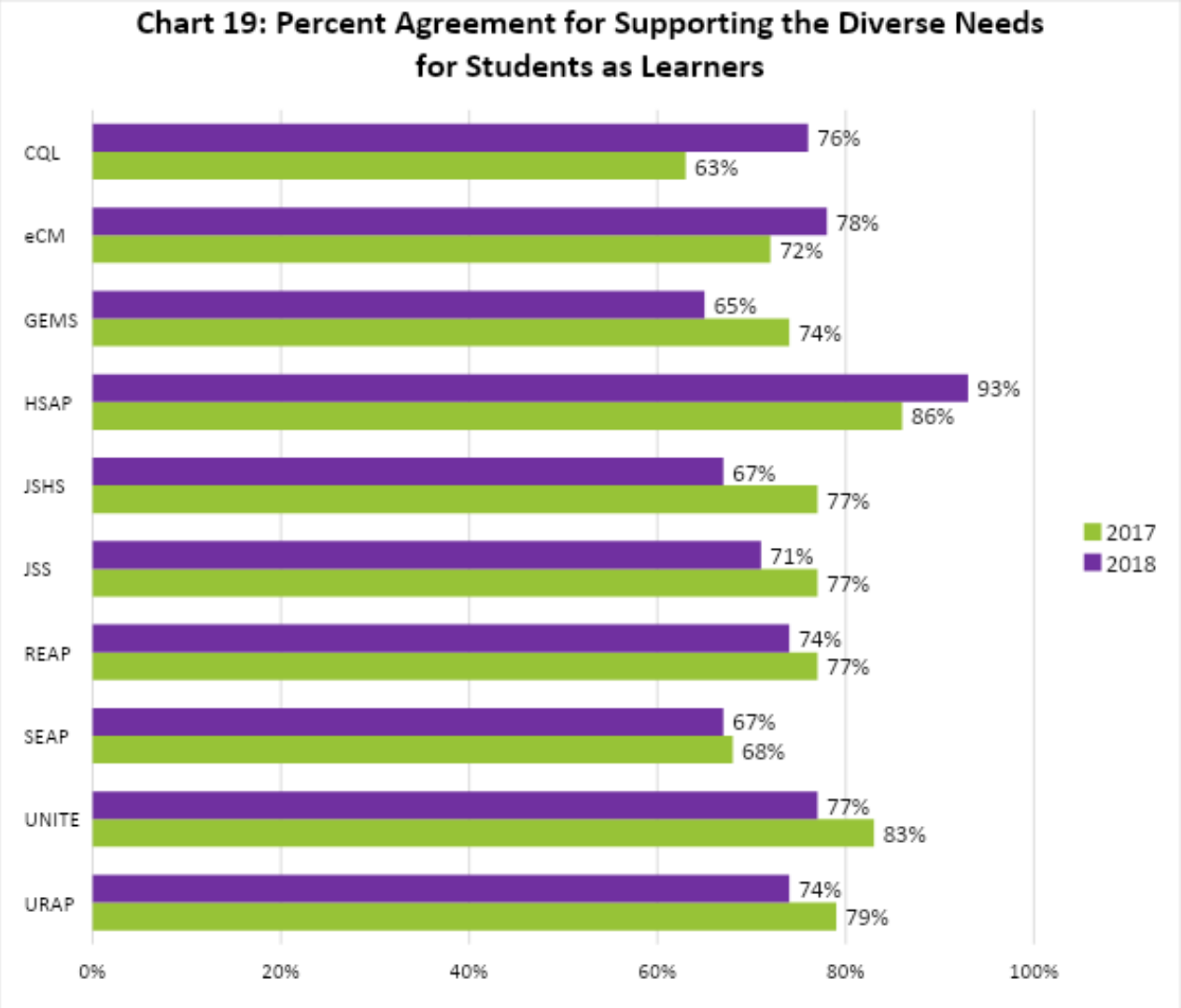


Table 37. Mentor Overall Percent Agreement for Supporting the Diverse Needs of Students as Learners		
Program	**2017 Composite % Agreement**	**2018 Composite % Agreement**
CQL	63%	74%
eCM	72%	77%
GEMS	74%	67%
HSAP	86%	74%
JSHS	77%	71%
JSS	77%	67%
REAP	77%	93%
SEAP	68%	65%
Unite	83%	78%
URAP	79%	76%

Items about strategies that together form the composite Supporting Student Development of Collaboration and Interpersonal Skills (Table 38 and Chart 20) were also asked of mentors. Large majorities (range 78%-96%) of mentors across all programs reported using these strategies. The percentage of mentors using these strategies increased from FY17 levels for half of the programs: CQL, eCM, HSAP, JSS, and SEAP. A comparison of composite scores from FY17 and FY18 is presented in Table 39.

Table 38. Items that form the Supporting Student Development of Collaboration and Interpersonal Skills Composite
1. Having student(s) tell others about their backgrounds and interests
2. Having student(s) explain difficult ideas to others
3. Having student(s) listen to the ideas of others with an open mind
4. Having student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own
5. Having student(s) give and receive constructive feedback with others
6. Having my student(s) work on collaborative activities or projects as a member of a team
7. Allowing my student(s) to resolve conflicts and reach agreement within their team

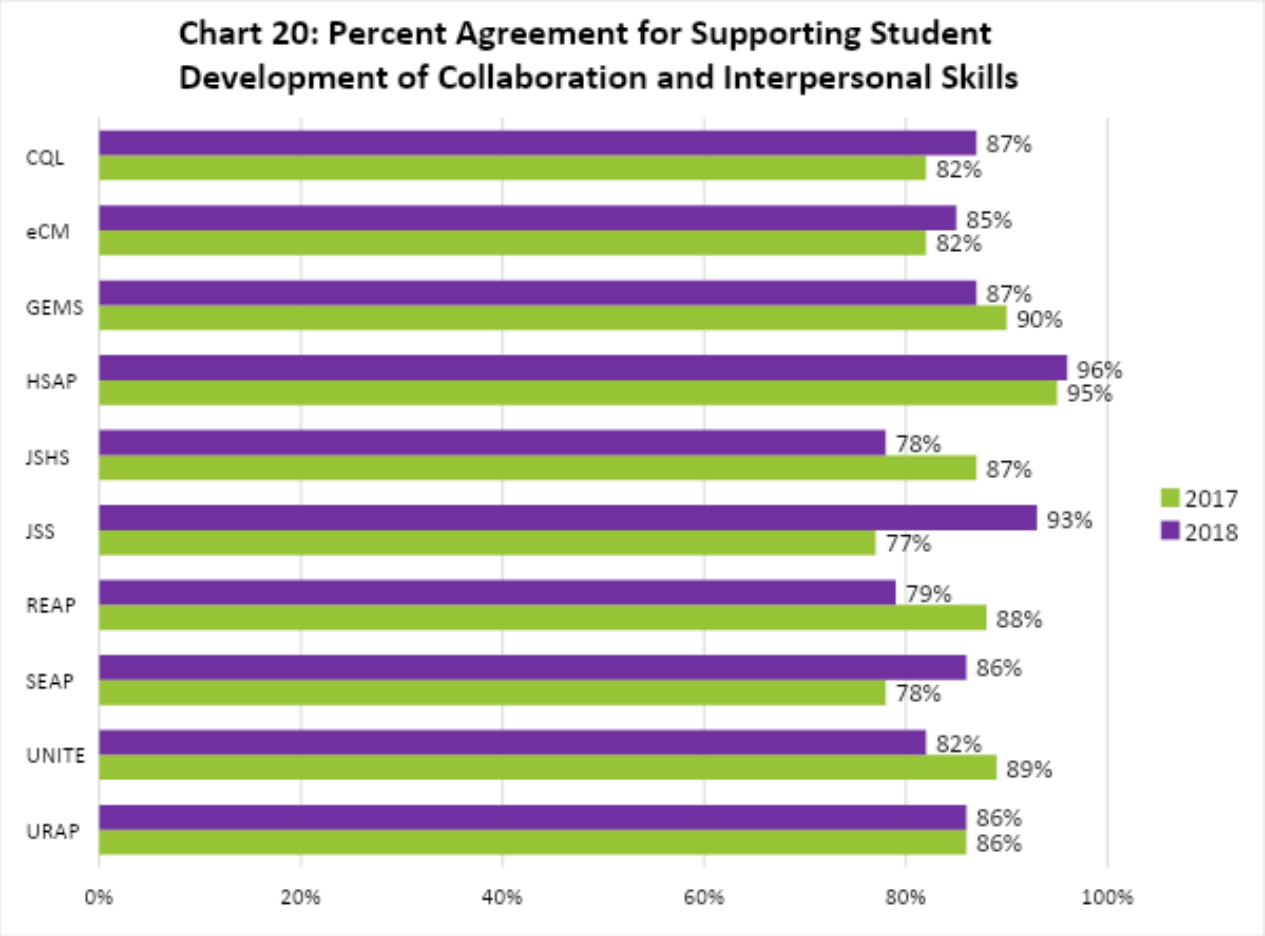


Table 39. Mentor Overall Percent Agreement for Supporting Student Development of Collaboration and Interpersonal Skills		
Program	**2017 Composite % Agreement**	**2018 Composite % Agreement**
CQL	82%	86%
eCM	82%	82%
GEMS	90%	86%
HSAP	95%	79%
JSHS	87%	93%
JSS	77%	78%
REAP	88%	96%
SEAP	78%	87%
Unite	89%	85%
URAP	86%	87%

The fourth set of mentoring strategies focused on supporting student engagement in "Authentic" STEM Activities. Items comprising the composite for these strategies are shown in Table 40 and the mean

composites for each program are displayed in Chart 21. A large majority of mentors (range 76%-100%) across programs reported using these strategies. Use of these strategies increased slightly for eCM, GEMS, HSAP, JSS, SEAP, and URAP as compared to FY17 (see Table 41).

Table 40. Items that form the Supporting Student Engagement in "Authentic" STEM Activities Composite
1. Teaching (or assigning readings) about specific STEM subject matter
2. Having my student(s) search for and review technical research to support their work
3. Demonstrating laboratory/field techniques, procedures, and tools for my student(s)
4. Supervising my student(s) while they practice STEM research skills
5. Providing my student(s) with constructive feedback to improve their STEM competencies
6. Allowing students to work independently to improve their self-management abilities
7. Encouraging students to learn collaboratively (team projects, team meetings, journal clubs, etc.)
8. Encouraging students to seek support from other team members

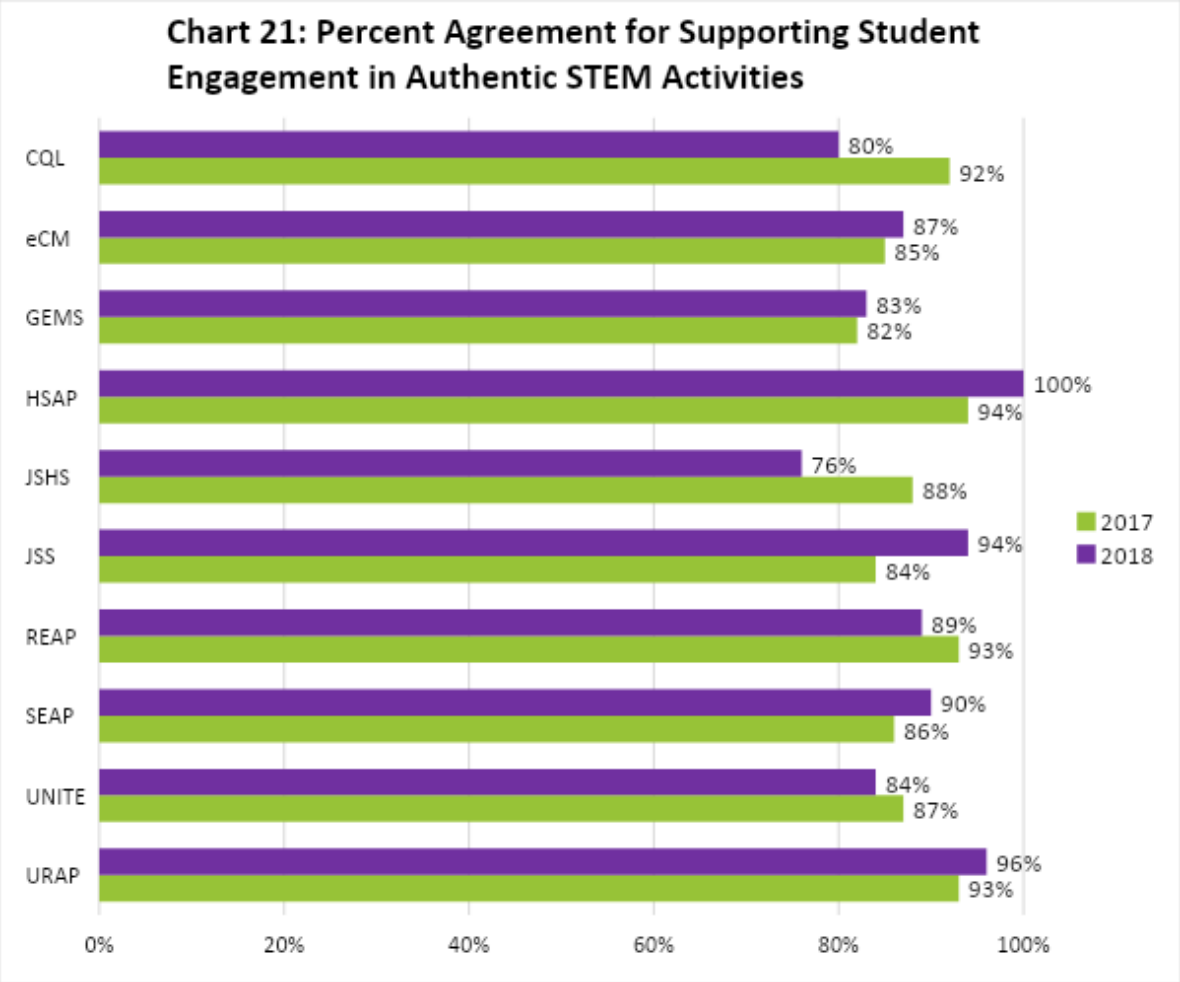


Table 41. Mentor Overall Percent Agreement for Supporting Student Engagement in Authentic STEM Activities		
Program	**2017 Composite % Agreement**	**2018 Composite % Agreement**
CQL	92%	96%
eCM	85%	84%
GEMS	82%	90%
HSAP	94%	89%
JSHS	88%	94%
JSS	84%	76%
REAP	93%	100%
SEAP	86%	83%
Unite	87%	87%
URAP	93%	80%

The final set of mentoring strategies focused on supporting students' STEM Educational and Career Pathways. Items comprising this composite are shown in Table 42, and mean composite scores are shown in Chart 22. Somewhat fewer mentors reported using these strategies as compared to the other

mentoring strategies, although half of mentors in all programs indicated use (range of 50%-88%). Slightly more mentors reported using these strategies in FY18 compared to FY17 for the following programs: CQL, eCM, HSAP, JSS, SEAP, and URAP (see Table 43).

Table 42. Items that form the Supporting Student STEM Educational and Career Pathways Composite
1. Asking my student(s) about their educational and/or career goals
2. Recommending extracurricular programs that align with students' goals
3. Providing guidance about educational pathways that would prepare student(s) for a STEM career
4. Recommending Army Educational Outreach Programs that align with students' educational goals
5. Discussing STEM career opportunities within the DoD or other government agencies
6. Discussing STEM career opportunities in private industry or academia
7. Discussing the economic, political, ethical, and/or social context of a STEM career
8. Recommending student and professional organizations in STEM to my student(s)
9. Helping students build a professional network in a STEM field
10. Helping my student(s) with their resume, application, personal statement, and/or interview preparations

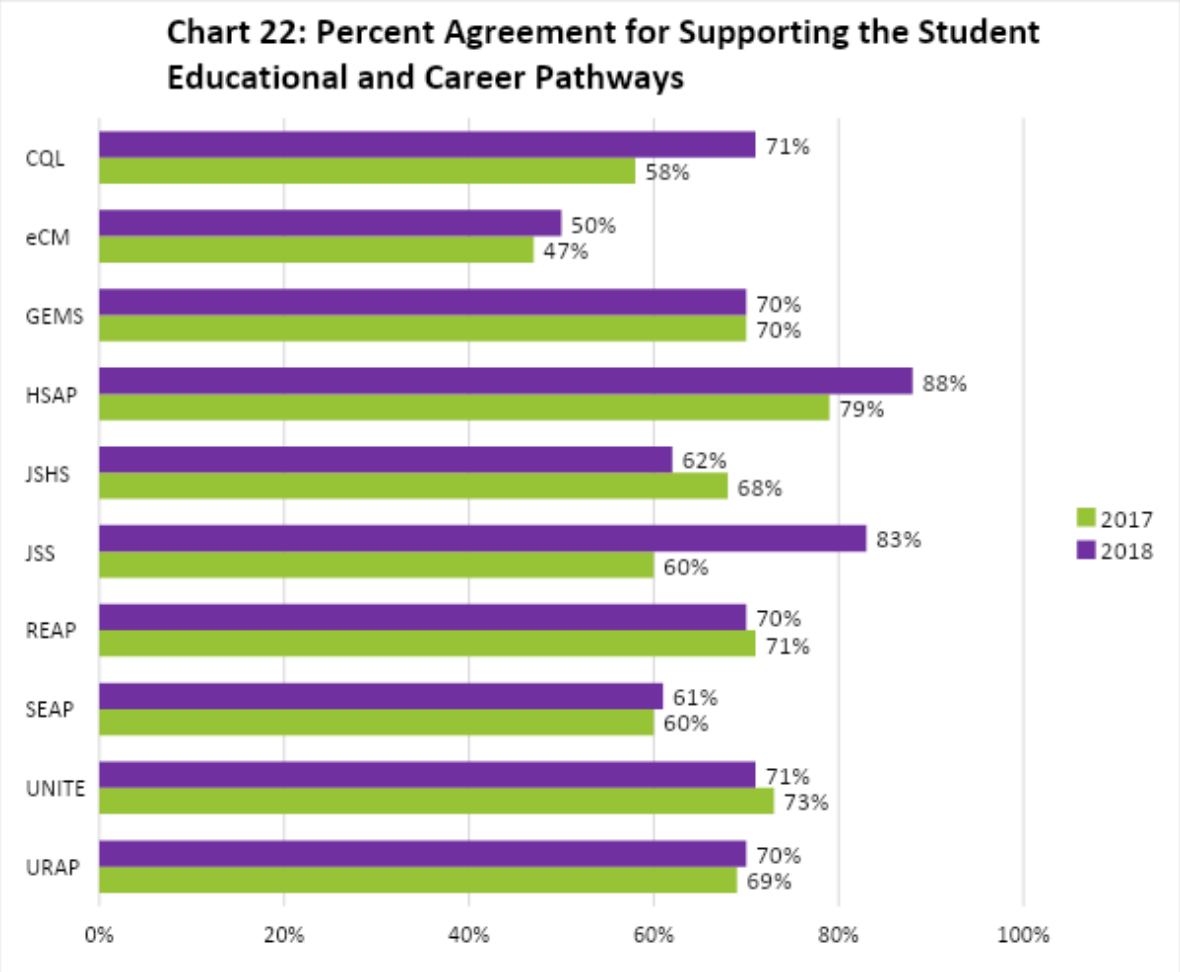
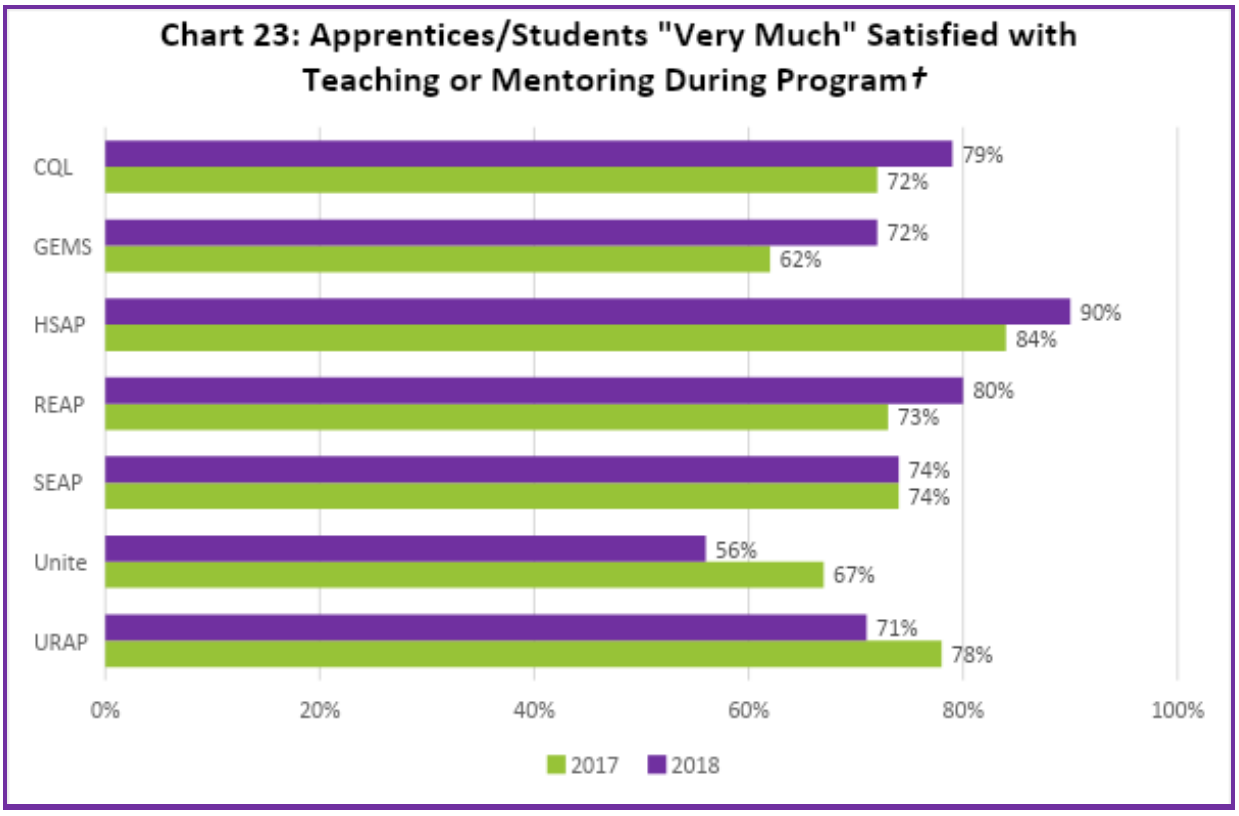


Table 43. Mentor Overall Percent Agreement for Supporting Student STEM Educational and Career Pathways		
Program	**2017 Composite % Agreement**	**2018 Composite % Agreement**
CQL	58%	70%
eCM	47%	71%
GEMS	70%	61%
HSAP	79%	70%
JSHS	68%	83%
JSS	60%	62%
REAP	71%	88%
SEAP	60%	70%
Unite	73%	50%
URAP	69%	71%

In sum, mentors were least likely to report using mentoring strategies related to supporting their students' educational and career pathways. A finding that raises particular concern when considered in

conjunction with findings that mentors face challenges in exposing students to and engaging them in DoD research (Priority 1, Finding #5) and mentors' mixed perceptions of the usefulness of resources for exposing students to DoD STEM careers (Priority 1, Finding #6). This is an area that should be addressed across the portfolio of AEOPs, possibly with additional training and orientation and a close examination of the availability of and usefulness of resources provided to mentors.

The FY18 evaluation included an examination of participant satisfaction with mentorship during the AEOP program experience. Satisfaction with mentorship serves as a gauge of student perceptions of the quality of their mentoring experience, with quality mentoring conceptualized as a positive relationship that will result in a more meaningful and impactful experience and that may be sustained after program participation ends. Chart 23 displays data for participants who indicated they were "very much" satisfied with the mentoring or instruction during their AEOP experiences, and Table 44 contains a comparison of these data for 2017 and 2018. Most apprentices and students in all programs reported high levels of satisfaction with their mentors and the quality of instruction they received (range of 56%-90%). Levels of satisfaction with mentorship were somewhat higher than those reported in FY17 for CQL, GEMS, HSAP, and REAP and were unchanged for SEAP. However, levels of satisfaction with mentors in Unite and URAP were lower than in FY17.



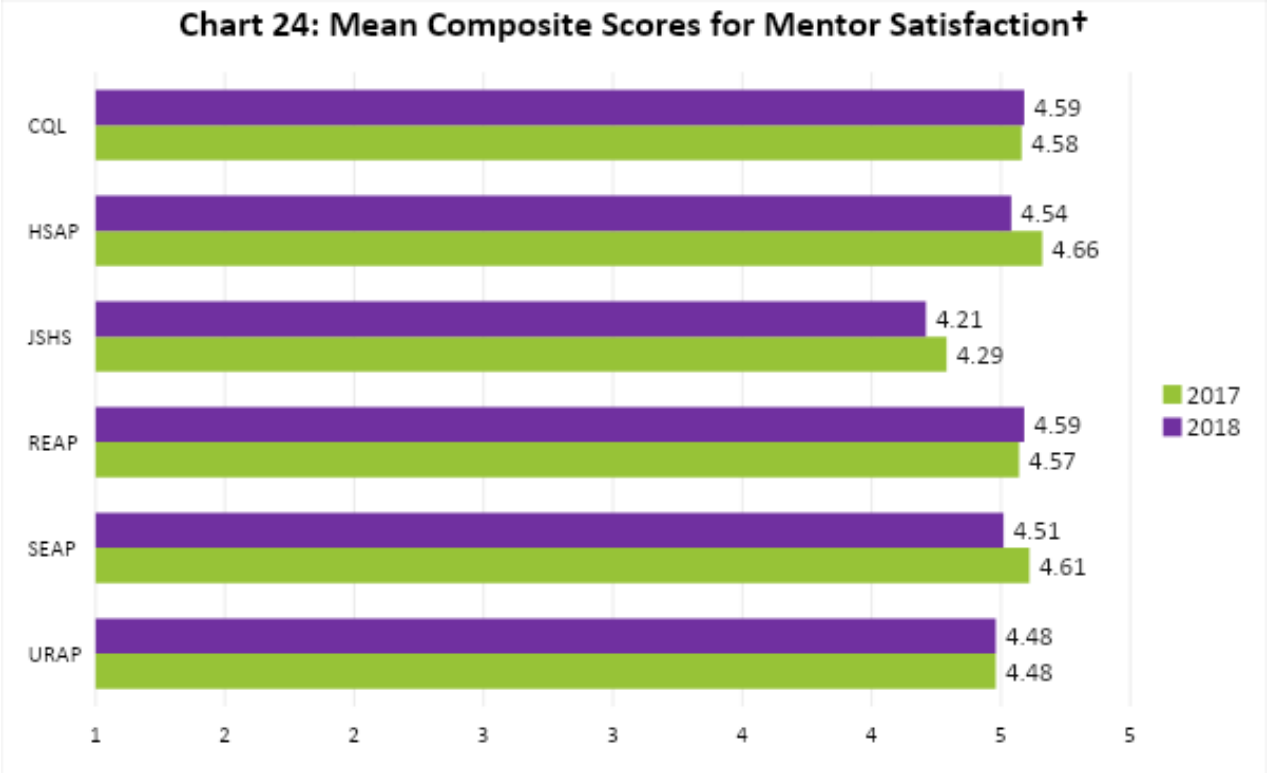
† *Only programs who work directly with a mentor (non-teacher) were asked this question.*

Table 44. Participants "Very Much" Satisfied with Teaching or Mentorship During Program		
Program	**2017**	**2018**
CQL	78%	71%
GEMS	67%	56%
HSAP	74%	74%
REAP	73%	80%
SEAP	84%	90%
Unite	62%	72%
URAP	72%	79%

Participants in apprentice programs (CQL, REAP, SEAP, and URAP) and JSHS were also asked to rate their satisfaction with several aspects of their mentoring experiences and their research experiences overall (see Table 45). Chart 24 shows that these scores remained uniformly high across programs in FY18, indicating that apprentices were quite satisfied with the quality of mentoring they received.

Table 45. Items that form the Mentor Satisfaction Composite for CQL, HSAP, JSHS, REAP, SEAP, and URAP
1. My working relationship with my mentor
2. My working relationship with the group or team[†]
3. The amount of time I spent doing meaningful research
4. The amount of time I spent with my research mentor
5. The research experience overall

[†] *This question was not included on the JSHS survey.*



† *Response options for the items forming this composite were: 1 – Did not experience, 2 – Not at all, 3 – A little, 4 – Somewhat, 5 – Very much.*

Research Question #7 – To what extent do teacher participants report increased use of new approaches to teaching research concepts within STEM practices, and infusion of careers?

FY18 was the third year of operation for the Research Experiences for STEM Educators and Teachers (RESET) program, an AEOP specifically designed to support STEM educators' content knowledge and to provide them with research experiences that they can translate into enhanced STEM curricula and learning experiences in their classrooms. Interviews with participants indicated that RESET supported the AEOP's objective of supporting and empowering educators with Army research and technology resources. Participants appreciated their experiences in Army labs, their exposure to Army/DoD research, and the opportunities to collaborate with other educators. RESET participants participating in interviews considered ways that their RESET research experiences and their online learning experiences could be incorporated into their teaching practices. For example:

> *"For 15 years of teaching science I didn't do a lot of experimenting and stuff, but now I feel like I have a whole new understanding of how to apply those real-life laboratory skills right here in my classroom."* (RESET Level II Participant)

> *"I have a master's in education. I don't have a master's in biology. I didn't have that research component, so that's really helped me understand how to lead my students. It's also the story*

that I could share with not only my students, but with other teachers that are aspiring to do things with their students." (RESET Level III Participant)

Priority Three: Sustainable Infrastructure

Findings from the FY18 AEOP evaluation reveal some progress toward achieving a sustainable infrastructure. Major trends that support the achievement of this AEOP priority along with evidence from assessment data that inform the findings are presented below by associated research question(s).

Research Question #8 - To what extent do participants report growth in awareness of and/or interest in AEOP opportunities?

As found in FY17, personal connections, including friends, teachers and or professors, or someone who works at the university or school the participant attends continue to be the most frequently cited means of participant information about programs (Table 46). As in FY17, a third or more of participants form some programs reported learning about the program through a past participant: GEMS (58%), HSAP (35%), SEAP (31%), and CQL (30%). This suggests that program alumnae often act as informal ambassadors for these programs. More than a third of CQL apprentices (43%) and SEAP apprentices (51%) learned about AEOP through someone who works with the DoD. A quarter to two-thirds of participants in SEAP (23%), Unite (24%), HSAP (24%), JSHS (26%), REAP (38%), URAP (47%), and JSS (63%) reported having heard about AEOP through a school or university newsletter or website. Approximately a quarter or more of participants in SEAP (23%), CQL (28%), and HSAP (41%) reported learning about AEOP through the AEOP website, which was higher than FY17.

Table 46. How Students Learned About their AEOP Program

	Year	CQL	eCM	GEMS	HSAP	JSHS	JSS	REAP	SEAP	Unite	URAP
Friend	2017	22%	5%	43%	17%	9%	11%	18%	30%	14%	17%
	2018	***25%***	***8%***	***28%***	***12%***	***13%***	***13%***	***18%***	***20%***	***16%***	***6%***
Family member	2017	20%	3%	41%	14%	5%	5%	11%	43%	25%	7%
	2018	***30%***	***3%***	***35%***	***24%***	***7%***	***0%***	***18%***	***54%***	***12%***	***3%***
Past participant of program	2017	17%	7%	38%	17%	18%	5%	22%	22%	7%	7%
	2018	***30%***	***12%***	***58%***	***35%***	***17%***	***0%***	***15%***	***31%***	***9%***	***3%***
School or university newsletter, email, or website	2017	9%	0%	13%	38%	18%	11%	35%	25%	22%	20%
	2018	***15%***	***<1%***	***16%***	***24%***	***26%***	***63%***	***38%***	***23%***	***24%***	***47%***
Someone who works with the Department of Defense	2017	33%	0%	7%	7%	1%	5%	0%	34%	1%	3%
	2018	***43%***	***<1%***	***7%***	***6%***	***<1%***	***0%***	***3%***	***51%***	***1%***	***3%***
Website: AEOP	2017	6%	1%	12%	14%	8%	0%	11%	27%	4%	3%

	2018	***28 %***	***2%***	***12%***	***41%***	***4%***	***0%***	***18%***	***23%***	***5%***	***0%***
Someone who works with the program	2017	28 %	0%	3%	3%	4%	5%	28%	10%	22%	23%
	2018	***32 %***	***NA***	***5%***	***0%***	***4%***	***0%***	***18%***	***6%***	***25%***	***15%***
AEOP social media	2017	0%	0%	3%	0%	2%	5%	4%	1%	0%	0%
	2018	***0%***	***1%***	***2%***	***6%***	***<1%***	***0%***	***3%***	***0%***	***0%***	***0%***
Teacher or someone who works at school/ university I attend	2017	25 %	47%	8%	34%	25%	26%	43%	12%	22%	57%
	2018	***15 %***	***35%***	***4%***	***59%***	***52%***	***63%***	***24%***	***11%***	***29%***	***59%***
Community group or program	2017	1%	3%	4%	7%	4%	5%	4%	9%	18%	0%
	2018	***2%***	***2%***	***4%***	***6%***	***3%***	***0%***	***3%***	***3%***	***15%***	***3%***
Choose not to report	2017	3%	24%	1%	0%	5%	21%	1%	0%	5%	0%
	2018	***2%***	***4%***	***0%***	***0%***	***6%***	***0%***	***3%***	***0%***	***9%***	***0%***

Mentors were also asked in a questionnaire item to indicate how they had learned about AEOP (see Table 47). The most frequently reported sources of information were a past participant of the program, someone who works with the DoD, a colleague or friend, and the AEOP website, however these findings varied broadly across programs. Past participants were a key source of information for HSAP mentors (100%), as well as for about a third of CQL (29%), Unite (32%), JSHS (33%), JSS (33%), and GEMS (42%) mentors. A quarter or more of mentors in GEMS (26%), SEAP (29%), CQL (35%), and REAP (36%) cited someone who works with the DoD as a source of AEOP information. Approximately a quarter or more of mentors learned about AEOP through the AEOP website from URAP (22%), CQL (24%), GEMS (32%), and eCM (33%).

Table 47. How Mentors Learned about AEOP

	Year	CQL	eCM	GEMS	HSAP	JSHS	JSS	REAP	SEAP	Unite	URAP
Past participant	2017	16%	NA	20%	33%	67%	28%	19%	19%	33%	32%
	2018	***29%***	***0%***	***42%***	***100%***	***33%***	***33%***	***0%***	***14%***	***32%***	***11%***
School, university, or professional organization newsletter, email, or website	2017	3%	0%	20%	0%	0%	6%	4%	0%	21%	5%
	2018	***6%***	***0%***	***11%***	***0%***	***12%***	***0%***	***7%***	***0%***	***12%***	***0%***
Site host, director, or someone who works with program	2017	16%	0%	41%	13%	NA	11%	23%	6%	26%	9%
	2018	***6%***	***0%***	***32%***	***0%***	***18%***	***0%***	***33%***	***14%***	***32%***	***4%***
Social media	2017	0%	0%	5%	0%	0%	0%	0%	0%	2%	0%
	2018	***0%***	***0%***	***0%***	***0%***	***<1%***	***0%***	***21%***	***0%***	***4%***	***0%***
Someone who works with the Department of Defense	2017	52%	0%	39%	53%	0%	0%	1%	38%	0%	41%
	2018	***35%***	***17%***	***26%***	***0%***	***0%***	***17%***	***36%***	***29%***	***4%***	***19%***
A colleague or friend	2017	6%	0%	27%	0%	11%	0%	NA	6%	2%	0%

	2018	***24%***	***17%***	***21%***	***0%***	***32%***	***17%***	***32%***	***14%***	***12%***	***4%***
Family member	2017	0%	0%	32%	0%	0%	0%	NA	0%	0%	0%
	2018	***NA***	***0%***	***42%***	***0%***	***NA***	***0%***	***NA***	***0%***	***8%***	***NA***
Community group or program	2017	0%	0%	5%	0%	0%	22%	NA	0%	2%	0%
	2018	***0%***	***17%***	***0%***	***0%***	***NA***	***0%***	***NA***	***0%***	***8%***	***NA***
Website: AEOP	2017	16%	50%	15%	53%	0%	22%	19%	16%	14%	41%
	2018	***24%***	***33%***	***32%***	***0%***	***5%***	***17%***	***4%***	***0%***	***16%***	***22%***
Choose Not to Report	2017	10%	50%	0%	0%	11%	NA	NA	13%	5%	5%
	2018	***0%***	***17%***	***0%***	***0%***	***0%***	***0%***	***0%***	***14%***	***8%***	***0%***

A goal of the AEOP is to build a pipeline of initiatives for students in STEM beginning in the elementary grades and continuing across their high school and post-secondary studies. In support of this goal, efforts have been made over the past several years to strengthen communication about AEOPs to prospective and current participants. In order to understand the effectiveness of these efforts, the FY18 evaluation examined students' and apprentices' past participation in AEOPs and their interest in future participation in AEOPs. Table 48 presents data for past participation in AEOPs and shows that very few participants had ever participated in any AEOP other than the one in which they were currently enrolled. Two notable exceptions to this are the 21% of REAP apprentices who reported they had previously participated in Unite, and the 37% of SEAP participants who reported having participated in GEMS in the past. These findings suggest there is a relatively robust pipeline relationship between the Unite and REAP programs and the GEMS and SEAP programs.

Table 48. AEOP Participants Reporting Having Participated in Other AEOPs

Current Program	Year	eCM	JSS	JSHS	GEMS	Unite	HSAP	REAP	SEAP	URAP	CQL
CQL	2017	1%	0%	1%	9%	0%	0%	0%	13%	0%	15%
	2018	***0%***	***0%***	***2%***	***15%***	***2%***	***0%***	***0%***	***19%***	***0%***	***26%***
eCM	2017	---	---	---	---	---	---	---	---	---	---
	2018	***25%***	***1%***	***0%***	***2%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
GEMS	2017	1%	0%	0%	49%	0%	0%	0%	0%	0%	0%
	2018	***0%***	***0%***	***0%***	***63%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
HSAP	2017	0%	0%	3%	0%	0%	0%	0%	3%	0%	0%
	2018	***0%***	***0%***	***0%***	***6%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
JSHS	2017	4%	1%	35%	2%	0%	0%	0%	1%	---	---
	2018	***2%***	***1%***	***26%***	***<1%***	***<1%***	***<1%***	***<1%***	***<1%***	***0%***	***0%***
JSS	2017	5%	42%	0%	5%	0%	NA	NA	NA	NA	NA
	2018	***4%***	***39%***	***0%***	***9%***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***
REAP	2017	0%	1%	1%	5%	23%	3%	16%	1%	1%	0%
	2018	***0%***	***0%***	***0%***	***5%***	***21%***	***0%***	***5%***	***0%***	***0%***	***0%***
SEAP	2017	3%	1%	0%	36%	0%	0%	0%	13%	0%	0%
	2018	***9%***	***3%***	***0%***	***37%***	***0%***	***0%***	***0%***	***20%***	***0%***	***0%***
Unite	2017	1%	0%	0%	1%	19%	0%	0%	0%	0%	0%
	2018	***0%***	***0%***	***0%***	***0%***	***19%***	***0%***	***<1%***	***0%***	***0%***	***0%***
URAP	2017	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

	2018	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***

Participants were also asked to indicate their level of interest in participating in each of the AEOPs for which they currently are or will be eligible in the future. Table 49 displays the percentage of current AEOP participants who indicated they were "interested" or "very interested" in other programs in the AEOP portfolio. Participants from each program expressed interest in participating in other AEOPs in the future. If eligible to participate in the same AEOP again, more than half of participants indicated they would be interested or very interested: URAP (56%), JSS (64%), Unite (76%), JSHS (88%), eCM (88%), GEMS (89%), and CQL (91%). eCM students were particularly interested in participating in most other programs, with half or more interested in all other programs except JSS (45%) and NDSEG (38%). The AEOP initiative with the most interest was SMART with five programs having more than half of their participants interested: eCM (51%), Unite (52%), SEAP (63%), HSAP (63%), and CQL (72%).

Table 49. AEOP Participants Reporting Interest in Participating in Other AEOPs

Current Program	Year	eCM	JSS	JSHS	GEMS	Unite	HSAP	REAP	SEAP	URAP	CQL	SMART	NDSEG	GEMS-NPM
CQL	2017	NA	NA	NA	NA	NA	NA	NA	NA	45%	74%	60%	48%	28%
	2018	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***54%***	***91%***	***72%***	***54%***	***33%***
eCM	2017	46%	8%	10%	12%	8%	11%	11%	12%	10%	11%	17%	12%	9%
	2018	***89%***	***45%***	***54%***	***76%***	***45%***	***57%***	***65%***	***53%***	***51%***	***50%***	***51%***	***38%***	***57%***
GEMS	2017	8%	14%	11%	73%	9%	21%	20%	22%	15%	14%	24%	16%	42%
	2018	***38%***	***37%***	***35%***	***89%***	***33%***	***39%***	***41%***	***44%***	***35%***	***32%***	***46%***	***40%***	***73%***
HSAP	2017	NA	NA	NA	NA	NA	NA	NA	NA	74%	19%	52%	26%	29%
	2018	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***74%***	***16%***	***63%***	***21%***	***21%***
JSHS	2017	NA	NA	90%	29%	23%	30%	30%	31%	28%	26%	32%	28%	26%

	2018	***NA***	***NA***	***88%***	***NA***	***NA***	***31%***	***33%***	***33%***	***30%***	***26%***	***36%***	***27%***	***24%***
JSS	2017	5%	71%	11%	13%	13%	16%	13%	20%	10%	11%	NA	18%	8%
	2018	***11%***	***64%***	***15%***	***2%***	***0%***	***8%***	***9%***	***11%***	***6%***	***6%***	***NA***	***11%***	***4%***
REAP	2017	31%	NA	41%	---	---	---	---	---	62%	41%	63%	42%	46%
	2018	***22%***	***NA***	***35%***	***NA***	***NA***	***NA***	***NA***	***NA***	***49%***	***31%***	***46%***	***39%***	***43%***
SEAP	2017	NA	NA	NA	NA	NA	51%	NA	NA	46%	53%	57%	36%	---
	2018	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***43%***	***54%***	***63%***	***32%***	***37%***
Unite	2017	NA	NA	37%	43%	83%	49%	60%	51%	38%	42%	61%	43%	36%
	2018	***NA***	***NA***	***38%***	***49%***	***76%***	***46%***	***58%***	***51%***	***42%***	***38%***	***52%***	***43%***	***40%***
URAP	2017	---	---	---	---	---	---	---	---	63%	28%	41%	41%	19%
	2018	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***56%***	***15%***	***44%***	***29%***	***15%***

As in previous evaluations, the FY18 evaluation findings suggests that youth participants and mentors across the AEOP have limited awareness of AEOP programs other than those in which they are currently participating. Students and apprentices' express interest in participating in other AEOPs in the future, however, suggesting that strategic efforts to disseminate information about AEOPs has potential to strengthen the pipeline of programs. Program administrators should continue their efforts to educate site and event coordinators, mentors, and other volunteers about AEOP opportunities so that all participants leave with a clear understanding of the AEOPs available to them.

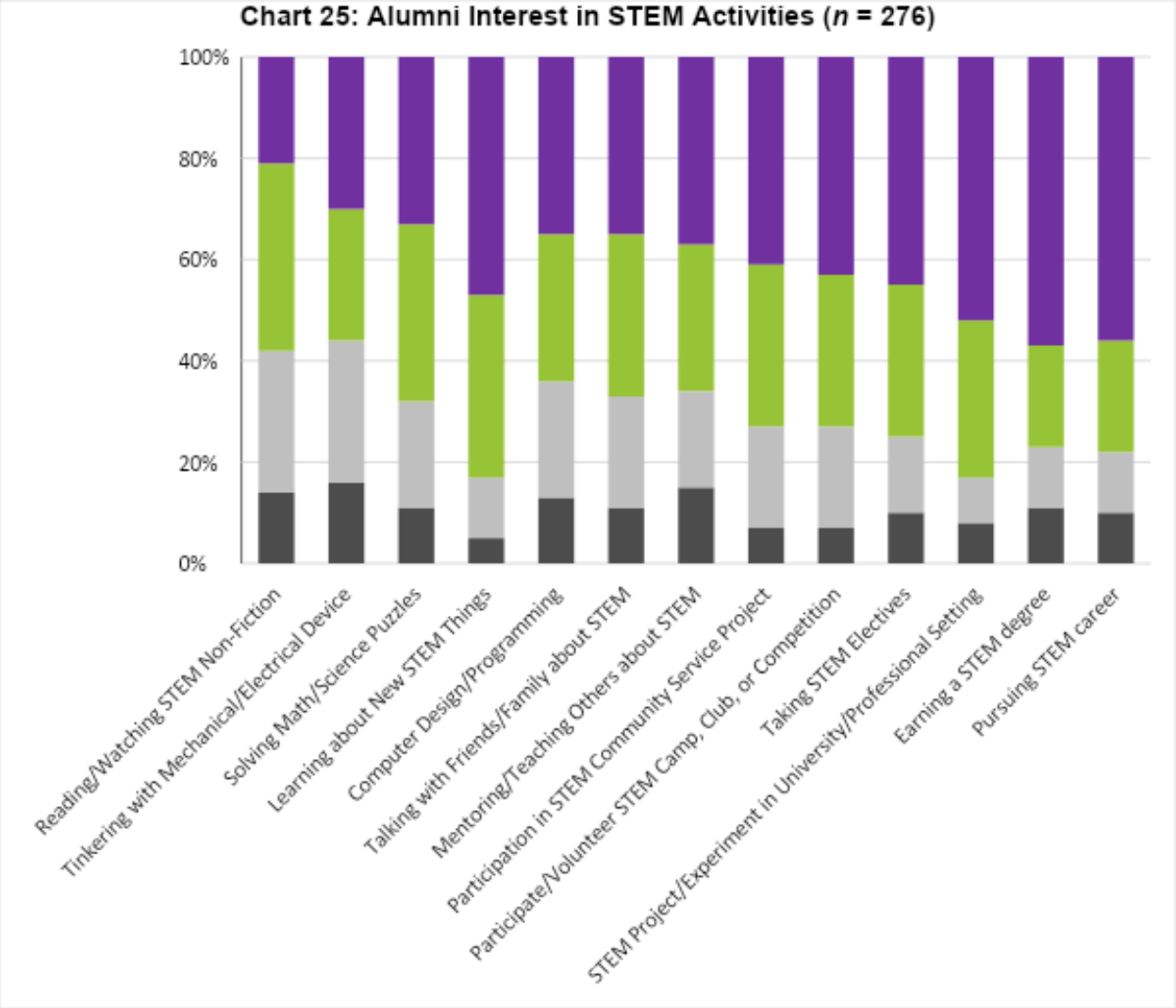
Mid to Long-Term Evaluation

The FY18 AEOP evaluation included an alumni survey. This portion of the evaluation is intended to capture near-term and mid-to long-term outcomes of AEOP participation.

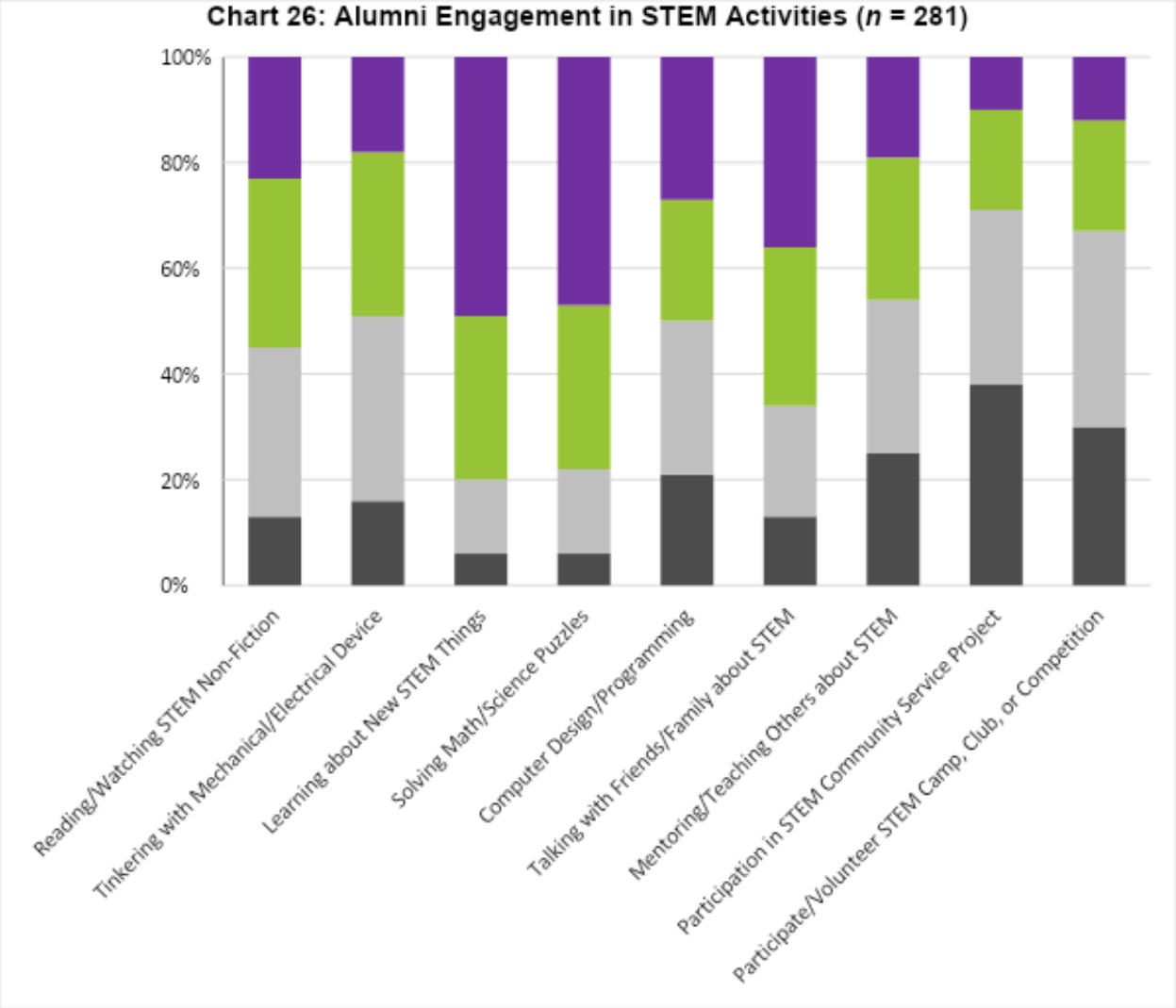
PRIORITY ONE: STEM Literate Citizenry

Research Question #1 - To what extent do alumni report positive, sustained interest and engagement in STEM?

Alumni completing the survey were asked to report their current interest in STEM activities. Chart 25 shows that alumni have strong current interest in STEM. Specifically, a majority of alumni participating in the survey indicated they were at least somewhat interested in earning a STEM degree (89%) and pursuing a STEM career (90%). More than 90% of alumni reported interest in learning about new things in STEM (95%), participating in STEM community service projects (93%), and participating in STEM camps, clubs, or competitions (93%).



Alumni were asked to report on their current engagement in STEM activities. Nearly half or more of alumni reported being at least sometimes engaged with all STEM activities from the survey except participating in STEM community service projects (29%) and STEM camps, clubs, or competitions (33%) (Chart 26). Three-quarters or more of alumni reported sometimes or frequently engaging in activities such as: learning about new things in STEM (80%) and solving math/science puzzles (78%). Further, half or more of alumni reported engaging in STEM sometimes or frequently by reading/watching STEM non-fiction (55%) and talking with friends/family about STEM (66%).



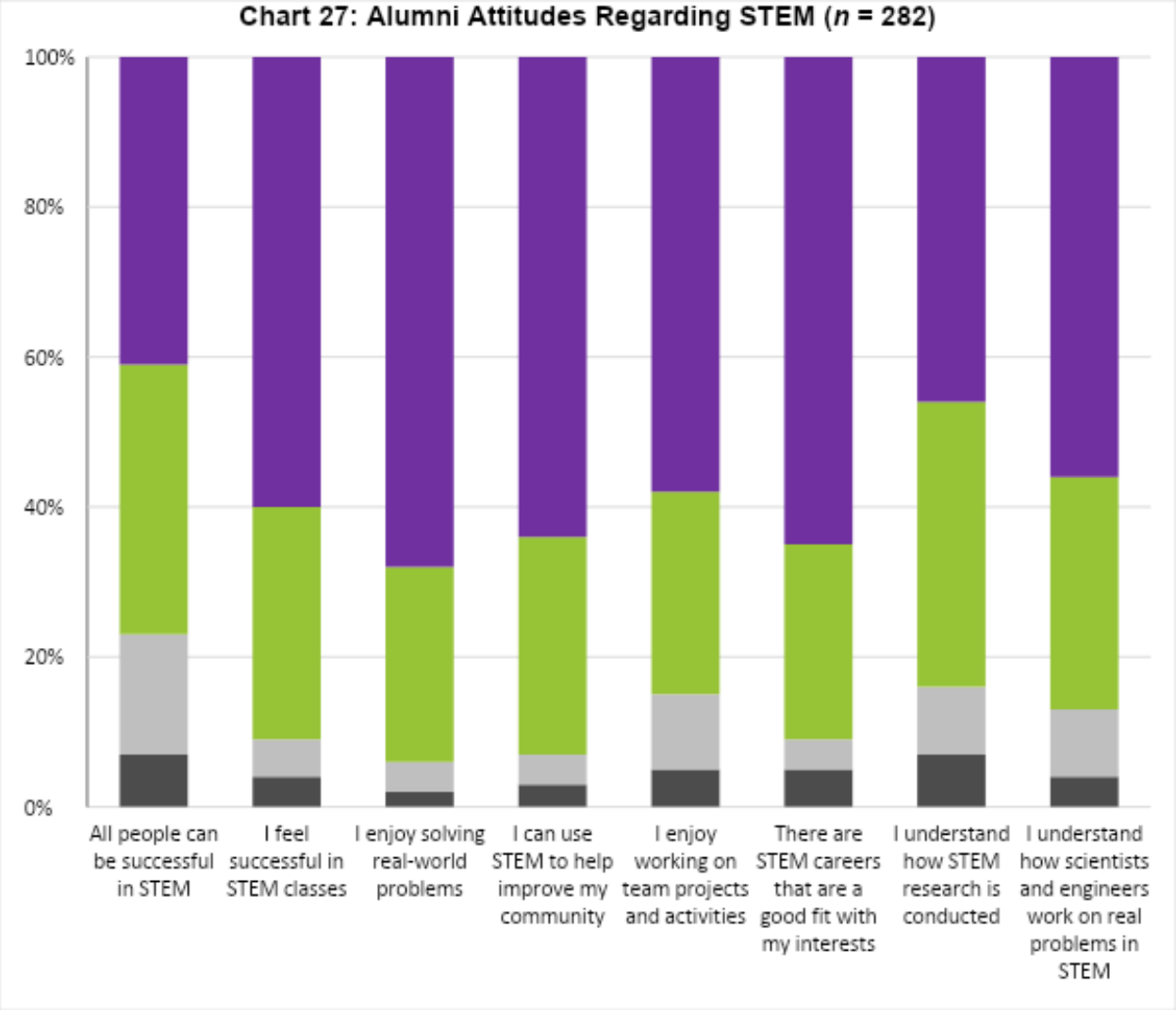
Forty three percent of AEOP alumni reported that they were currently talking a STEM elective course (43%). A third of alumni indicated they are currently pursuing a STEM degree (27%), and 14% are already working in a STEM career (Table 50).

Table 50. Alumni Current STEM Activities (*n* = 282)

Item	Percentage
Taking a STEM elective	43%
Working on STEM project/experiment in university/professional setting	25%
Pursuing a STEM degree	27%
Working in a STEM career	14%

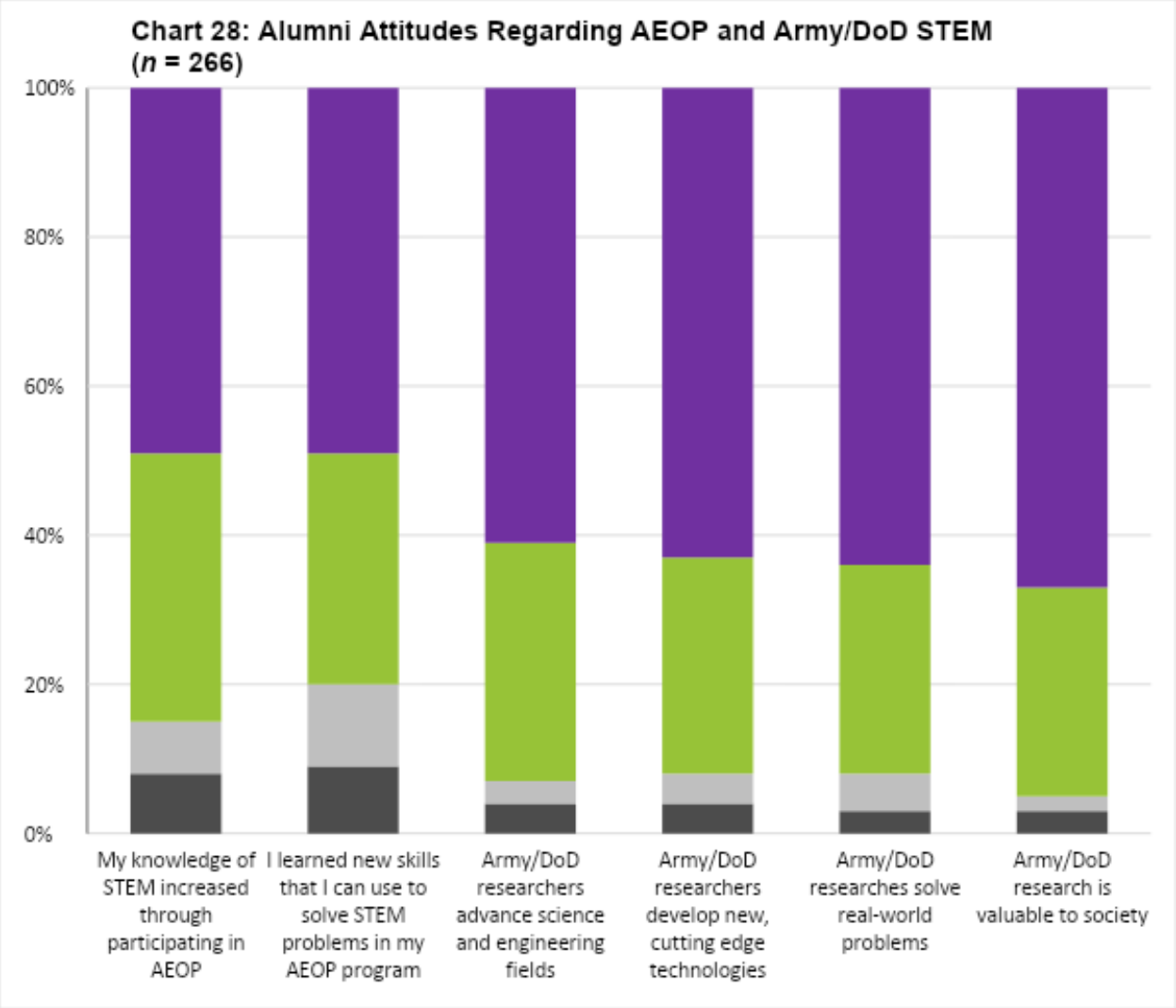
Research Question #2 - To what extent do alumni report positive attitudes toward STEM, and particularly Army/DoD STEM?

Working to create a STEM literate society is an AEOP priority. Developing positive youth attitudes toward STEM is an important step in this work. As such, alumni were asked through to respond to items regarding their attitudes toward STEM in general and specifically related to Army/DoD STEM. Chart 27 shows that AEOP alumni have extremely positive perceptions toward STEM in general with more than three-quarter at least somewhat agreeing with all items. More than 90% of participants agreed with the following items: there are STEM careers that are a good fit with their interests (91%); they feel successful in STEM classes (91%); they can use STEM to help improve their community (93%); and they enjoy solving real-world problems (94%).



Concerning alumni beliefs that are specifically related to the AEOP and Army/DoD STEM, alumni also shared highly positive views with 80% or more at least somewhat agreeing with all items (Chart 28).

Nearly all alumni indicated feeling Army/DoD research is valuable to society (95%), advances STEM fields (93%), solves real-world problems (92%), and develops new, cutting edge technologies (92%).



Research Question #3 - To what extent do alumni report pursuit of and achievement in STEM courses in secondary school, post-secondary STEM degrees, STEM careers, and Army/DoD STEM careers?

Large proportions of AEOP alumni reported completing STEM coursework in high school (Table 51). One third to two-thirds of alumni indicated they had completed higher level STEM classes such as AP Math (32%), Calculus (38%), AP Science (41%), Chemistry (73%), and Physics (53%).

Table 51. Alumni Reported STEM High School Coursework Completed (*n* = 282)

HS STEM Course	Percentage
Algebra I	86%

Algebra II	75%
AP Math	32%
AP Science	41%
Biology	87%
Calculus	38%
Chemistry	73%
Computer Science	29%
Earth Science	30%
Engineering	21%
Environmental Science	27%
Geometry	83%
Human Anatomy	18%
Intro Chemistry and Physics	28%
Physics	53%
Pre-Calculus	54%

AEOP alumni also reported on their enrollment in post-secondary STEM degree programs (Table 51). Among the more than 40% of AEOP alumni indicated that they were enrolled in post-secondary education, 40% reported that they were pursuing some form of STEM degree or certificate. Most responding alumni currently in post-secondary STEM programs were pursuing bachelor's degrees (20%).

Table 52. STEM Degree at College or University

Degree Level	Percentage
Associate (*n* = 276)	
Yes	7%
No	36%
Still in High School	57%
Bachelor's (*n* = 276)	
Yes	20%
No	22%
Still in High School	58%
Graduate (*n* = 279)	

Yes	7%
No	35%
Still in High School	57%
STEM Certificate/Training (*n* = 275)	
Yes	6%
No	38%
Still in High School	56%

Table 53 shows that alumni in post-secondary programs were most likely to be enrolled in engineering-focused programs (12%). This was followed by physical science (4%), technology/computer science (4%), life science (3%), and medicine (1%). Less than 1% of alumni reported pursuing a teaching degree. Most alumni reported having completed credits toward their degree (Table 54).

Table 53. STEM Degree Program Enrolled In (*n* = 264)

STEM Degree Program	Percentage
Business	<1%
Earth science	<1%
Engineering	12%
Environmental science	<1%
Life science	3%
Mathematics or statistics	<1%
Medicine	1%
Physical science	4%
Teaching	<1%
Technology/Computer science	4%
Other	5%
Not enrolled	63%
Missing data	6%

Table 54. AEOP Alumni College Credit Hours Completed in STEM Degree Program (*n* = 282)

STEM Credits	Percentage
0-30 Credits	10%
31-60 Credits	4%
61-90 Credits	4%
91-120 Credits	6%
121+ Credits	5%
Not enrolled in classes	28%
Not enrolled in STEM	3%
Still in High School	38%
Missing data	4%

AEOP alumni reported on their current GPAs (Table 55). Approximately a third of alumni (31%) indicated they held a 4.0 or higher GPA. More than three-quarters indicated they held a GPA of 3.0 or higher (76%).

Table 55. AEOP Alumni College Student Current GPA (*n* = 282)	
GPA	**Percentage**
4.0 or better	31%
3.75 - 3.9	21%
3.50 - 3.74	12%
3.0 - 3.49	12%
2.5 - 2.9	3%
2.0 - 2.49	<1%
Lower than 2.0	0%
Not enrolled	18%
Missing data	4%

A smaller subset of AEOP alumni indicated they had already completed a post-secondary STEM degree program (Table 56). Approximately one-third (32%) had earned bachelor's degrees, 28% master's degrees, 2% associate degrees, and 27% had completed a STEM technical certificate program.

Table 56. STEM Degree Program Completed (*n* = 56)	
STEM Degree Program	**Percentage**
Associates	2%
Bachelors	32%
Masters	28%
Doctoral	11%
Certificate	27%

Of the 88 questionnaire respondents who provided a title for their degree programs, 71 (81%) listed degree programs in STEM fields. Among the STEM majors most reported being in engineering programs (49%) followed by physical science (17%), technology/computer science (14%), life science (10%), medicine (6%), mathematics or statistics (3%), and environmental science (1%).

Among the 45 questionnaire respondents who included a description of their employment in STEM-focused jobs, most reported being K-12 teachers (40%). After this were engineers (20%), STEM-related positions within the DoD (11%), research scientists (9%), technology-related (9%), university faculty (7%), and mathematics-oriented fields (4%).

Research Question #4 - To what extent do alumni report awareness of and interest in STEM research and careers overall and for the Army/DoD specifically?

The alumni questionnaire included questions about STEM research generally that respondents had learned about through AEOP and STEM research within the DoD that alumni had learned about through AEOP. In addition, alumni were asked to list up to 3 Army/DoD STEM careers they had learned about in their programs.

Alumni provided a variety of responses about the STEM research they had learned about during their AEOP experiences. Responses included:

- 3D Printing
- Actuarial Science
- Aerospace
- Agriculture Science
- Animal Testing/Dosing
- Antenna Positioning Systems
- Artificial Intelligence
- Autonomous Vehicles
- Bacterial Cellulose
- Biochemistry
- Biological Engineering
- Biology
- Biostatistics
- Biotechnology
- Cancer research
- Chemical Engineering
- Chemistry
- Computer Engineering
- Coral Reefs
- Cybersecurity
- Earth Science
- Electrical Engineering
- Electronics
- Engineering
- Environmental Science
- Food Packaging Technologies
- Genomics
- Health
- Materials Science
- Mechanical Engineering
- Microbiology
- Multifunctional Materials
- Nano chemistry
- Nanoscience
- Neurobiology
- Neuroscience
- Oceanography
- Parallel Programming with GPUs
- Particle Physics
- Pharmacy
- Robotics
- Technology
- Water Research
- Wind Turbine Research
- Wireless Communications

When asked about areas of Army/DoD STEM research that they had learned about during AEOP, alumni responses included the following:

- Aerospace Research
- Applied Materials Science
- Biology
- Bioscience
- Cancer
- Chem bio defense
- Computer science
- Cybersecurity
- Detection Technology
- Developing Supercomputers
- Epidemiology
- Flood Control
- Fluid Dynamics
- Forensic Biology
- High Power Lasers
- Immunology and Virology
- Mechanical Engineering
- Microbiological Research
- Multifunctional Materials
- Particle Physics

- Drug Discovery/Virology
- Electronics
- Engineering
- Environment
- Prototype Building
- Two-Dimensional Materials
- Weapons
- Wireless Communications

Alumni also listed a variety of Army/DoD STEM careers they had learned about during their AEOP experiences. These included:

- Actuarial Science
- Aeronautical Engineer
- Architect
- Behavioral Analysis Specialist
- Biochemist
- Biologist
- Biologist
- Biomedical Engineer
- Broadcast Engineer
- Chemical Engineer
- Chemist
- Civilian Scientists
- Combat Engineer
- Computer Engineering
- Computer Science and Information Technology
- Cryptologic Engineer
- Doctor
- Electronics Engineer
- Fire Protection Engineer
- Food Scientist
- General Engineer
- Geologist
- Industrial Engineer
- Marine Scientists
- Mechanical Engineering
- Mechanical Engineers
- Medical Scientists
- Missile Defense Contractor
- Nano chemist
- Physicist
- Research Scientists
- Safety Engineer
- Structural Engineer
- Systems Engineers
- Urban Planner

Research Question #5 – To what extent do alumni report an increase in STEM career participation and success overall, as well as within the Army/DoD specifically?

AEOP alumni were asked to report on their awareness and interest in participating in STEM careers (Table 57). Nearly 90% of alumni reported being interested in pursuing a STEM career (88%) in general. Approximately two-thirds indicated they were aware of Army/DoD STEM careers (63%), and 71% of alumni indicated they would be interested in learning more about Army/DoD STEM careers. More than half (58%) of alumni indicated that they were interested in pursuing an Army/DoD STEM career.

Table 57. Alumni Awareness and Interests (*n* = 272)

Item	Somewhat Agree/Agree
I am aware of Army or DoD STEM careers	63%
I am interested in pursuing a career in STEM	88%
I am interested in pursuing a DoD/Army STEM career	58%
I am interested in learning more about Army/DoD careers focused on STEM research	71%

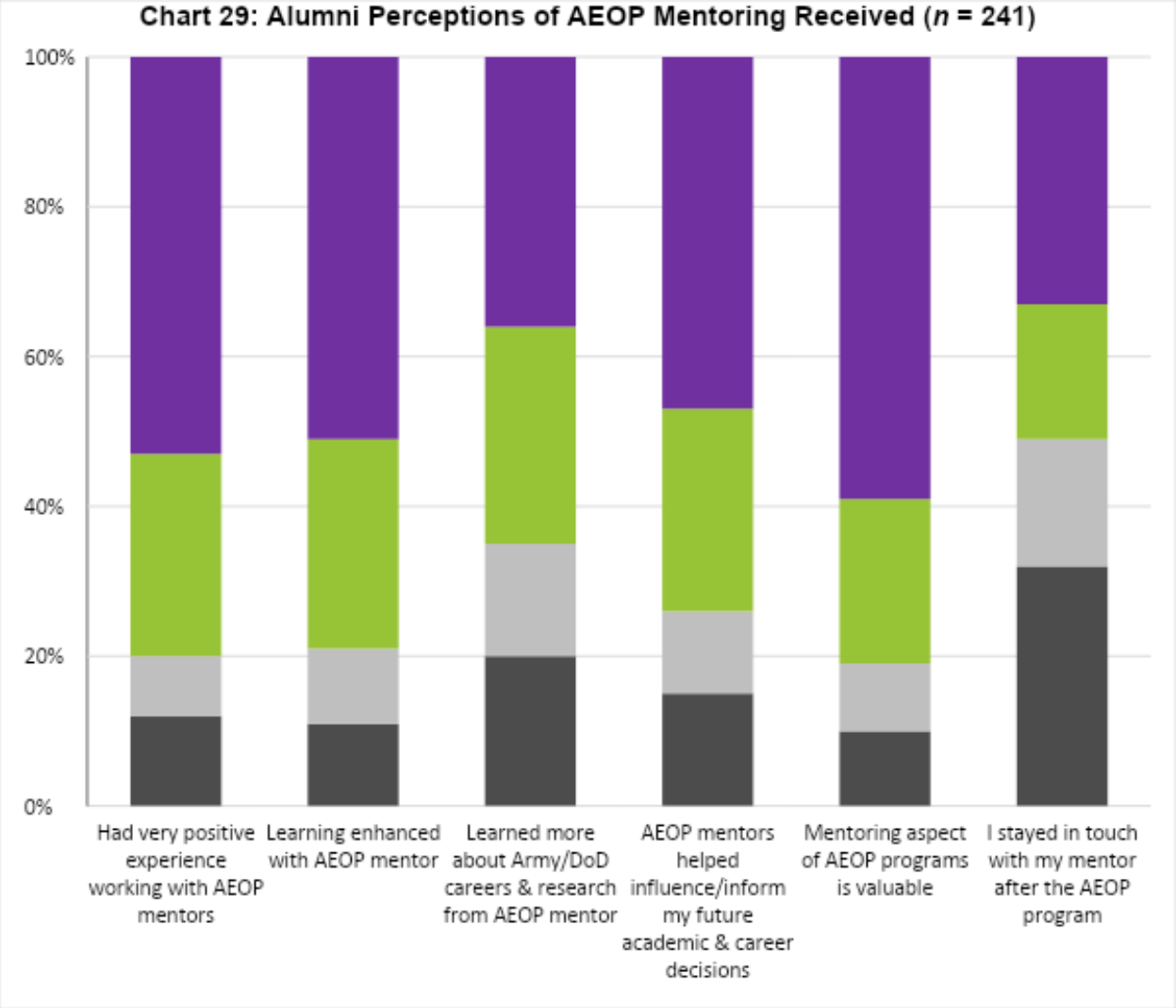
Alumni were asked to report on their STEM career plans (Table 57). Most alumni indicated that they plan to seek a STEM-focused career in the future (77%). Some alumni have already applied for STEM-focused jobs (25%) or currently have a STEM-focused career (19%). Fewer AEOP alumni indicated they plan to seek an Army/DoD STEM-focused career in the future (8%), and 6% already have such a position.

Table 58. Alumni STEM Career Focus (*n* = 272)	
Item	**Yes**
I have applied for STEM-focused job positions	25%
My current job is in a STEM-focused career	19%
I plan to seek a STEM-focused career position in the future	77%
My current position is an Army/DoD STEM focused position	6%
I plan to seek an Army/DoD STEM-focused career position in the future	8%

PRIORITY TWO: STEM Savvy Educators

Research Question #6 - What is the impact of Scientists and Engineers (S&E) Mentors on AEOP alumni?

Alumni reported on their perceptions of the mentoring they received while in their AEOP (Chart 29). Most alumni felt their mentoring experience was very positive (80%), enhanced their learning (79%), and was a valuable aspect of their AEOP (81%). Many alumni also believed their AEOP mentor helped influence their future academic career decisions (74%), and helped them learn about Army/DoD careers (65%). While the reported mentoring relationships appeared to be strong, only half indicated they have stayed in touch with their AEOP mentor after the program (51%).



Research Question #7 – Are there measurable changes in teacher approaches to teaching research concepts within STEM practices, and careers after participation in AEOP (RESET)?

There are no findings to report on this research question in FY18.

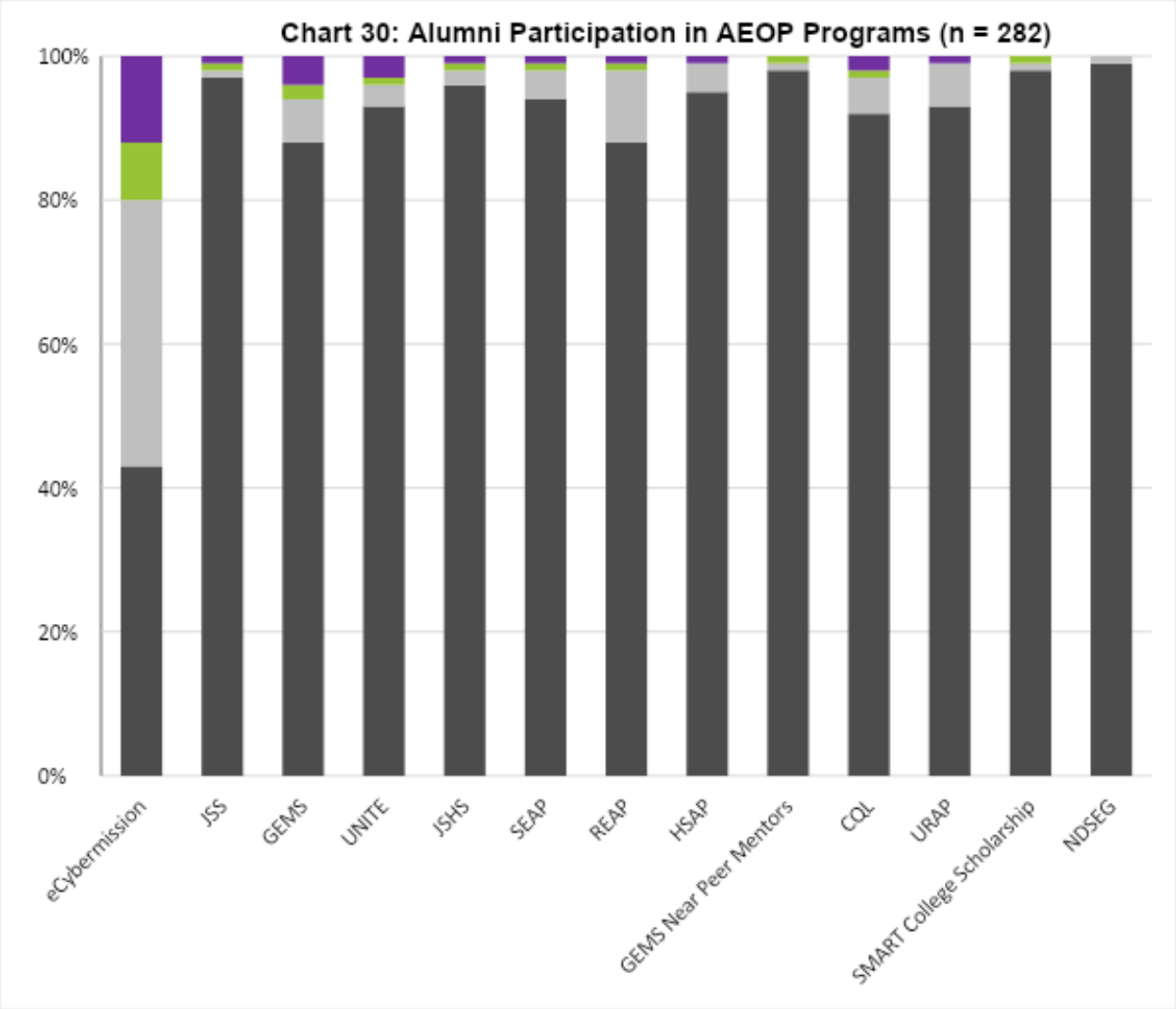
PRIORITY THREE: Sustainable Infrastructure

Research Question #8 - To what extent do alumni report increased awareness of and/or interest in AEOP opportunities?

AEOP alumni (*n* = 282) were asked to report on their awareness of and interest in other AEOPs. More than half of alumni (53%) indicated that they were familiar with other AEOP programs, and 77% reported being interested in participating in other AEOPs.

Research Question #9 - To what extent do alumni report participation in an AEOP program multiple times, in other AEOP elements, or in other DoD workforce development programs?

AEOP Alumni were asked to report past participation in AEOPs (Chart 30). The program with the most participation by alumni was eCM with 57% of respondents reporting to have participated at least once. GEMS and REAP both had 22% of alumni indicate having participated at least once in these programs. Alumni participants represented all programs. Further, alumni survey participants reported receiving each of the AEOP scholarships: SMART (2%) and NDSEG (1%).



7 | Summary of Findings

The 2018 AEOP evaluation collected data about participants, their perceptions of program processes, resources, and activities, and indicators of achievement related to outcomes aligned with AEOP and program objectives. A summary of findings is provided in Tables 58 and 59.

Table 58. 2018 Summary of Findings - Near Term

Priority 1: STEM Literate Citizenry *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base.*	
Finding #1	**Decline in overall student participation and some program participation but increase in adult mentors/teachers/volunteers.** In FY18, participation in AEOPs decreased overall by 9% from FY17, resuming the downward trend in enrollments since 2014 that was reversed in FY17 (41,802 in FY14; 38,039 in FY15; 30,972 in FY16; 32,947 in FY17; and 30,334 in FY18). Seven programs experienced increases in enrollment in FY18 as compared to FY17 (CII, 21%; GEMS, 15%; JSS, 17%; REAP, 15%; SEAP, 1%; Unite, 17%; URAP, 12%). These slight increases were largely offset by the substantial enrollment decreases in JSHS (82% decrease: 5,577 in FY17; 3,069 in FY18) and eCM (6% decrease: 21,277 in FY17; 20,002 in FY18). CQL and HSAP also experienced enrollment declines in FY18 (CQL, 6%; HSAP, 13%). Adult participants increased 12% in FY18 to 9,774.
Finding #2	**Slight decline in participation for apprenticeship programs.** Despite overall growth in participation in three apprenticeship programs, REAP, SEAP, and URAP, overall enrollment declined by 2% as compared to FY17 due to the enrollment decreases in CQL and HSAP noted above.
Finding #3	**Slight decline in number of applications to participate in AEOPs with accompanying overall increase in placement rates in FY18.** The number of applications received in FY18 (39,325) decreased by 18% as compared to the number of applications in FY17 (48,419) but increased by 5% over FY16 applications. The overall placement rate across AEOPs, however, increased to 77% in FY18, up from 68% in FY17. This increase in placement rate is due to the decreased number of applications received since, as noted above, overall enrollment for AEOP declined in FY18 as compared to FY17. Three apprenticeship programs experienced decreased placement rates as compared to prior years: CQL - 37% in FY18, 41% FY17, and 51% in FY16; REAP - 15% in FY18, 17% in FY17, and 25% in FY16; URAP – 20% in FY18, 9% in FY17, and 29% in FY16. Placement rates in the other apprenticeship programs remained unchanged from FY17 levels (HSAP,

	9%; SEAP, 13%). Other programs showed growth in placement rates, however. JSHS served 72% of applicants in FY18 as compared to 65% in FY17; Unite placed 59% of applicants in FY18 as compared to 45% in FY17; and URAP placed 20% of applicants as compared with 9% in FY17. The placement rate for GEMS remained unchanged from FY17 (61%).
Finding #4	**AEOPs continued to serve underserved populations.** The AEOPs continued to prioritize the participation of students from traditionally underserved groups, per the AEOP definition: *AEOP's definition of underserved includes at least two of the following: low-income students; students belonging to race and ethnic minorities that are historically underrepresented in STEM; students with disabilities; students with English as a second language; first-generation college students; students in rural, frontier, or other federally targeted outreach schools; females in certain STEM fields.* Overall, 45.5% of AEOP youth participants were classified as underrepresented. This number ranged from as high as 96% in REAP and as low as 18% in URAP. Programs with half or more of their youth participants classified as U2 students were HSAP, eCM, Unite, and REAP. While each individual underserved demographic category was found among youth participants, none held 50% or more of the overall participants. The closest to half were females (49%), school location (38%), and racial/ethnic minority (33%). Programs still have room to grow their inclusion of U2 populations across the AEOP.
Finding #5	**Participants reported engaging in STEM practices significantly more in their AEOP programs as compared to in their typical school experiences for each program.** Evaluation findings indicated that AEOPs consistently provided opportunities for participants to engage in authentic STEM activities that are significantly more intensive than those they experience in their typical school settings.
Finding #6	**Participants reported increased STEM competencies, STEM skills, STEM knowledge, STEM practices, and confidence in STEM after participating in AEOPs.** ● Participants from all programs reported gains in their STEM knowledge after participating in AEOPs. Most programs averaged between "some" and "large" gains. However, the overall eCM regional participants experienced smaller gains than any other program, reporting only "a little gain" in STEM knowledge, STEM practices, and STEM identity. ● Likewise, students and apprentices in all programs reported gains in their STEM competencies, however FY18 gains were slightly lower than those reported in FY17 for all programs except for GEMS and HSAP, which reported slightly higher average gains as compared to FY17. ● Participants in each program also reported gains in their 21st Century Skills, however, most programs reported slightly lower gains in FY18 compared to FY17 except for REAP and SEAP which reported slightly greater gains. ● Participants in all programs reported some level of gains in their STEM identities, however, only CQL, JSS, and REAP reported larger gains in FY18 compared to FY17.

	• For all programs except eCM and JSHS, more than half of participants agreed their AEOP program contributed to their increased confidence and interest in each area about which they were asked. Confidence in STEM knowledge, skills, and abilities was ranked consistently highest, with a range of 65% (eCM) to 100% (HSAP) agreement.
Finding #7	**Participants demonstrated increased attainment toward mastery of the 21st Century Skills across their participation in the AEOPs.** Participants from apprenticeship programs (CQL, SEAP, REAP, URAP, HSAP) and STEM programs and competitions (Unite and eCM mini-grant) demonstrated growth in all areas of the 21st Century Skills Assessment from baseline (first days of program) to end of program as assessed by their mentors or teachers. Participants showed the largest growth in the skill sets of Creativity and Innovation as well as Critical Thinking and Problem Solving. Participants from SEAP and REAP generally had the lowest pre-assessment scores and also demonstrated large amounts of growth. While CQL students demonstrated growth in most domains, these students came in at a higher pre-assessment level and had slightly less room for growth. Participants demonstrated growth in Creativity & Innovation; Critical Thinking & Problem Solving (all programs except SEAP and CQL); Communication, Collaboration, and Social and Cross-Cultural Skills; Information, Media, & Technological Literacy (all programs except CQL); Flexibility, Adaptability, Initiative, & Self-Direction (all programs except CQL); Productivity, Accountability, Leadership, & Responsibility (all programs except HSAP).
Finding #8	**Participants reported positive attitudes toward Army/DoD STEM Research.** A majority of participants across programs agreed that Army/DoD research and researchers advance science and engineering fields (range of 48%-97%), develop new cutting-edge technologies (range of 52%-93%), that DoD researchers solve real-world problems (range of 56%-97%), and that DoD research is valuable to society (range of 56%-95%). These responses are similar to those from 2017. The highest rates of agreement (averaging 90% or higher) continues to be from participants at programs hosted at DoD research laboratories (CQL and SEAP) and DoD-sponsored college/university laboratories (HSAP and URAP). Competition programs (eCM, JSHS, and JSS) had the lowest rates of agreement averaging below three-quarters (53%-73%), with eCM regional participants being significantly lower than other programs ranging from 48-56% agreement.
Finding #9	**Evaluation findings indicated that the AEOP exposed participants to STEM careers generally and to Army and DoD STEM careers, and participating in AEOPs increased their interest in pursuing STEM careers.** In all programs except eCM, JSS, and URAP -- a majority of participants (32%-91%) reported learning about 3 or more STEM careers during their AEOP participation. eCM regional participants were the lowest, reporting only 37% learned about 3 or more STEM jobs/careers during their program.

	Less than 50% of students in eCM, JSHS, JSS, HSAP, REAP, and URAP learned about 3 or more DoD STEM careers. However, majority of students (range of 60%-86%) in CQL, eCM National, GEMS, SEAP, and Unite had learned about 3 or more DoD STEM careers. Only 17% of eCM regional participants reported learning about 3 or more DoD STEM jobs/careers in FY18. In FY18 a greater percentage of participants in CQL, eCM, GEMS, JSHS, REAP, and SEAP learned about DoD STEM careers as compared to FY17. As in previous years, comparisons of participants participating in AEOPs held at Army research laboratories (CQL, GEMS, and SEAP), with participants at Army-sponsored university labs (HSAP and URAP), and non-Army affiliated settings (eCM Regional, JSHS, REAP, and Unite) reveal that, overall, participants in programs hosted at Army sites learned about more DoD STEM careers. Between 34% and 86% of participants indicated that their AEOP participation resulted in an increased interest in DoD STEM careers. More than half of responding apprentices reported interest in DoD STEM careers in FY18 (range of 56%-86%), findings slightly lower than those for FY17 (range of 66%-87%). eCM reported the least interest in a STEM career (39%) and awareness of DoD STEM careers (47%), as well as appreciation of Army/DoD STEM research (52%) and interest in pursuing a STEM career with the DoD (34%). SEAP was the only program to show an upward trend from FY17 (75%) to FY18 (86%).
Priority 2: STEM Savvy Educators *Support and empower educators with unique Army research and technology resources.*	
Finding #1	**Adult participants (i.e. mentors, S&E's, Team Advisors, teachers) reported use of effective mentoring strategies in varying degrees across the AEOPs in FY17.** Strategies to engage students in authentic STEM activities (range of 76%-100%) and to support the development of collaboration and interpersonal skills (78%-96%) were used most frequently, while strategies to support participants STEM educational and career pathways (range of 50%-88%) were used the least. In addition, a majority of all adults (range of 71%-93%) reported using strategies to establish the relevance of learning activities and support the needs of diverse students as learners (65%-93%). There is still room for improvement in this area, to move toward all mentors using the effective strategies with student participants.
Finding #2	**In FY18, participants continued to be satisfied with the support received from their mentors/S&Es/Team Advisors/teachers.** Most apprentices and students in all programs reported high levels of satisfaction with their mentors and the quality of instruction they received (range of 56%-90%). Levels of satisfaction with mentorship were somewhat higher than those reported in FY17 for CQL, GEMS, HSAP, and REAP, however levels of satisfaction with mentors in Unite and URAP were lower than in FY17.

Priority 3: Sustainable Infrastructure *Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.*	
Finding #1	**The primary means of learning about AEOPs and associated opportunities in FY18 continues to be personal connections, school/university connections, past participants, or someone connected directly with AEOPs.** A continued strength of AEOP is the expansive network of connections to local communities that serves as a continued means of recruitment for the program, suggesting that program alumnae often act as informal ambassadors for these programs. Overwhelmingly, participants and mentors reported that AEOP social media, AEOP website, and other materials were much less frequently used as a means for introducing them to the program.
Finding #2	**Despite limited past participation and awareness of participants and mentors of AEOP opportunities, FY18 participants reported interest in participating in AEOP initiatives in the future.** Very few participants had ever participated in any AEOP other than the one in which they were currently enrolled with the exception of the 21% of REAP apprentices who reported they had participated in Unite, and the 37% of SEAP participants who reported having participated in GEMS in the past. These findings suggest there is a relatively robust pipeline relationship between the Unite and REAP and GEMS and SEAP programs. Findings suggest that youth participants and mentors across the AEOP have limited awareness of AEOP programs other than those in which they are currently participating. Participants primarily expressed interest in repeating participation in the AEOP in which they were currently enrolled (range of 56%-91%), but also expressed interest in participating in other AEOPs. The most interest was expressed in SMART with five programs having more than half of their participants interested: eCM (51%), Unite (52%), SEAP (63%), HSAP (63%), and CQL (72%).
Finding #3	**Participation in the AEOP evaluation has room for improvement.** Participation in the evaluation questionnaire declined for all programs for both youth and adult participants with the exception of eCM team advisors (9% in FY17, 32% in FY18) and Unite students (65% in FY17, 69% in FY18) and mentors (17% in FY17, 26% in FY18). In regard to the 21st Century Assessment, CQL, HSAP, REAP, SEAP, and URAP (all apprenticeship programs) had less than 20 participants in the assessment. Unite and eCM had over 200 participants each in the assessment, by comparison.

Table 59. 2018 Summary of Findings - Mid to Long Term

Priority 1: STEM Literate Citizenry *Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base.*	
Finding #1	**AEOP alumni indicated interest in pursuing STEM degrees and careers.** a majority of alumni participating in the survey indicated they were at least somewhat interested in earning a STEM degree (89%) and pursuing a STEM career (90%).
Finding #2	**Alumni are engaged in pursuing STEM opportunities and careers.** Nearly half (43%) of AEOP alumni reported that they were currently talking a STEM elective course. Nearly a third (27%) are currently pursuing a STEM career, and 14% are already working in a STEM career.
Finding #3	**AEOP Alumni participate in other STEM-related activities.** Three-quarters or more of alumni reported sometimes or frequently engaging in activities such as learning about new things in STEM (80%) and solving math/science puzzles (78%). Further, half or more of alumni reported engaging in STEM sometimes or frequently by reading/watching STEM non-fiction (55%) and talking with friends/family about STEM (66%).
Finding #4	**Alumni hold positive views toward STEM generally and Army/DoD STEM specifically.** AEOP alumni have extremely positive perceptions toward STEM in general, with more than 90% of participants agreeing with the following items: there are STEM careers that are a good fit with their interests (91%); they feel successful in STEM classes (91%); they can use STEM to help improve their community (93%); and they enjoy solving real-world problems (94%). Furthermore, nearly all alumni indicated feeling Army/DoD research is valuable to society (95%), advances STEM fields (93%), solves real-world problems (92%), and develops new, cutting edge technologies (92%).
Finding #5	**Alumni report interest in STEM careers generally, as well as with the Army/DoD specifically.** A large majority of alumni reported being interested in pursuing a STEM career (88%) in general. Approximately two-thirds indicated they were aware of Army/DoD STEM careers (63%), and 71% of alumni indicated they would be interested in learning more about Army/DoD STEM careers. More than half (58%) of alumni indicated that they were interested in pursuing an Army/DoD STEM career.
Finding #6	**AEOP Alumni reported completing STEM coursework and being enrolled in STEM degree programs.** Large proportions of AEOP alumni reported completing STEM coursework in high school. One third to two-thirds of alumni indicated they had completed higher level STEM classes such as AP Math (32%), Calculus (38%), AP Science (41%), Chemistry (73%), and Physics (53%). Among the more than 40% of AEOP alumni indicated that they were enrolled in post-secondary education, 40% reported that they were pursuing some form of STEM degree or certificate. Of those enrolled in STEM degree programs, alumni were most likely to be enrolled in engineering-focused programs (12%) followed by, physical science (4%), technology/computer science (4%), life science (3%), and medicine (1%).
Priority 2: STEM Savvy Educators	

Support and empower educators with unique Army research and technology resources.	
Finding #1	**Participants reported very positive impacts of their mentors and agreed mentoring is a valuable aspect of AEOPs.** Most alumni felt their mentoring experience was very positive (80%), enhanced their learning (79%), and was a valuable aspect of their AEOP (81%). Many alumni also believed their AEOP mentor helped influence their future academic career decisions (74%), and helped them learn about Army/DoD careers (65%). While the reported mentoring relationships appeared to be strong, only half indicated they have stayed in touch with their AEOP mentor after the program (51%).
Priority 3: Sustainable Infrastructure *Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.*	
Finding #1	**Alumni reported strong interest in participating in other AEOPs, though less than 60% indicated they were familiar with other AEOPs.** While only slightly more than half of alumni (53%) indicated that they were familiar with other AEOP programs, 77% reported being interested in participating in other AEOPs.

What AEOP Participants are saying…..

*"The work [in **CQL**] was impactful, interesting, and pushed me to be a better engineer. And almost all of my satisfaction was a result of my mentors and the work environment they created for me. They made sure I was progressing, understanding what I was doing, and overall having an enjoyable experience. Because of them, I will definitely consider working for the DoD and hope to apply for a SMART Scholarship."* (CQL Apprentice)

*"[**CQL** Apprentices] actually see that the DoD does a lot of really, really good world class science that impacts people's lives all over the world, not just the soldiers…As they go on, whether they become involved with DoD or not, when they're out there working in science in another area, they have a respect. They may come back and collaborate and do projects with the DoD because they have that experience. That's all very, very positive."* (CQL Mentor)

*"I believe **eCYBERMISSION** was a great experience, not only helping me learn about STEM, but also making me a better team player, as well as helping me solve real world problems. I know more about the world around me and can hopefully one day use my newfound knowledge to make something important."* (eCM-R Student)

*"**eCYBERMISSION** continues to be the highlight of science for my 6th - 9th graders. They show tremendous growth during the experience and from year to year as they grow through the program. It is the single best way I've found to develop independent workers."* (eCM Team Advisor)

*"Being in **GEMS** was an amazing experience. I was introduced to new STEM careers and technology. For example, we made some circuits, got to experience VR, and we were able to lean about moral dilemmas…I am glad that I choose to go to GEMS for a week I wish it would be longer!"* (GEMS Student)
"

"*I love teaching students in **GEMS**. Not only do I see how their perspective on STEM changes towards a positive one, but I can truly see kids grow in their interests over the years."* (GEMS Mentor)

*"The connections I had made with my mentor, the other interns, and the other people in the lab group made the summer a fulfilling experience. I learned to be more persistent, creative, and inquisitive because research does not come easily. At the end of the program, I learned more about what researchers do, made great friendships, gained a lot of respect for researchers and was able to reflect on my growth. I am glad that I applied and am highly satisfied with my **HSAP** experience!"* (HSAP Apprentice)

*"As a university professional, **HSAP** gives me an opportunity to interact on a daily basis with high school students to better understand their experiences before they become undergraduates. I am most excited about the opportunity to provide mentoring and guidance to these students as they formulate potential career pathways, and to encourage them to succeed. As one of my previous students said, 'The program and your mentoring changed my life! I had been told by many high school teachers that certain areas and subjects were 'beyond my capability',' but you showed me that I can do it. You really gave me confidence to succeed.'"* (HSAP Mentor)

*"**JSHS** was a phenomenal experience for me to share both my independent research and get to meet new people that share my same passion for science. Being able to present to many people of diverse backgrounds was an eye-opening experience."* (R-JSHS Student)

*"I've been involved in **JSHS** for the last 34 years in education and have seen how it captures the interest of students and gives them a vehicle to answer questions about the world in which they live."* (JSHS Mentor)

"*I really enjoyed my **JSS** experience. I feel that I have grown with my knowledge of mechanics. I learned more about solar panels and how they are used. Creating a car and overcoming obstacles with my teammate was a fun experience."* (JSS Regional Student)

*"I LOVE **JSS**! This was my second year and I will do it again in the future. One of the things that I really like about this opportunity is that it challenges the students to try things and then make decisions for improvements based on evidence and data. Also, this is NOT an area of STEM that I am very familiar with, so I couldn't provide answers for the students, but I could give them tips or strategies for research and problem solving. Since they didn't have a teacher that 'knew the answers' they really had to take some risks and try things. It is amazing to watch them, and I had total student engagement throughout the project. It is wonderful!"* (JSS Team Advisor)

*"[**REAP**] was very good and helped me learn more about research and careers in STEM. The mentors were very helpful and easy to work with and the other participants were also fun to be around. Overall the experience was great, and I learned a lot from my research and interacting with other people and made me learn more about careers."* (REAP Apprentice)

*"The **REAP** experience has been very productive…I believe the students gained deeper knowledge and understanding about how to engage in research. They also seemed to gain real knowledge and appreciation for working in a university laboratory. It was enjoyable to watch the mentors and mentees interact with each other. Great experience! I hope to have more students in future summer offerings."* (REAP Mentor)

*"I have had an amazing experience in the **SEAP** program! I have always been interested in pursuing a degree in the STEM field, specifically engineering, and I feel like the program gave me the confidence to follow through with it. When I first began the program, I was extremely worried that I didn't have the skills or intelligence to work on a real-world project. However, the more I learned, asked questions, and designed, the more self-assured I became. Now, I feel as though I have the conviction and knowledge to seek more STEM opportunities with confidence and eagerness!"* (SEAP Apprentice)

*"I was very satisfied with the **SEAP** experience. The student I worked with was intelligent, well-mannered, dependable, and eager to learn. It was beneficial to me, as I could rely on the student to assist in the lab. I believe the student had a good experience being exposed to numerous projects and researchers to get a sense of the types of problems we are faced with."* (SEAP Mentor)

*"There are no words to express how blessed I feel to experience this month of challenges, accomplishments, making new friends, exploring into careers, visiting interesting places. During [**Unite**] I have gained so much like knowing the basics of engineering and working as a team. This opportunity has showed me that there is so much to be offered if I put work to and my mind into it."* (Unite Student)

*"[**Unite**] has helped many students become interested in STEM degrees and careers. Many students have been exposed to new opportunities through this program and have started on a path to obtain a STEM career."* (Unite Mentor)

*"I was extremely satisfied with my [**URAP**] apprenticeship program to say the very least. What I believe made it most worth while was my mentor... From the very beginning of the program all the way to the end, [my mentor] made sure that I not only felt comfortable with what it was I was doing, but also constantly reminded me of the significance of the work and why we were doing the things we did. [He] took the time to explain every aspect of the research to me, and made sure I knew the importance of everything I was doing, which made the experience extremely rewarding. By the end of the program I felt a great sense of accomplishment, and I would not trade the experience for anything. I thank and appreciate everyone involved in the program and am very grateful to have had this opportunity."* (URAP Apprentice)

*"I am extremely satisfied with the **[URAP]** experience. It is a great opportunity to mentor undergraduates, expose them to research, and motivate them STEM careers and graduate school.*

As a prior military officer, the best part is exposing students to non-uniform DoD service which 99% have never even known about, let alone considered." (URAP Mentor)

Recommendations for FY19 Program Improvement/Growth

While the successes for AEOP detailed above are commendable, there are some areas that remain with potential for growth and/or improvement. The evaluation team therefore offers the following recommendations for FY19 and beyond.

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

Increase and broaden participation in selected AEOP programs. Despite some progress in growing participation numbers in FY17, AEOP programs experienced a 9% decrease in enrollment in FY18. However, participation numbers remain strong at over 30,000. It is recommended that in FY19 and beyond that programs which have the capacity to grow utilize new and innovative means to market and communicate opportunities to new audiences. As in FY17, it is suggested that programs with capacity for growth examine strategies that programs such as Unite and JSS have used to produce growth in FY17 and FY18 (over 15%). AEOPs should continue to work to grow the percentage and number of underserved students who are participating in the program. Unite, REAP and HSAP can serve as potential models for the consortium of how to achieve this in a more rapid and impactful manner.

Examine means for increasing infrastructure to grow placement rates in JSHS and apprenticeship programs. As in FY17, we are recommending exploring infrastructure growth to accommodate more participants in selected programs. NSTA presents new leadership for JSHS in FY19 and should employ strategies that have been successful with growing eCM to its' current level of over 20,000 participants.

Examine programmatic modifications to grow impact on students. Despite continued impact on providing students a more authentic, effective STEM experience than in school across the board with AEOP programs, some individual programs are having less influence on STEM knowledge, practices, and identity. Further, some programs are also struggling with integrating STEM careers and DoD STEM careers to students. For example, the regional eCM participants (~20,000) reported the lowest percentage of agreement that the program had impacted them in STEM competencies (knowledge, practices, identity) than other programs while also coming in with the lowest exposure to STEM careers, attitudes toward DoD, and future interest in FY18. As the AEOP works to align the work of the consortium with the new Federal STEM Education Strategic Plan, it is recommended that the AEOP examine program alignment with desired outcomes and develop consortium-wide resources that can be used to integrate DoD and STEM careers carte blanche into the curriculum.

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

As in FY17, continue to focus on strengthening role of adults in mentoring and instruction. In FY18, most program mentors reported 50-100% use of the various effective mentoring strategies with their participants. However, several areas were reported at less than 75% use including: strategies to support STEM educational and career pathways, strategies to support the needs of diverse learners, and strategies to establish the relevance of learning activities. In the previous two years it has been recommended that the consortium develop tools/trainings for mentors to use to support more use of the strategies for effective mentoring. It is recommended that the AEOP contract with a provider to develop an online mini-MOOC that can be accessed by mentors in AEOP (and shared across agencies if desired) to onboard mentors in a formal and best-practice manner. The MOOC is self-paced and can include resources to be used in programming.

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

Expand reach of AEOP marketing, recruitment strategies beyond current local networks. Over the past four years of the AEOP evaluation, it has become increasingly clear that the portfolio has a vibrant, grass-roots network that has served the AEOP very well in the past and currently. However, this network has resulted in lack of scale in recruitment efforts and many areas/regions have not been provided with the opportunity to participate. For example, the JSHS Kentucky regional site includes participants from a 100-mile radius historically, excluding students from the southeastern and central parts of the state. This is typical for many other JSHS sites, as well as other programs, such as those situated at Army laboratories (GEMS, CQL, SEAP) that use personal and work connections to recruit participants.

This is not to say that the current AEOP network be disregarded – it should continue to be nurtured and leveraged. It is recommended that the consortium work to develop, at a minimum, a targeted plan for outreach and participation for FY19.

Recommendations include expanding beyond the Strategic Outreach Partners to provide seed funding to organizations such as STEMx, FETC, or others to market AEOP opportunities in the frequent communications to state leaders. Additionally, states such as Indiana have the entire school directory available on their website. Perhaps Widmeyer could devote some of their effort to communicating with superintendents/principals regarding AEOP opportunities. There are also listservs that can be utilized for state teacher associations, higher education faculty organizations, rural school networks, etc.

Participation in AEOP evaluation. Garnering the appropriate level of participation in our annual AEOP evaluation has some inherent challenges. There were several programs in FY18 that had less than desired engagement in the evaluation activities. Three programs had less than 20 mentors who completed the questionnaire, for example. All apprenticeship programs had less than 20 completed and matched pre/post 21st Century Skills Assessments in FY18. It is recommended that the AEOP programs continue to communicate the importance of participation in the evaluation and provide multiple reminders across the duration of their program at strategic times to make completion of the tasks a bit easier for staff. The evaluation team will be revising the Evaluation Toolkit for programs in FY20 to provide more supports within to help accomplish this.