Army Educational Outreach Program

High School Apprenticeship Program

2015 Annual Program Evaluation Report

HSAP_03_05112016

U.S. Army Contacts

Jagadeesh Pamulapati, Ph.D.
Director for Integration and Laboratory Management Policy
Office of the Assistant Secretary of the Army
Acquisition, Logistics, and Technology
(703) 617-0309
jagadeesh.pamulapati.civ@mail.mil

Andrea Simmons-Worthen
Army Educational Outreach Program Director on
behalf of the Office of the Deputy
Secretary of the Army for Research and Technology
(703) 617-0202
andrea.e.simmons.ctr@mail.mil

AEOP Cooperative Agreement Managers

Louie Lopez
AEOP Cooperative Agreement Manager
U.S. Army Research, Development, and
Engineering Command (RDECOM)
(410) 278-9858
louie.r.lopez.civ@mail.mil

Battelle Memorial Institute – Lead Organization

David Burns
Project Director, AEOP CA
Director of STEM Innovation Networks
(859) 322-7431
burnsd@battelle.org

HSAP Program Administrators

Michael Caccuitto
Chief, Technology Integration and Outreach Division
U.S. Army Research Office
(919) 549-4369
Michael.j.caccuitto.civ@mail.mil

Reshockie Smith
HSAP Program Administrator
U.S. Army Research Office
(919) 459-4339
reshockie.smith.ctr@us.army.mil

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Evaluation Contacts

Carla C. Johnson, Ed.D.
Evaluation Director, AEOP CA
Purdue University
(765) 494-0019
carlacjohnson@purdue.edu

Toni A. Sondergeld, Ph.D.
Asst. Evaluation Director, AEOP CA
Metriks Amerique
(419) 902-6898
tonisondergeld@metriks.com

Erin Peters Burton, Ph.D.
Asst. Evaluation Director, AEOP CA
Metriks Amerique
(419) 902-6898
erin.peters1@gmail.com

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Executive Summary

The High School Apprenticeship Program (HSAP), managed by the U.S. Army Research Office (ARO), is an Army Educational Outreach Program (AEOP) commuter program for high school students who demonstrate an interest in science, technology, engineering, or mathematics (STEM) to work as an apprentice in an Army-funded university or college research laboratory. HSAP is designed so that students (herein called apprentices) can apprentice in fields of their choice with experienced scientists and engineers (S&Es, herein called mentors) full-time during the summer or part-time during the school year.

Students receive an educational stipend equivalent to $10 per hour, and are allowed to work up to 300 hours total. The students contribute to the research of the laboratory while learning research techniques in the process. This "hands-on" experience gives students a broader view of their fields of interest and shows students what kind of work awaits them in their future career. At the end of the program, the students prepare abstracts for submission to the US Army Research Office Youth Science programs office.

In 2015, HSAP provided outreach to 49 apprentices and their 35 mentors at 28 Army-sponsored university/college laboratory sites (herein called HSAP sites). Seven of the university/college sites were HBCU/MIs.

This report documents the evaluation of the 2015 HSAP program. The evaluation addressed questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and program objectives. The assessment strategy for HSAP included post-program questionnaires distributed to all apprentices and mentors, individual interviews with four apprentices, and an online focus group with three mentors.

2015 HSAP Fast Facts	
Description	STEM Apprenticeship Program – Summer, in Army-funded laboratories at colleges/universities nationwide, with college/university S&E mentors
Participant Group	9th-12th grade students
No. of Applicants	267
No. of Students (Apprentices)	49
Placement Rate	18%
No. of Adults (Mentors)	35
No. of K-12 Schools	42
No. of K-12 Schools – Title I	20
No. of College/University S&Es	28
No. of College/Universities	28
No. of HBCU/MIs	7
Total Cost	$148,687.50

Total Stipends	$128,250.00
Cost Per Student Participant	$3,304.17

Response rate for the post-program apprentice survey was good at 72%, but was down from 80% response rate in 2014. However this is a marked improvement from a 63% response rate in FY13. The response rate for the mentor survey was much higher than 29% in 2014 at 61% in 2015. Although both apprentice and mentor response rates were above 50%, they still have a large margin of error in terms of being able to generalize from the sample to the HSAP population.

Summary of Findings

The FY15 evaluation of HSAP collected data about participants; their perceptions of program processes, resources, and activities; and indicators of achievement in outcomes related to AEOP and program objectives. A summary of findings is provided in the following table.

2015 HSAP Evaluation Findings	
Participant Profiles	
HSAP continues to be a popular and selective program which serves students of historically underrepresented and underserved populations.	HSAP has been extremely successful in reaching out to more high school students. In 2014, there were only 84 applicants to HSAP, and in 2015 there were 267 applicants – a 318% increase. The ARO office utilized direct email to targeted schools, which produced a significant increase in applications. As a result, there were 10 more participants in HSAP for FY15 and a 6% increase in the placement rate for applicants. Further, the growth in participants yielded inclusion of 10 more high schools in the HSAP program in FY15 and 20 of the participating high schools were Title I.
	HSAP experienced continued success in providing outreach to students from historically underrepresented and underserved race/ethnic and low-income groups. Twenty-one additional sites were added from 2014 with an increase from placing HSAP sites at 7 HBCU/MIs in 2015 (an increase from 2 HBCU/MI sites in 2014).
	Approximately half of the respondents in the HSAP program were from race/ethnicity categories other than White.
HSAP is more cost effective in 2015.	The cost per apprentice decreased over $500 per person in 2015 from the previous year. This may be due to the large increase in applicants and in site proposals.
Actionable Program Evaluation	
HSAP marketing and recruitment continue to be mainly from personal contacts.	Most HSAP apprentices learn about the program from personal contacts such as a teacher. Only after this contact occurs, do the apprentices learn about the program from the website.
	Marketing via social media such as Facebooks, Twitter or Pinterest were the least frequently used sources for learning about HSAP specifically and AEOP generally.

HSAP gives apprentices unique and authentic ways to learn about STEM that are not available in school.	Data gathered during registration indicate that apprentices were motivated to participate in HSAP by the desire to learn something new or interesting, because of their interest in STEM, and to learn in ways not possible in school.
HSAP offers opportunities for high school students in authentic STEM learning that provides insight into college and beyond.	Most responding apprentices reported learning about applications of STEM to real-life situations, cutting-edge STEM research, and STEM topics on most days or every day of their HSAP experience. Further, they reported an increased understanding of college-level STEM research
	Apprentices reported their mentors were available for them throughout the HSAP experience.
	Apprentices reported active engagement in doing STEM during the HSAP program. All STEM practices were experienced by the HSAP apprentices the majority of most days or every day.
HSAP mentors were less aware of DoD STEM research and careers than STEM careers/research in general. However, many were interested in participating in other AEOP opportunities.	The number of HSAP mentors increased 20% in FY15. 91% of HSAP apprentices learned about at least one general STEM job/career, but only 62% learned about at least one specific DoD STEM job/career. Apprentices are aware of other AEOP opportunities and are interested in participation. When asked how interested they are in participating in future AEOP programs, more than 50% of the apprentices report an interest in URAP (71%), SMART (56%), and NDSEG (59%). A smaller portion of HSAP apprentices are interested in pursuing CQL (39%), and GEMS Near Peers (10%).
HSAP was highly valued by apprentices and mentors alike.	Most apprentices and mentors reported being satisfied with their HSAP experience, including communications from Army Research Office, and the application/ registration process. Mentors reported in the interview that they felt having high school students in their laboratories was a valuable professional development experience.
Outcomes Evaluation	
HSAP apprentices gained STEM knowledge and skills, and expect to use their STEM knowledge and skills extensively in the future.	Apprentices reported large or extreme gains on their knowledge of how professionals work on real problems in STEM, what everyday research work is like in STEM, a STEM topic or field in depth, and research conducted in a STEM topic or field.
	Apprentices reported increased abilities to do STEM, including such things as communicating information about their design processes and/or solutions in different formats and supporting a proposed explanation with relevant scientific, mathematical, and/or engineering knowledge.
HSAP had positive impacts on apprentices' 21st Century Skills.	The majority of responding apprentices reported large or extreme gains in their ability to work collaboratively with a team and to have patience with the slow pace of research.

HSAP positively impacted apprentices' confidence and identity in STEM, and had a significantly higher impact on minority apprentices STEM identity.	An overwhelming majority of apprentices reported large or extreme gains in their preparedness for more challenging STEM activities, confidence to do well in future STEM courses, feeling like part of a STEM community, and feeling responsible for a STEM project or activity.
	All apprentices reported that HSAP had a positive influence on their STEM identify and confidence in doing STEM, however, there was a significant difference based on race/ethnicity with minority apprentices expressing greater impacts on STEM Identity compared to non-minority apprentices
HSAP raised students' education aspirations and positively influenced career aspirations.	After participating in HSAP, responding apprentices indicated being more likely to go further in their schooling than they would have before HSAP, particularly in the pursuit of a terminal degree such as a Ph.D.
	Apprentices were asked to indicate what kind of work they expected to be doing at age 30, with the majority indicating interest in a STEM-related career, both before and after HSAP. However, more apprentices indicated that after HSAP they were more likely to pursue mathematically oriented careers such as engineering and physical science.
HSAP raised apprentice awareness and appreciation of DoD STEM research and careers and how these careers affect the larger community.	Approximately three-quarters of apprentices agree or strongly agree that DoD researchers develop new, cutting edge technologies, solve real-world problems, advance science and engineering fields, and that their research is valuable to society.

Recommendations

Evaluation findings indicate that 2015 was a successful year for the HSAP program. HSAP had a 318% increase in the number of apprentice applicants and had a very competitive 19% acceptance rate of the apprentice applicants, which indicates there is great interest in this program. From the high quality applicants (mentors and apprentices), there were 38 mentors and 49 apprentices selected. HSAP has experienced some success in recruiting diverse apprentices, as half of the respondents to the questionnaire reported a race/ethnicity category other than White. Apprentices and mentors overwhelmingly reported satisfaction with HSAP experience. Mentors indicated they use innovative and research-based strategies to engage apprentices in STEM activities, and by engaging the apprentices; they help graduate students become better educators. The apprentices similarly report increased ability to engage in STEM activities and have STEM identities, due to the HSAP experience. Notably, there was a significant increase based on race/ethnicity with minority apprentices expressing greater impacts on STEM Identity compared to non-minority apprentice. Additionally, engaging in more hands-on STEM experiences motivated the apprentices, which was delivered by their HSAP experience.

While the successes for HSAP 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 FY16 and beyond.

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

1. AEOP objectives include expanding participation of historically underrepresented and underserved populations. Between 2014 and 2015, HSAP has engaged more apprentices who identify with a typically underrepresented group in STEM, which is a positive trend. Additionally, it is positive that the HBCU/MI sites increased from 2 in 2014 to 7 in 2015. Future marketing efforts could focus on the need for a more diverse pool of STEM professionals, and take the opportunity to showcase the diversity of mentors in electronic and printed materials.

2. Similar to past years, in HSAP, recruitment of apprentices is largely accomplished with personal interactions, either by knowing a teacher who is familiar with AEOP or a personal friend who has received an email about HSAP. As a result, the ability of HSAP to recruit underserved or underrepresented populations of students depends upon the diversity of the high schools in which recruitment takes place. Thus, HSAP may want to emphasize recruiting a more diverse pool of mentors and apprentices, perhaps specifically targeting more urban schools or schools who receive Title 1 funding. A focused and strategic plan to engage a more diverse pool of apprentices could ultimately improve the diversity of the STEM pipeline, based on the large impact that HSAP has on STEM knowledge, skills, and identity.

3. HSAP is very effective in giving apprentices authentic opportunities to engage in STEM professional activities, and for mentors to build the next generation of STEM professionals. Mentors are particularly skilled in being able to engage high school students into their laboratory by giving them meaningful learning experiences and asking them to report on their work to graduate students and STEM professionals. Although mentors are particularly skilled in their area of expertise, mentors can be more effective in helping students understand the big picture of how STEM can improve community. Only 54% of mentors reported communicating how STEM can improve community. Only 52% of the mentors highlighted the under-representation of women and racial and ethnic minority populations in STEM as well. Mentors can be provided ways to incorporate how STEM topics affect the larger community in a systematic way by the program, so that the bigger picture of how STEM fits into society can be explicitly emphasized.

4. Similar to recommendation #3, given the goal of exposing apprentices to Army/DoD STEM research and careers, the program may want to build in systematic opportunities to provide this information to their apprentices. More than half of apprentices who completed the survey reported that they did not learn about any DoD STEM jobs/careers during HSAP. Perhaps more importantly, only a few mentors were aware of specific Army/DoD STEM research and careers and even fewer mentors explicitly discussed this with their apprentices. This lack of awareness is a barrier in communicating about Army/DoD STEM research and careers. In an effort to increase and standardize the information provided to apprentices, it would be beneficial to create a resource that profiles Army STEM interests and the education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about Army STEM careers and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific Army/DoD STEM research and careers. The application to be a HSAP site or a mentor could ask for their plan to

explicitly discuss these resources (e.g., Army and directorate STEM career webpages, online magazines, federal application guidelines), thus developing a network of ongoing opportunities for the apprentices.

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

1. Apprentices and mentors who participate in HSAP are only aware in a general way that other programs in AEOP exist. When asked, the mentors and apprentices could not name many of the other AEOP programs. Apprentices rated the HSAP program (88%) and their mentors (89%) at somewhat or very much impactful on their awareness of AEOPs. However, the majority of HSAP apprentices reported not experiencing the AEOP brochure and AEOP social media. Social media efforts, in particular, require constant updates and focused attention on messaging to gain attention. Since most HSAP applicants hear about the program through another individual, having a social media presence may increase the likelihood that an apprentice or mentor may hear about the program from other person who learned about it on Facebook, Twitter, or Pinterest. A recommendation for the FY16 years and beyond would be for the HSAP program mentors to provide time for apprentices to complete the survey during their apprenticeship meeting time. This will provide a more accurate measure to gauge how effective HSAP activities and communications are in growing awareness of AEOPs.

Introduction

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

AEOP Goals

Goal 1: STEM Literate Citizenry.

- Broaden, deepen, and diversify the pool of STEM talent in support of our defense industry base.

Goal 2: STEM Savvy Educators.

- Support and empower educators with unique Army research and technology resources.

Goal 3: Sustainable Infrastructure.

- Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.

This report documents the evaluation of one of the AEOP elements, the Undergraduate Research Apprentice Program (HSAP). HSAP is managed by the U.S. Army Research Office (ARO). The evaluation study was performed by Purdue University in cooperation with Battelle, the Lead Organization (LO) in the AEOP CA consortium. Data analyses and reports were prepared using data collected by the former LO, Virginia Tech (VT).

Program Overview

The High School Apprenticeship Program (HSAP), managed by the U.S. Army Research Office (ARO), is an Army Educational Outreach Program (AEOP) commuter program for high school students who demonstrate an interest in science, technology, engineering, or mathematics (STEM) to work as an apprentice in an Army-funded university or college research laboratory. HSAP is designed so that students (herein called apprentices) can apprentice in fields of their choice with experienced scientists and engineers (S&Es, herein called mentors) during the summer.

Apprentices receive an educational stipend equivalent to $10 per hour, and are allowed to work up to 300 hours total. The apprentices contribute to the research of the laboratory while learning research techniques in the process. This "hands-on" experience gives apprentices a broader view of their fields of interest and shows them what kind of work awaits them in their future career. At the end of the program, the apprentices prepare abstracts for submission to the U.S. Army Research Office's Youth Science Programs office.

In 2015, HSAP was guided by the following priorities:

1. Provide hands-on science and engineering research experience to high school students;
2. Educate students about the Army's interest and investment in science and engineering research and the associated educational opportunities available to students through the AEOP;
3. Provide students with experience in developing and presenting scientific research;
4. Benefit students from the expertise of a scientist or engineer as a mentor; and
5. Develop students' skills and background to prepare them for competitive entry to science and engineering undergraduate programs.

HSAP awards were made at 28 universities or colleges in 17 different U.S. States and one U.S. territory and funded 49 apprentices (see Table 1). Seven of these institutions have Historically Black College and University (HBCU) or Minority-serving (MI) status (denoted with an asterisk below.)

Table 1. 2015 HSAP Sites

2015 HSAP Site	City	State
Alabama State University*	Montgomery	Alabama (AL)
Brown University	Providence	Rhode Island (RI)
City University of New York	New York	New York (NY)
Duke University	Durham	North Carolina (NC)
Hampton University	*Hampton*	*Virginia (VA)*
Marshall	Huntington	West Virginia (WV)
Michigan State University	East Lansing	Michigan (MI)
North Carolina A&T*	Greensboro	North Carolina (NC)
Rutgers	New Brunswick	New Jersey (NJ)
Purdue	West Lafayette	Indiana (IN)
San Diego State University*	San Diego	California (CA)
Stony Brook University	Stony Brook	New York (NY)
Tufts University	Medford	Massachusetts (MA)
University of California, Berkeley	Berkeley	California (CA)
University of California, Irvine	Irvine	California (CA)
University of California, Riverside*	Riverside	California (CA)
University of California, Santa Barbara	Santa Barbara	California (CA)
University of Alabama	Tuscaloosa	Alabama (AL)
University of Arizona	Tucson	Arizona (AZ)
University of Central Florida	Orlando	Florida (FL)
University of Houston, Victoria*	Victoria	Texas (TX)
University of Maryland, College Park	College Park	Maryland (MD)

University of Miami	Coral Gables	Florida (FL)
University of Missouri	Columbia	Missouri (MO)
University of New Hampshire	Durham	New Hampshire (NH)
University of Notre Dame	Notre Dame	Indiana (IN)
University of Puerto Rico*	Rio Piedras	Puerto Rico (PR)
University of Rochester	Rochester	New York (NY)
University of the Incarnate Word*	San Antonio	Texas (TX)

The total cost of the 2015 HSAP program was $148,687.50, including $128,250.00 in stipends. The average cost per HSAP participant was $3,304.17. Table 2 summarizes these and other 2015 HSAP program costs. Funding was provided by ARO program managers with matching funds from AEOP.

Table 2. 2015 HSAP Program Costs	
2015 HSAP - Cost Per Participant	
Total Participants (Apprentices)	49 (45 funded by AEOP and ARO)
Total Cost	$148,687.50
Total Stipends	$128,250.00
Cost Per Participant	**$3,304.17**

Evidence-Based Program Change

AEOP programs are tasked with achieving three broad priorities: (1) STEM Literate Citizenry – Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base; (2) STEM Savvy Educators – Support and empower educators with unique Army research and technology resources; and (3) Sustainable Infrastructure – Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army. ARO initiated the following program changes/additions to the FY15 administration of the HSAP program in light of the AEOP priorities, the FY14 HSAP evaluation study, and site visits conducted by ARO:

I. **STEM Literate Citizenry – Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base.**
   a. HSAP had a substantial increase in applicants and accepted apprentices. At least 267 junior and senior high school students were informed about HSAP, UNITE, and the AEOP website as part of the application process. The HSAP apprentices further were given an “exit letter” inside their Certificate of Completion folder, which highlighted the AEOP pipeline.
   b. Forty-nine junior and senior high school students apprenticed in 28 distinctive Army-funded laboratories over the summer. The ARO facilitated and coordinated the student selection and placement process of the program.

c. An abstract of the work done during HSAP was required to receive a certificate of completion, and the ARO conducted local site visits where students verbally presented their scientific research. Of the 49 HSAP apprentices, at least 11 presented their results in a formal setting.

II. **STEM Savvy Educators – Support and empower educators with unique Army research and technology resources.**

a. Site proposals required resumes for PIs and other site-based mentors at the university locations. The 49 HSAP apprentices were supervised by at least one PI and sometimes more than one mentor during their research in the laboratory.

b. It was requested that PIs familiarize themselves with the AEOP website in the beginning of the student application process. In addition, the PIs were supported with AEOP brochures and marketing materials.

III. **Sustainable Infrastructure – Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army.**

a. A requirement of the proposal for mentors was to identify the educational merit intent for the student apprentice, and this intent statement must meet an educational merit threshold to receive approval. Because of this requirement, mentors and apprentices were well prepared to collaborate at an appropriate level.

b. ARO installed a web-cam on the administrator's computer with the plans to eventually host webinars that could be useful in working with sites to address issues of infrastructure building.

FY15 Evaluation At-A-Glance

Purdue University, in collaboration with AAS and using data collected by Virginia Tech, conducted a comprehensive evaluation of the HSAP program. The HSAP logic model below presents a summary of the expected outputs and outcomes for the HSAP program in relation to the AEOP and HSAP-specific priorities. This logic model provided guidance for the overall HSAP evaluation strategy.

Inputs	Activities	Outputs	Outcomes (Short term)	Impact (Long Term)
• Army and ARO sponsorship • ARO providing oversight of programming • Operations conducted by 28 Army-funded university/college labs (HSAP sites) • Forty-nine students participating in HSAP apprenticeships • Twenty-eight university/college S&Es serve as HSAP mentors • Apprenticeship funds administered to university/college labs to support student participation • Centralized branding and comprehensive marketing • Centralized evaluation	• Students engage in authentic STEM research experiences through hands' on summer apprenticeships at Army-sponsored university/college labs • University/college S&Es supervise and mentor students' research • Program activities that expose students to AEOP programs and/or STEM careers in the Army or DoD	• Number and diversity of student participants engaged in HSAP • Number and diversity of university/college S&Es engaged in HSAP • Number and Title 1 status of high schools served through student engagement • Students, university/college S&Es, and ARO contributing to evaluation	• Increased student STEM competencies (confidence, knowledge, skills, and/or abilities to do STEM) • Increased student interest in future STEM engagement • Increased student awareness of and interest in other AEOP opportunities • Increased student awareness of and interest in STEM research and careers • Increased student awareness of and interest in Army/DoD STEM research and careers • Implementation of evidence-based recommendations to improve HSAP programs	• Increased student participation in other AEOP opportunities and Army/DoD-sponsored scholarship/ fellowship programs • Increased student pursuit of STEM coursework in secondary and post-secondary schooling • Increased student pursuit of STEM degrees • Increased student pursuit of STEM careers • Increased student pursuit of Army/DoD STEM careers • Continuous improvement and sustainability of HSAP

The HSAP evaluation gathered information from apprentice and mentor participants about HSAP processes, resources, activities, and their potential effects in order to address key evaluation questions related to program strengths and challenges, benefits to participants, and overall effectiveness in meeting AEOP and HSAP program objectives.

Key Evaluation Questions

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

The assessment strategy for HSAP included post-program apprentice and mentor questionnaires, individual interviews with four apprentices (1 online and 3 via telephone), and an online focus group with three mentors. Tables 3-6 outline the information collected in apprentice and mentor questionnaires, apprentice interviews, and mentor focus group.

Table 3. 2015 Apprentice Questionnaire

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

Table 4. 2015 Mentor Questionnaire	
Category	**Description**
Profile	**Demographics:** Participant gender, race/ethnicity, occupation, past participation
Satisfaction & Suggestions	Awareness of HSAP, motivating factors for participation, satisfaction with and suggestions for improving the HSAP program, benefits to participants
AEOP Goal 1	**Capturing the Apprentice Experience:** In-program experience
	STEM Competencies: Gains in Knowledge of STEM, Science & Engineering Practices; contribution of AEOP
	Transferrable Competencies: Gains in 21st Century Skills
	AEOP Opportunities: Past participation, awareness of other AEOP programs; efforts to expose apprentices to AEOPs, impact of AEOP resources on efforts; contribution of AEOP in changing apprentice AEOP metrics
	Army/DoD STEM: Attitudes toward Army/DoD STEM research and careers, efforts to expose apprentices to Army/DoD STEM research/careers, impact of AEOP resources on efforts; contribution of AEOP in changing apprentice Army/DoD career metrics
AEOP Goal 2 and 3	**Mentor Capacity:** Perceptions of mentor/teaching strategies
	Comprehensive Marketing Strategy: How mentors learn about AEOP, usefulness of AEOP resources on awareness of AEOPs and Army/DoD STEM research and careers

Table 5. 2015 Apprentice Interviews	
Category	**Description**
Profile	Gender, race/ethnicity, grade level, past participation in HSAP, past participation in other AEOP programs
Satisfaction & Suggestions	Awareness of HSAP, motivating factors for participation, involvement in other science programs in addition to HSAP, satisfaction with and suggestions for improving the HSAP program, benefits to participants
AEOP Goal 1 and 2 Program Efforts	**AEOP Opportunities:** Extent to which apprentices were exposed to other AEOP opportunities
	Army/DoD STEM: Extent to which apprentices were exposed to STEM and Army/DoD STEM jobs

Table 6. 2015 Mentor Focus Group	
Category	**Description**
Profile	Gender, race/ethnicity, occupation, organization, role in HSAP, past participation in HSAP, past participation in other AEOP programs
Satisfaction & Suggestions	Perceived value of HSAP, benefits to apprentices, benefits to mentors, suggestions for improving the HSAP program
AEOP Goal 1 and 2 Program Efforts	**AEOP Opportunities:** Efforts to expose apprentices to AEOP opportunities
	Army/DoD STEM Careers: Efforts to expose apprentices to STEM and Army/DoD STEM jobs
	Mentor Capacity: Strategies used to increase diversity/support diversity in HSAP

Detailed information about methods and instrumentation, sampling and data collection, and analysis are described in Appendix A, the evaluation plan. The reader is strongly encouraged to review Appendix A to clarify how data are summarized, analyzed, and reported in this document. Respective data summaries are provided in Appendix B (apprentice) and Appendix C (mentor). The apprentice and the mentor interview protocol is provided in Appendix D, the apprentice questionnaire is provided in Appendix E, and the mentor questionnaire is provided in Appendix F. Major trends in data and analyses are reported herein.

Study Sample

Table 7 provides a display of apprentice and mentor participation in the HSAP program by university. There were 49 apprentices placed with 35 different mentors at 28 universities. Seven of these universities are identified as historically Black colleges and universities (HBCUs) or minority serving status (MIs). The number of apprentices has increased 5-fold from the 2014 HSAP program.

Table 7. 2015 HSAP Site Survey Participant Numbers

2015 HSAP Site	Apprentices	Mentors
	No. of Participants	No. of Participants
Alabama State University*	1	1
Brown University	1	1
City University of New York	1	1
Duke University	3*	1
Hampton University*---	0	0
Marshall	1	1
Michigan State University	1	1
North Carolina A&T*	6	4
Rutgers	1	1
Purdue	1	1
San Diego State University*	1	1
Stony Brook University	2	1
Tufts University	2	1
University of California, Berkeley	1	1
University of California, Irvine	1	1
University of California, Riverside*	4*	3
University of California, Santa Barbara	4	2
University of Alabama	1	1
University of Arizona	1	1
University of Central Florida	5*	2

University of Houston, Victoria*	1	1
University of Maryland, College Park	1	1
University of Miami	2	1
University of Missouri	2	1
University of New Hampshire	1	1
University of Notre Dame	1	1
University of Puerto Rico*	1*	1
University of Rochester	1	1
University of the Incarnate Word*	1	1
Total	**49**	**35**
	**A student is NOT ARO/AEOP funded*	

The response rate for the post-program apprentice survey was good at 72%, but was down from 80% response rate in 2014. However this is a marked improvement from a 63% response rate in FY13. The response rate for the mentor survey was much higher than 29% in 2014 at 61% in 2015. Although both apprentice and mentor response rates were above 50%, they still have a large margin of error in terms of being able to generalize from the sample to the HSAP population.

Table 8. 2015 HSAP Questionnaire Participation

Participant Group	Respondents (Sample)	Total Participants (Population)	Participation Rate	Margin of Error @ 95% Confidence[1]
Apprentices	35	49	72%	±8.7%
Mentors	25	41	61%	±9.2%

Individual interviews were conducted with eight apprentices (3 females, 5 males and 5 Asian, 2 White, 1 Hispanic). Participants ranged from rising 10th graders to rising college freshmen. Eight mentor interviews were also conducted. The interviews were not intended to yield generalizable findings; rather they were intended to provide additional evidence of, explanation for, or illustrations of apprentice questionnaire data. They add to the overall narrative of HSAP's efforts and impact, and highlight areas for future exploration in programming and evaluation.

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

Respondent Profiles

Apprentice Demographics

Demographic information collected from HSAP apprentice questionnaire respondents is summarized in Table 9.[2] Approximately equal numbers of males and females completed the questionnaire. More responding apprentices identified with the race/ethnicity category of White (48%) than any other single race/ethnicity category. Respondents ranged from rising 10th graders to rising college freshmen.

Findings revealed HSAP experienced success in attracting participation from female students—a population that is historically underrepresented in many STEM fields. HSAP also had success in providing outreach to students from historically underrepresented and underserved race/ethnicity and low-income groups, as approximately half of the respondents reported being in a race/ethnicity category other than White.

Table 9. 2015 HSAP Apprentice Respondent Profile

Demographic Category	Questionnaire Respondents	
Respondent Gender (n = 35)		
Female	14	40%
Male	19	54%
No Response	2	6%
Respondent Race/Ethnicity (n = 35)		
Asian	8	23%
Black or African American	2	6%
Hispanic or Latino	4	11%
Native American or Alaska Native	0	0%
Native Hawaiian or Other Pacific Islander	1	3%
White	17	48%
Other race or ethnicity, (specify):†	1	6%
Choose not to report	2	3%
Respondent Grade Level (n = 35)		
10th	1	3%
11th	21	60%
12th	11	31%
Choose not to report	2	6%

[2] In FY15 the AEOP developed and implemented a new application tool through the vendor, Cvent. This centralized tool will facilitate accurate and improved collection of demographic information from participants across the portfolio of AEOP initiatives.

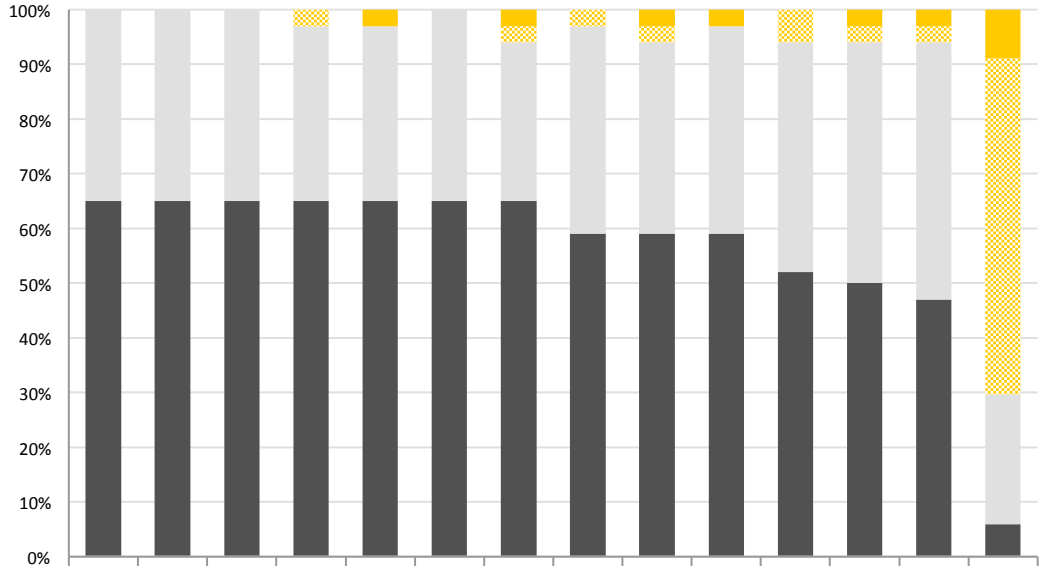
Demographic information collected from HSAP mentor questionnaire respondents is summarized in Table 10. In 2014 only 2 mentors responded to the questionnaire, so it is difficult to make comparisons from year to year. It is notable that the response rate for the 2015 questionnaire was greatly increased. The 2015 demographic information indicated that like the apprentices, approximately half of the mentors were from race/ethnicity categories other than White. Having a diverse group of mentors is necessary for providing role models for apprentices who come from typically underrepresented groups in STEM.

Table 10. 2015 HSAP Mentor Respondent Profile

Demographic Category	Questionnaire Respondents	
Respondent Gender (n = 41)		
Female	7	17%
Male	34	83%
No Response	0	0%
Respondent Race/Ethnicity (n = 41)		
Asian	16	39%
Black or African American	2	5%
Hispanic or Latino	3	7%
Native American or Alaska Native	0	0%
Native Hawaiian or Other Pacific Islander	0	0%
White	20	49%
No Response	0	0%
Respondent Occupation (n = 41)		
University educator	20	59%
Scientist, Engineer, or Mathematician in training (undergraduate or graduate apprentice, etc.)	7	21%
Scientist, Engineer, or Mathematics professional	5	15%
Other, (specify):	2	6%
Respondent Role in HSAP (n = 41)		
Research Mentor	38	93%
Research Team Member but not a Principal Investigator	3	7%
Other, (specify) †	0	0%

In order to determine the effectiveness of the AEOP pipeline, apprentices were asked about their participation in other programs in AEOP. Chart 1 displays their responses. Approximately one-third of respondents indicated that they participated in other AEOP programs, URAP being the most frequent. It appears that there is an increase in participation over the years across the AEOP portfolio.

Chart 1: Student Participation in AEOP Programs (n = 33-34)



	Camp Invention	eCYBERMISSION	Junior Solar Sprint (JSS)	Gains in the Education of Mathematics and Science (GEMS)	GEMS Near Peers	UNITE	College Qualified Leaders (CQL)	Junior Science & Humanities Symposium (JSHS)	Science & Engineering Apprenticeship Program (SEAP)	National Defense Science & Engineering Graduate (NDSEG) Fellowship	Research & Engineering Apprenticeship Program (REAP)	High School Apprenticeship Program (HSAP)	Science Mathematics, and Research for Transformation (SMART) College Scholarship	Undergraduate Research Apprenticeship Program (URAP)
Three or more times	0%	0%	0%	0%	3%	0%	3%	0%	3%	3%	0%	3%	3%	9%
Twice	0%	0%	0%	3%	0%	0%	3%	3%	3%	0%	6%	3%	3%	62%
Once	35%	35%	35%	32%	32%	35%	29%	38%	35%	38%	42%	44%	47%	24%
Never	65%	65%	65%	65%	65%	65%	65%	59%	59%	59%	52%	50%	47%	6%

Actionable Program Evaluation

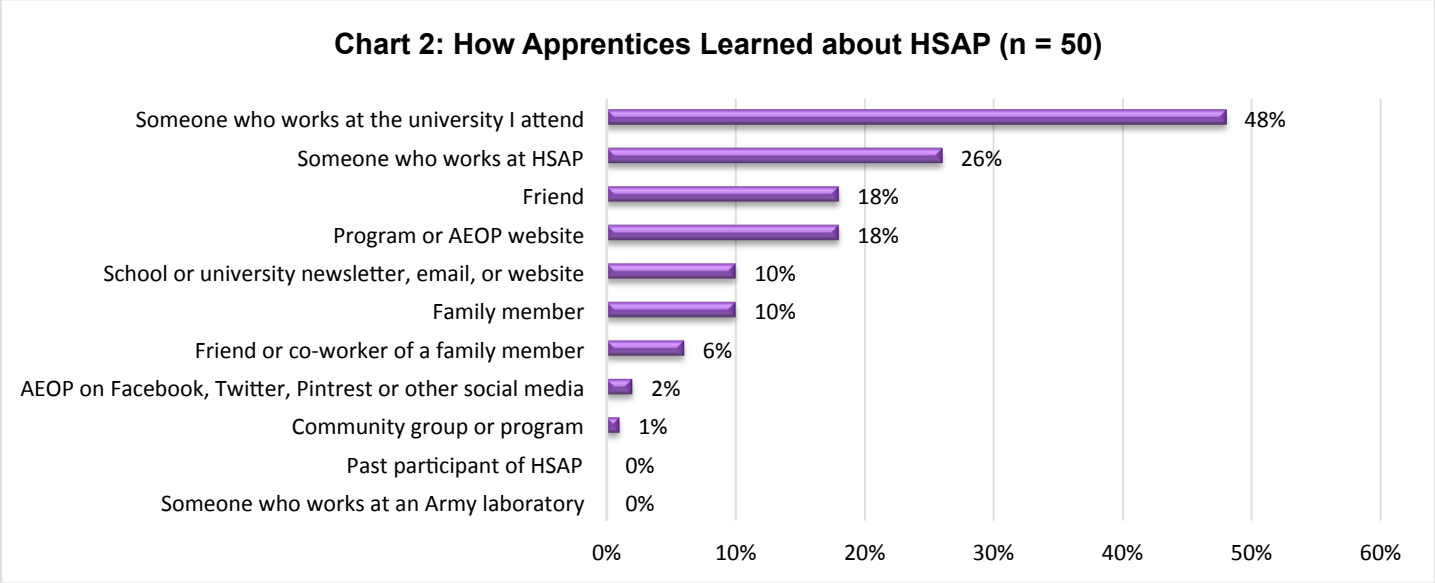
The Actionable Program Evaluation provides information about tangible changes that can be made to improve programs. Actionable Program Evaluation is intended to provide assessment and evaluation of program processes, resources, and activities for the purpose of recommending improvements as the program moves forward. This section highlights information outlined in the Satisfaction & Suggestions sections of Tables 3-6.

Efforts toward the long-term goal of HSAP to increase and diversify the future pool of talent capable of contributing to the nation's scientific and technology progress is realized in the Actionable Program Evaluation. HSAP sites reach out to students of traditionally underrepresented and underserved populations. Thus, it is important to consider how HSAP is marketed and ultimately recruits student participants, the factors that motivate students to participate in HSAP, participants' perceptions of and satisfaction with activities, what value participants place on program activities, and what recommendations participants have for program improvement. The following sections report perceptions of apprentices and mentors that pertain to current programmatic efforts and recommend evidence-based improvements to help HSAP achieve outcomes related to AEOP programs and objectives.

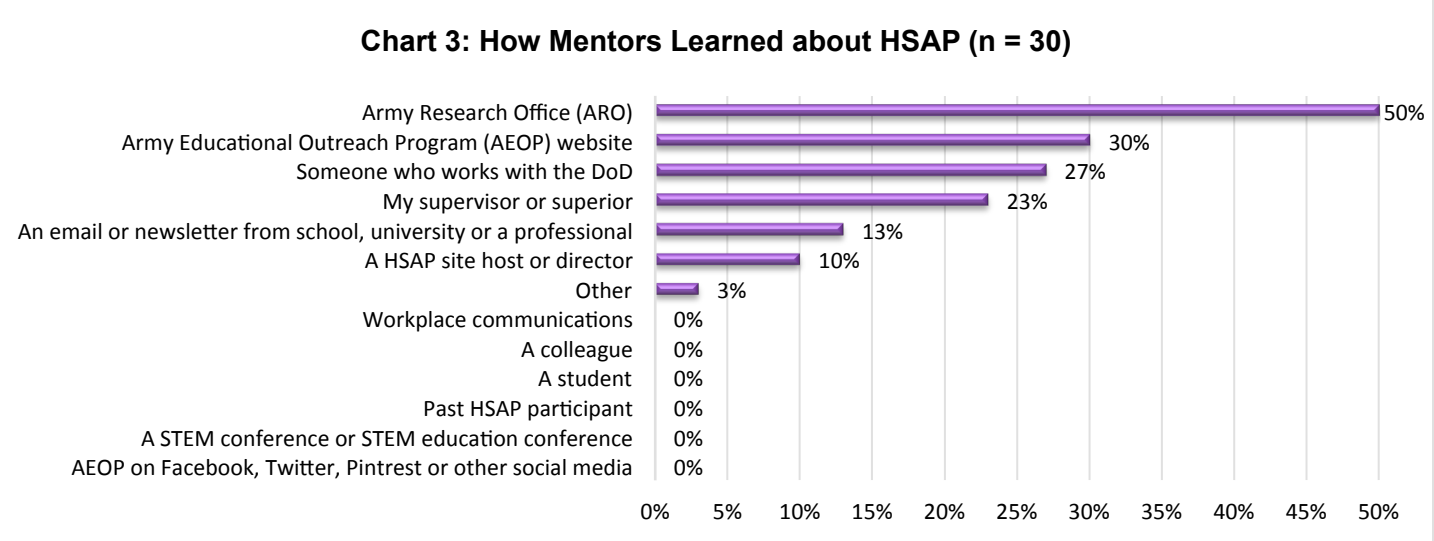
Marketing and Recruiting Underrepresented and Underserved Populations

The solicitation of host sites and students was a focus in the marketing and recruiting of underrepresented and underserved populations. ARO, the manager of HSAP as well as the Undergraduate Research Apprenticeship Program (URAP), invited ARO-funded principal investigators at university and college laboratories nationwide to apply for the opportunity to host HSAP and/or URAP apprentices. Once the host labs were selected, HSAP apprenticeships were marketed to students in the following ways: together with the AEOP portfolio of opportunities on the AEOP website, print materials, and social media; targeted marketing through email to high school in proximity to HSAP opportunities; and through targeted distribution of marketing materials at regional STEM events, including the Junior Science & Humanities Symposium (JSHS). It is unclear how these marketing and recruiting efforts targeted underrepresented and underserved student and mentor populations.

HSAP applicants were asked to identify all of the different ways they heard about HSAP in order to understand which recruitment methods are most effective. Chart 2 shows that someone who works at the university (48%) and someone who works at HSAP were the most frequently mentioned sources of information about HSAP. Other responses include hearing about HSAP from a friend (18%) and from the Program or AEOP website (18%).



Mentors were asked how they learned about HSAP on their submitted proposals. Chart 3 displays their responses, which indicate that the ARO (50%) was the most prominent source of information about HSAP. The other frequent responses include the AEOP website (30%), someone who works for the DoD (27%) and a supervisor or superior (23%). Conferences and social media were not sources of information for the mentors about HSAP.



Factors Motivating Apprentice Participation

In order to understand the students who apply to be HSAP apprentices, the HSAP application asked what motivated apprentices to decide to participate in the program. Table 10 shows that all the most frequent motivation was an

interest in STEM (70%), a desire to learn something new or interesting (46%), and a desire to expand laboratory or research skills (44%). It appears that the HSAP apprentices are self-motivated because there was a low or zero frequency of responses such as being motivated by teacher encouragement or a program mentor.

Table 11. Factors Which Were Very Motivating for Apprentices to Participate in HSAP (n = 50)

Item	Questionnaire Respondents
Teacher or professor encouragement	1 (2%)
An academic requirement or school grade	0 (0%)
Desire to learn something new or interesting	23 (46%)
The program mentor(s)	1 (2%)
Building college application or resume	10 (20%)
Networking opportunities	2 (4%)
Interest in science, technology, engineering, or mathematics (STEM)	35 (70%)
Interest in STEM careers with the Army	6 (12%)
Having fun	3 (6%)
Earning stipends or awards for doing STEM	2 (4%)
Opportunity to do something with friends	0 (0%)
Opportunity to use advanced laboratory technology	11 (22%)
Desire to expand laboratory or research skills	22 (44%)
Learning in ways that are not possible in school	16 (32%)
Serving the community or country	3 (6%)
Recommendations of past participants	0 (0%)
Figuring out education or career goals	8 (16%)
Exploring a unique work environment	5 (10%)
Seeing how school learning applies to real life	2 (4%)
Other	0 (0%)

Similar data appeared in the interviews with the apprentices. The following three apprentices spoke about their interest in STEM topics and how HSAP helped them expand on their interests and prepare for careers. In the words of three apprentices:

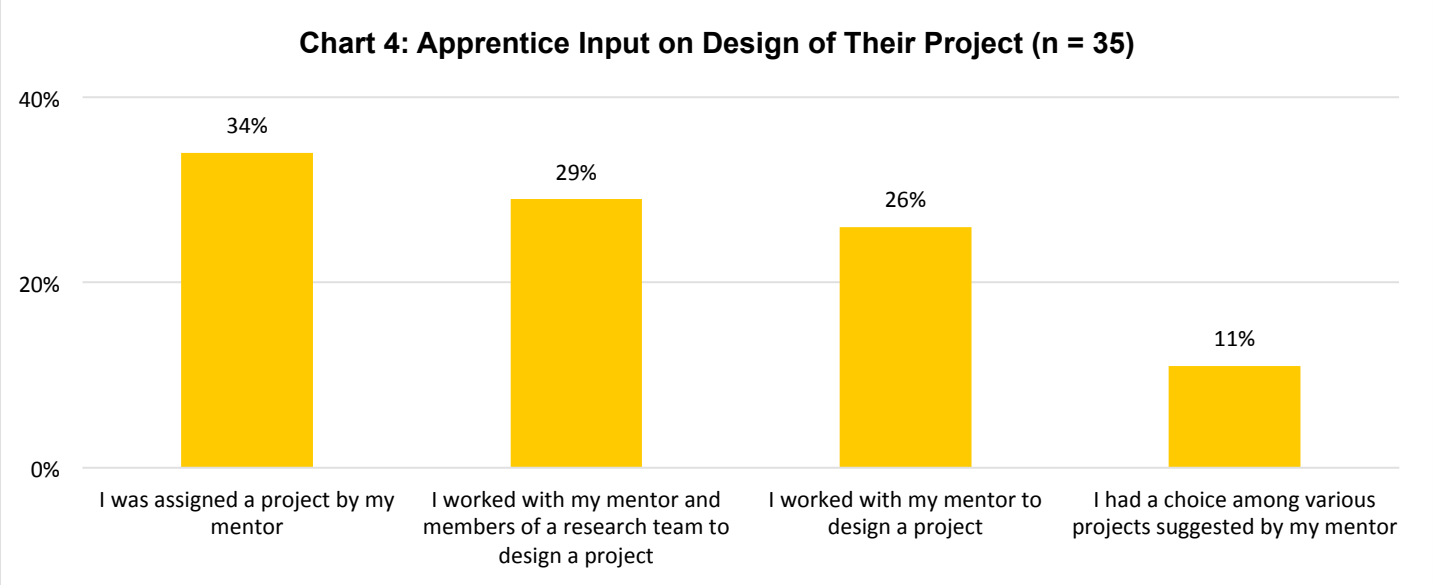
> *I love science. I love participating in experiments. I have always enjoyed science. I have always done well in my science classes. The physics class that we have in our school, we don't have that many experiments and I wanted to get more out of that. I wanted to understand scientific process, scientific investigation, and that sort of stuff, so I looked around and I found HSAP. (HSAP Apprentice)*

Being close to a research environment would definitely give me an edge, in terms of like, undergraduate time, like having created abstracts, having created experiments, having created presentations, definitely. (HSAP Apprentice)

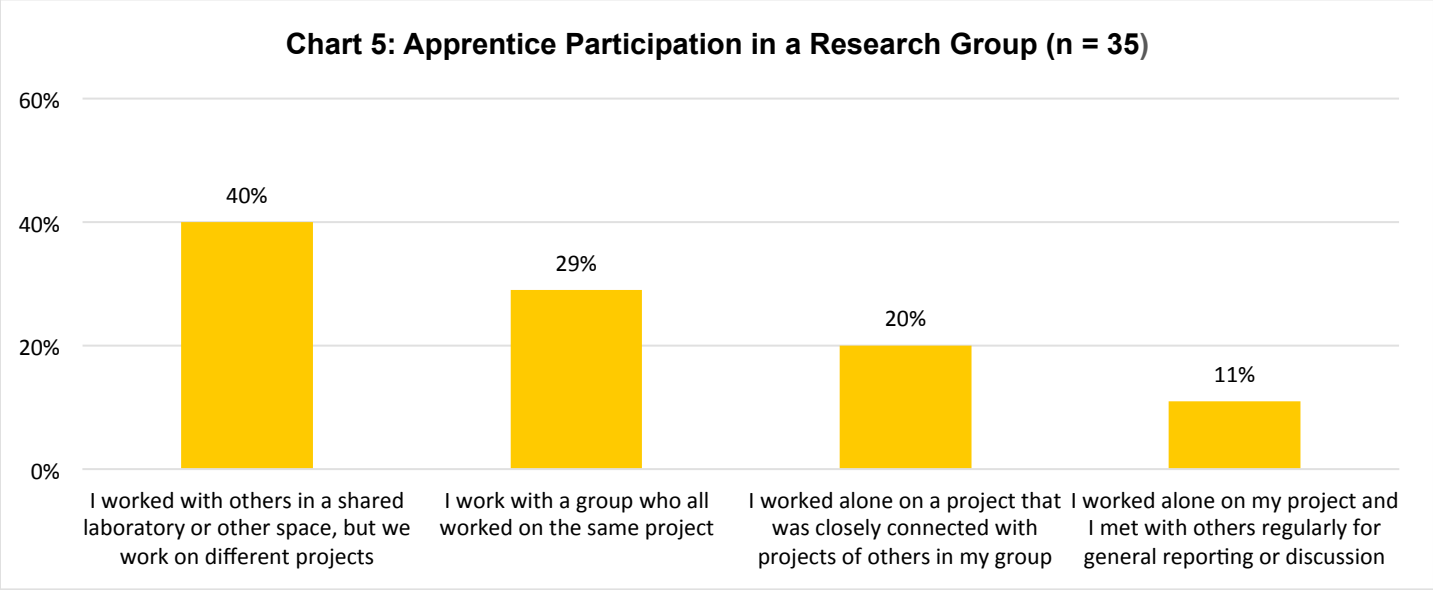
I've done some other like pre-college programs and everything, but I wanted something that would get me more involved. Get a better idea of what research is out there, and what I will actually do to contribute. Especially, when I get to the university level, maybe what I can look into myself. (HSAP Apprentice)

The HSAP Experience

The intent of HSAP is to provide high school students with STEM experiences they wouldn't normally obtain in schools and many of the evaluation survey items focused on the HSAP experience specifically. For instance, the apprentice questionnaire included several items asking about the nature of apprentices' input on their project. The most frequent response was that the apprentice was assigned a project by their mentor (34%), followed by working with a mentor and members of a research team (29%) and working with a mentor to design a project (26%). Only 11% of apprentices had a choice among various projects suggested by their mentors.

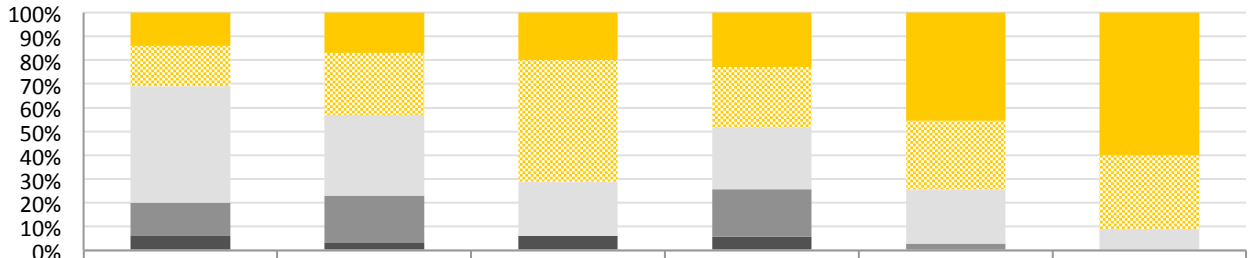


Forty percent of responding apprentices reported working with others in a shared laboratory space but on separate projects, and 29% reported that they worked in a group on the same project. The remaining 31% worked alone and were either closely connected with other projects or met regularly for discussion (see Chart 5).



In order to get a better understanding of the activities apprentices experienced in HSAP, apprentices were asked a series of questions about what their HSAP experience focused on. Chart 6 shows the 91% of apprentices on most days or every day communicated with other students about STEM. Similarly, 75% of the HSAP program learned about new STEM topics and 71% applied this new knowledge to real life situations on most days or every day.

Chart 6: Nature of Apprentice Activities in HSAP (n = 35)



	Learn about different STEM careers	Learn about cutting-edge STEM research	Apply STEM knowledge to real life situations	Interact with STEM professionals	Learn about new science, technology, engineering, or mathematics (STEM) topics	Communicate with other students about STEM
Every day	14%	17%	20%	23%	46%	60%
Most days	17%	26%	51%	26%	29%	31%
A few times	49%	34%	23%	26%	23%	9%
At least once	14%	20%	0%	20%	3%	0%
Not at all	6%	3%	6%	6%	0%	0%

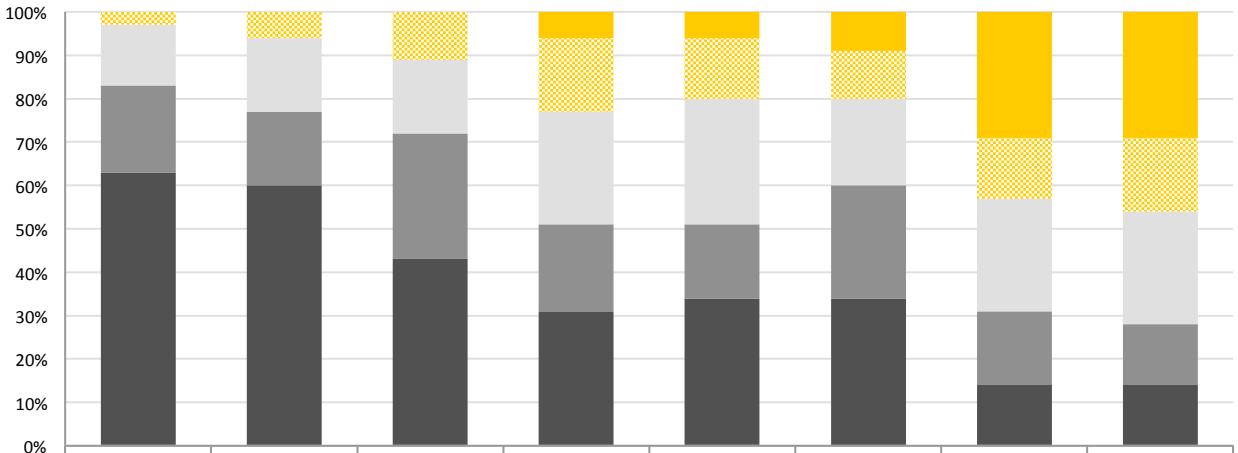
One goal of the HSAP program is to increase the number and diversity of students who purse STEM careers. Therefore, questions on the apprentice questionnaire asked about the number of jobs/careers in STEM in general and specifically STEM jobs/careers in the DoD that apprentices learned about during their experience. Table 12 shows that 91% HSAP apprentices learned about at least one general STEM job/career, but only 62% learned about at least one specific DoD STEM job/career.

Table 12. Number of STEM Jobs/Careers Apprentices Learned about During HSAP (n = 35)

	STEM Jobs/Careers	DoD STEM Jobs/Careers
None	9%	38%
1	9%	20%
2	20%	14%
3	14%	14%
4	5%	0%
5 or more	43%	14%

To better understand the channel of communication about DoD STEM careers, apprentices were asked which resources impacted their awareness of DoD STEM careers. Chart 7 shows that there was little overall impact of resources on apprentice awareness of DoD STEM careers, and that only 46% of HSAP apprentices felt that their participation in the program impacted their awareness and 43% felt that their mentors impacted their awareness.

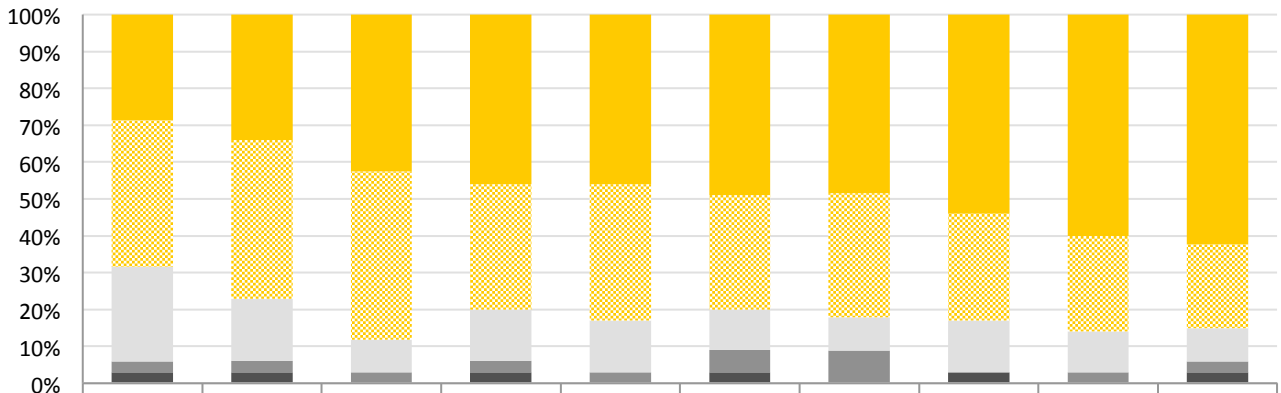
Chart 7: Impact of Resources on Apprentice Awareness of DoD STEM Careers (n = 35)



	AEOP social media	AEOP brochure	Invited speakers or "career" events	Army Educational Outreach Program (AEOP) website	AEOP instructional supplies (Rite in the Rain notebook, Lab Coat)	Army Research Office website	My mentor(s)	Participation in HSAP
Very Much	0%	0%	0%	6%	6%	9%	29%	29%
Somewhat	3%	6%	11%	17%	14%	11%	14%	17%
A little	14%	17%	17%	26%	29%	20%	26%	26%
Not at all	20%	17%	29%	20%	17%	26%	17%	14%
Did not experience	63%	60%	43%	31%	34%	34%	14%	14%

Apprentices were asked how often they engaged in various STEM practices during HSAP. Results in Chart 8 indicate that apprentices were very actively engaged in doing STEM during the HSAP program. The entire STEM practices were experienced by the HSAP apprentices the majority of most days or every day. The most frequently experienced STEM practice was drawing conclusions from an investigation (89%) and participating in hands-on STEM activities (86%).

Chart 8: Apprentice Engagement in STEM Practices in HSAP (n = 35)



	Design an investigation	Come up with creative explanations or solutions	Draw conclusions from an investigation	Carry out an investigation	Build (or simulate) something	Pose questions or problems to investigate	Analyze and interpret data or information	Work as part of a team	Participate in hands-on STEM activities	Practice using laboratory or field techniques, procedures, and tools
Every day	29%	34%	43%	46%	46%	49%	49%	54%	60%	63%
Most days	40%	43%	46%	34%	37%	31%	34%	29%	26%	23%
A few times	26%	17%	9%	14%	14%	11%	9%	14%	11%	9%
At least once	3%	3%	3%	3%	3%	6%	9%	0%	3%	3%
Not at all	3%	3%	0%	3%	0%	3%	0%	3%	0%	3%

A composite score[3] was calculated for each of these two sets of items, the first titled "Learning about STEM in HSAP,"[4] and the second "Engaging in STEM Practices in HSAP."[5] Response categories were converted to a scale of 1 = "Not at all" to 5 = "Every day" and the average across all items in the scale was calculated. The composite scores were used to test whether there were differences in apprentice experiences by gender and race/ethnic group (minority vs. non-minority apprentices). There were no significant differences by gender or race/ethnicity.

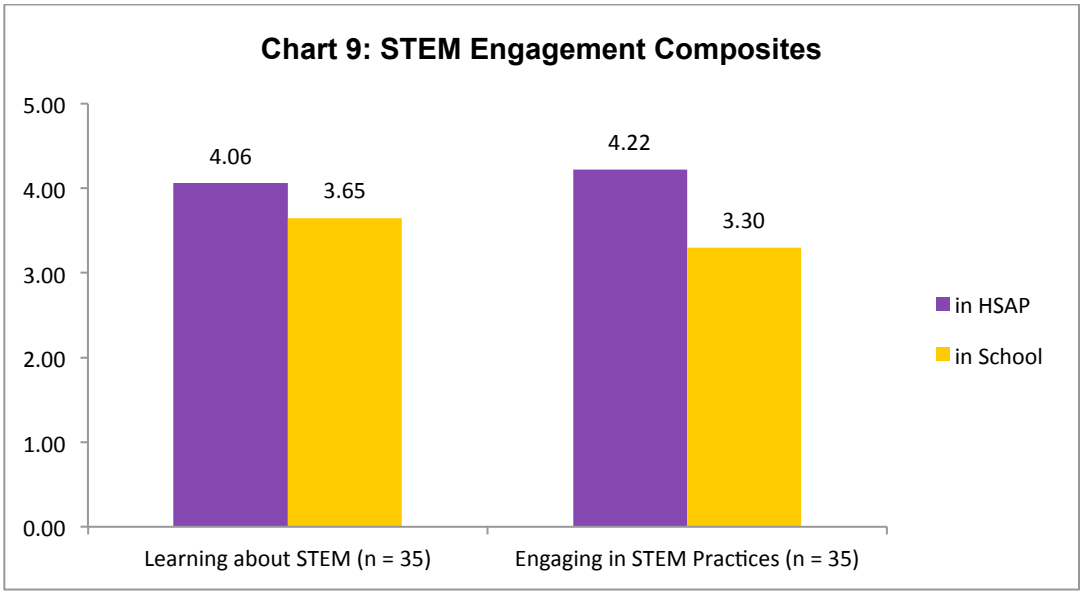
To examine how the HSAP experience compares to their typical school experience, apprentices were asked how often they engaged in the same activities in school (individual item responses can be found in Appendix B). These responses

[3] Using multiple statistical tests on related outcomes requires the use of a Type I error rate adjustment to reduce the likelihood of false positives (i.e., detecting a difference when one does not truly exist). However, Type I error rate adjustments lead to a reduction in statistical power (i.e., the ability to detect a difference if it does exist). The use of a composite score helps avoid both of these problems by reducing the total number of statistical tests used. In addition, composite scores are typically more reliable than individual questionnaire items.

[4] The Cronbach's alpha reliability for these 6 items was 0.642.

[5] The Cronbach's alpha reliability for these 10 items was 0.870.

were also combined into two composite variables: "Learning about STEM in School,"[6] and "Engaging in STEM Practices in School"[7] that are parallel to the ones asking about HSAP. As can be seen in Chart 9, scores were significantly higher on the "in HSAP" versions of both composites than on the in school versions (large effects[8] of d = 2.76 standard deviations and d = 2.13 standard deviations).[9] These data indicate that HSAP provides apprentices with more intensive STEM learning experiences than they would typically receive in school.



The Role of Mentors

Mentors were asked about the strategies they used to establish relevance of learning activities during the HSAP experience. Table 13 shows that most of the strategies listed on the questionnaire were reportedly used by 75% or more of the mentors and in the case of becoming familiar with apprentices' backgrounds, 100% of mentors performed this strategy. Only 54% of the mentors used the strategies of understanding how STEM can help them improve their own community.

[6] The Cronbach's alpha reliability for these 6 items was 0.758.

[7] The Cronbach's alpha reliability for these 10 items was 0.849.

[8] Effect sizes are used to facilitate comparison of the magnitude of differences across different outcomes and/or studies by putting differences on a standardized metric. For difference between means, effect size is calculated as Cohen's d: the difference in means of the two groups divided by the pooled standard deviation. For Cohen's d, effect sizes of about 0.20 are typically considered small, 0.50 medium, and 0.80 large. Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates.

[9] Two-tailed dependent samples t-tests: Learning about STEM, $t(34) = 8.05$, $p < 0.001$; Engaging in STEM Practices, $t(34) = 6.21$, $p < 0.001$

Table 13. Mentors Using Strategies to Establish Relevance of Learning Activities (n = 24-25)	
Item	**Questionnaire Respondents**
Become familiar with my student(s) background and interests at the beginning of the HSAP experience	100%
Giving students real-life problems to investigate or solve	92%
Selecting readings or activities that relate to students' backgrounds	88%
Encouraging students to suggest new readings, activities, or projects	80%
Helping students become aware of the role(s) that STEM plays in their everyday lives	75%
Asking students to relate real-life events or activities to topics covered in HSAP	71%
Helping students understand how STEM can help them improve their own community	54%

One of the goals of HSAP is to encourage typically underrepresented students to participate in STEM activities. Therefore, mentors were asked which strategies they used to support the diverse needs of students as learners. As Table 14 shows, more than 80% of the mentors used 5 of the 7 strategies listed on the questionnaire, and 100% of the mentors provided extra readings, activities, or learning support for students who lack essential background skills and knowledge. Only 52% of the mentors highlighted the under-representation of woman and racial and ethnic minority populations in STEM.

Table 14. Mentors Using Strategies to Support the Diverse Needs of Students as Learners (n = 24-25)	
Item	**Questionnaire Respondents**
Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	100%
Use a variety of teaching and/or mentoring activities to meet the needs of all students	96%
Interact with students and other personnel the same way regardless of their background	88%
Identify the different learning styles that my student (s) may have at the beginning of the HSAP experience	83%
Directing students to other individuals or programs for additional support as needed	84%
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	54%
Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	52%

In a laboratory environment, it is important to be able to work with a variety of people. Mentors were asked which strategies they used to support student development of collaboration and interpersonal skills. The majority of the mentors engaged in all of the strategies mentioned on the survey, and 100% of the mentors reported helping students give and receive constructive feedback, and work on collaborative activities, as seen in Table 15.

Table 15. Mentors Using Strategies to Support Student Development of Collaboration and Interpersonal Skills (n = 25)	
Item	**Questionnaire Respondents**
Having my student(s) give and receive constructive feedback with others	100%
Having students work on collaborative activities or projects as a member of a team	100%
Having my student(s) explain difficult ideas to others	96%
Having my student(s) listen to the ideas of others with an open mind	96%
Allowing my student(s) to resolve conflicts and reach agreement within their team	88%
Having my student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	80%
Having my student(s) tell other people about their backgrounds and interests	72%

The qualitative information obtained from mentor interviews confirms the mentor's use of strategies to help apprentices collaborate and work as a member of a team. As explained by two mentors below, collaborating does not only offer practice in 21st century skills, but also helps the apprentices obtain STEM knowledge.

> [When you first enter the lab environment] *it is overwhelming hearing people speak in jargon that sounds like another language. I think it's intimidating but I think it's a great experience because by the time they're done they're not intimidated any more. They understand what it's like to do research at university level and it really helps focus them on their STEM career paths. (HSAP mentor)*

> *For example, in our project we learned different computer language coding, some physics -- our project was in physics but, physics concepts -- quantum mechanics, physical mechanics. It's the value of the actual knowledge. It is knowledge. It's the type, it's that concept. We experienced the process by which research is done. They interacted with college students. They participated in these meetings so they could see how research was done. We gave several presentations. We wrote a little report. We learned a little bit about communicating science. I think it has a lot of different levels. (HSAP mentor)*

Table 16 shows results from mentors reporting which strategies they used to support student engagement in authentic STEM activities. Mentors were very strong in using all of the strategies, and 96% to 100% of the mentors reported using all of the strategies listed on the questionnaire.

Table 16. Mentors Using Strategies to Support Student Engagement in "Authentic" STEM Activities (n = 25)	
Item	**Questionnaire Respondents**
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	100%
Supervising my student(s) while they practice STEM research skills	100%
Providing my student(s) with constructive feedback to improve their STEM competencies	100%
Allowing students to work independently to improve their self-management abilities	100%
Teaching (or assigning readings) about specific STEM subject matter	96%
Having my student(s) search for and review technical research to support their work	96%
Encouraging students to learn collaboratively (team projects, team meetings, journal clubs, etc.)	96%
Encouraging students to seek support from other team members	96%

Mentors were asked which strategies they used to support student STEM educational and career pathways in order to determine the effectiveness of the HSAP program in demonstrating to students their choices in the STEM pipeline. At least half of the mentors used all of the strategies to support STEM educational and career pathways. Notably, 100% of the mentors provided guidance to the apprentices for a STEM career, but only 50% of the mentors recommended AEOP that aligned with student goals.

Table 17. Mentors Using Strategies to Support Student STEM Educational and Career Pathways (n = 24-25)	
Item	**Questionnaire Respondents**
Providing guidance about educational pathways that will prepare my student(s) for a STEM career	100%
Asking my student(s) about their educational and/or career goals	96%
Discussing STEM career opportunities in private industry or academia	92%
Recommending extracurricular programs that align with students' goals	75%
Helping students build a professional network in a STEM field	72%
Discussing the economic, political, ethical, and/or social context of a STEM career	64%
Discussing STEM career opportunities within the DoD or other government agencies	60%
Recommending student and professional organizations in STEM to my student(s)	60%
Helping my student(s) with their resume, application, personal statement, and/or interview preparations	60%
Recommending Army Educational Outreach Programs that align with students' goals	50%

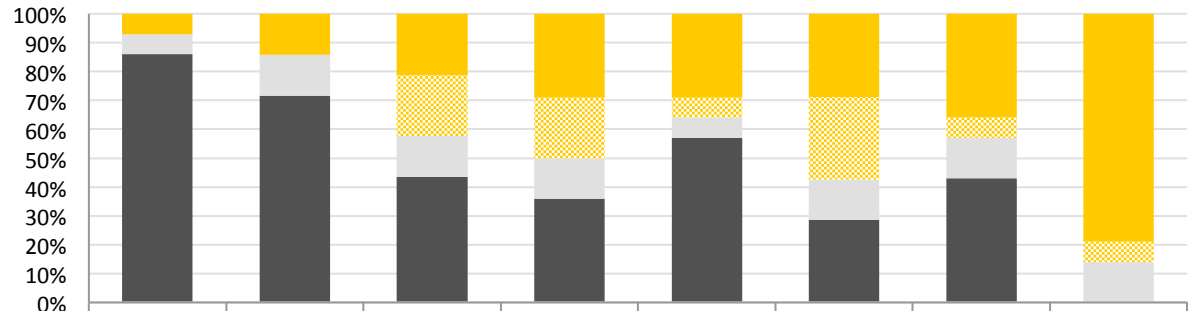
Because a goal of the AEOP is to generate interest in other AEOP programs, mentors were asked which program they explicitly discussed with apprentices. Compared to the mentor response regarding STEM skills, mentors reported lower frequencies across all programs, as displayed in Table 18. The most frequently discussed programs were HSAP (79%) and

URAP (67%). Almost half (48%) of the mentors reported that they only discussed AEOP in a general way, and did not discuss any program.

Table 18. Mentors Explicitly Discussing AEOPs with Apprentices (n = 23-24)	
Item	**Questionnaire Respondents**
High School Apprenticeship Program (HSAP)	79%
Undergraduate Research Apprenticeship Program (URAP)	67%
I discussed AEOP with my student(s) but did not discuss any specific program	48%
Research & Engineering Apprenticeship Program (REAP)	25%
Gains in the Education of Mathematics and Science (GEMS)	21%
Science & Engineering Apprenticeship Program (SEAP)	17%
Science Mathematics, and Research for Transformation (SMART) College Scholarship	17%
National Defense Science & Engineering Graduate (NDSEG) Fellowship	17%
College Qualified Leaders (CQL)	9%
GEMS Near Peer Mentor Program	8%
Junior Science & Humanities Symposium (JSHS)	4%
UNITE	0%

To better understand the sources of information about AEOP awareness, mentors were asked which resources were helpful in exposing apprentices to AEOPs. As Chart 10 shows, by far, participation in HSAP was the most useful with 86% of the mentors reporting it was somewhat or very much useful. AEOP instructional supplies were also reported to be somewhat or very much useful (58%). Other sources were reported by less than half of the mentors as being somewhat or very much useful. Social media and invited speakers were reported to be the least useful or not experienced.

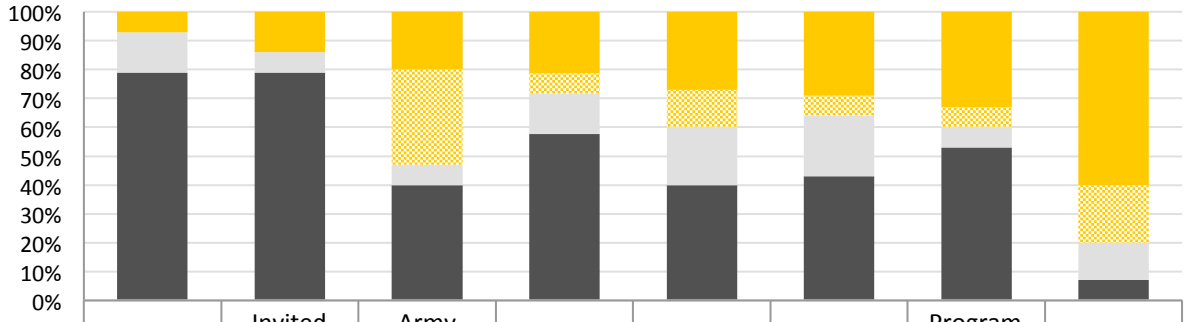
Chart 10: Usefulness of Resources for Exposing Apprentices to AEOPs (n = 14-15)



	Invited speakers or "career" events	AEOP social media	Army Research Office website	AEOP website	AEOP brochure	AEOP instructional supplies	Program administrator or site coordinator	Participation in HSAP
Very Much	7%	14%	21%	29%	29%	29%	36%	79%
Somewhat	0%	0%	21%	21%	7%	29%	7%	7%
A little	7%	14%	14%	14%	7%	14%	14%	14%
Not at all	0%	0%	0%	0%	0%	0%	0%	0%
Did not experience	86%	71%	43%	36%	57%	29%	43%	0%

Mentors were asked to share which resources were useful for exposing apprentices to DoD STEM careers. The results in Chart 11 show that participation in HSAP was somewhat or very much useful to 80% of the mentors. Likewise, the ARO website was found to be useful by 53% of the mentors. Other resources were found to be less useful or not experienced, such as invited speakers and social media.

Chart 11: Usefulness of Resources for Exposing Apprentices to DoD STEM Careers (n = 14-15)

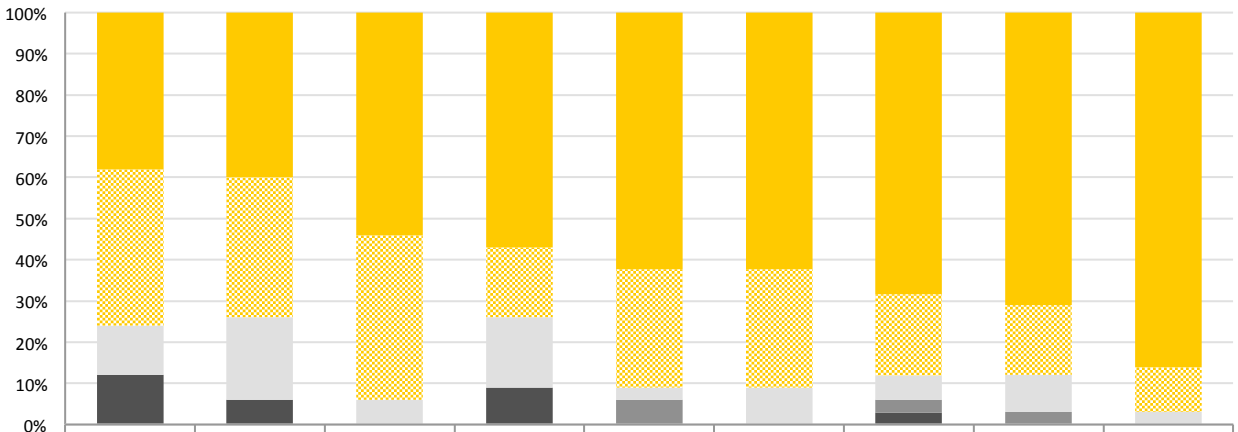


	AEOP social media	Invited speakers or "career" events	Army Research Office website	AEOP brochure	AEOP website	AEOP instructional supplies	Program administrator or site coordinator	Participation in HSAP
Very Much	7%	14%	20%	21%	27%	29%	33%	60%
Somewhat	0%	0%	33%	7%	13%	7%	7%	20%
A little	14%	7%	7%	14%	20%	21%	7%	13%
Not at all	0%	0%	0%	0%	0%	0%	0%	0%
Did not experience	79%	79%	40%	57%	40%	43%	53%	7%

Satisfaction with HSAP

To better serve the needs of apprentices, questions were included that asked about satisfaction with a number of features of the HSAP program. Chart 11 shows that all or nearly all respondents were somewhat or very much satisfied with each of the listed program features. For example, instruction or mentorship during the program activities were found by 97% of the apprentices to be somewhat or very much useful. Ninety-four percent found the application process to be satisfactory, and 92% found the research abstract requirements and stipends to be satisfactory.

Chart 12: Apprentice Satisfaction with HSAP Program Features (n = 34-35)



	Communications from Army Research Office	Other administrative tasks	Application or registration process	Communications from [HSAP site]	Participation stipends (payment)	Research abstract preparation requirements	Location(s) of program activities	Availability of program topics or fields that interest you	Instruction or mentorship during program activities
Very Much	38%	40%	54%	57%	63%	63%	69%	71%	86%
Somewhat	38%	34%	40%	17%	29%	29%	20%	17%	11%
A little	12%	20%	6%	17%	3%	9%	6%	9%	3%
Not at all	0%	0%	0%	0%	6%	0%	3%	3%	0%
Did not experience	12%	6%	0%	9%	0%	0%	3%	0%	0%

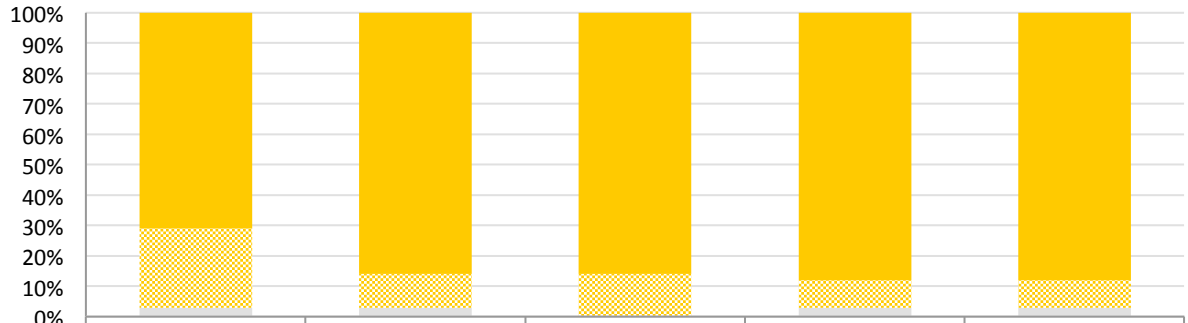
Mentor access is a key component of HSAP, and apprentices were asked about the availability of their mentor. Table 19 indicates that mentors were always available to apprentices in HSAP and only 9% were available for less than half of the time of the project.

Table 19. Apprentice Reports of Availability of Mentors (n = 35)

Item	Questionnaire Respondents
The mentor was always available	77%
The mentor was available more than half of the time	14%
The mentor was available about half of the time of my project	6%
The mentor was available less than half of the time	3%
The mentor was never available	0%

In addition, apprentices were asked about their satisfaction with their mentors and the research experience (see Chart 13). The overall responses were very positive. All apprentices experienced satisfaction with all aspects of the program, and no apprentices reported they did not experience an aspect nor did they report they were not at all satisfied. One-hundred percent of the apprentices were somewhat or very much satisfied with their research experience.

Chart 13: Apprentice Satisfaction with Their Experience (n = 35)



	The amount of time I spent doing meaningful research	The amount of time I spent with my research mentor	The research experience overall	My working relationship with my mentor	My working relationship with the group or team
Very Much	71%	86%	86%	89%	89%
Somewhat	26%	11%	14%	9%	9%
A little	3%	3%	0%	3%	3%
Not at all	0%	0%	0%	0%	0%
Did not experience	0%	0%	0%	0%	0%

An open-ended item on the apprentice questionnaire and interviews with apprentices asked apprentices about their overall satisfaction with their HSAP experience. Apprentice responses were overwhelmingly positive. In the words of three apprentices:

> *In my opinion, it was the best summer I have had during high school. I really enjoyed being exposed in that environment where people are not only creative but also investigative, where people are pursuing all sorts of interests, and are immersed into science, the scientific method. (HSAP apprentice)*

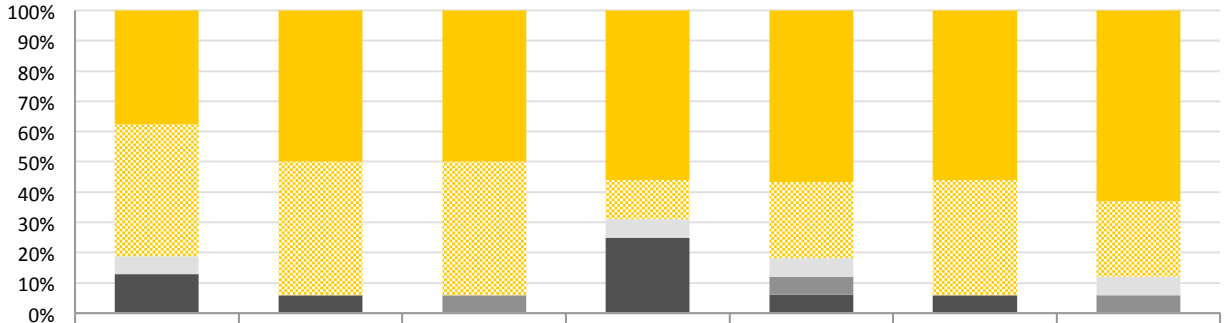
> *I learned how to write a coherent report and express that. I was definitely happy with that since I learned how to express something scientifically. I was also happy with the fact I got to experience something new at a university, since I'm only a high school student, and probably we can go on the campus and actually see how the university works and all that. (HSAP Apprentice)*

> *Yesterday was actually my last day in the lab and it was one of the saddest things because I can honestly say that my experience with HSAP this summer was one of if not the best summer experience that I had. I think that, specifically, that the opportunity that this program provides in the way that it encourages independence and free thinking for people like me who are basically high school students. Really develops the sort of mindset that you need going forward being in high school or in college whether or not you decided to go into research. I am*

definitely am so glad that I decided to do HSAP job that gave me a great way to spend my summer and learn more about what a career in research is going to be like. (HSAP Apprentice)

Mentors likewise were asked about their level of satisfaction with HSAP program features. Similar to the apprentice responses, mentors were overwhelmingly satisfied with features of HSAP. Mentors were most satisfied with the application process and the stipends (94% for each category). However, mentors were less satisfied with administrative tasks, but it must be noted that 25% of the mentors did not experience these types of tasks, so the percentage of satisfied mentors is less than other aspects of the program.

Chart 14: Mentor Satisfaction with HSAP Program Features (n = 16)



	Communications from [HSAP site]	Application or registration process	Participation stipends (payment)	Other administrative tasks	Support for instruction or mentorship during program activities	Research abstract preparation requirements	Communications from Army Research Office
Very Much	38%	50%	50%	56%	56%	56%	63%
Somewhat	44%	44%	44%	13%	25%	38%	25%
A little	6%	0%	0%	6%	6%	0%	6%
Not at all	0%	0%	6%	0%	6%	0%	6%
Did not experience	13%	6%	0%	25%	6%	6%	0%

The mentor interviews conducted with 8 mentors explored their perspective of the benefits of the program for apprentices. Mentors described how HSAP allows students to experience research and the environments in which research occurs and how being in HSAP builds an awareness of STEM careers. Mentors also described the benefits for their own professional development. In their own words:

To a high school student, it helps them see the importance of STEM disciplines. It helps them make the connection between learning a programming language and how that skill set is used to solve real world problems. (HSAP Mentor)

It's always encouraging to see young people a bit excited about things, on your day to day operations this is a life that I live and often times I forget how cool or interesting or novel some of these things might be and to see their interest in the topics is inspiring. (HSAP Mentor)

For us, this experience is also wonderful. Most of my colleagues here still kept contact with the high school students and they very often write them letters to support different stages. This kind of experience to me is also wonderful. (HSAP Mentor)

There's a lot of investment of time and energy. What we get is a great environment. I love my job, I love teaching people, and I love having an environment in the eval laboratory. That people can come and they can learn really good skills like biology, biochemistry, protein analysis with different forms spectroscopy. For me, it's a win-win situation where I work hard to keep the lab up and running, and then I get really green high school students that seem...that almost 99.9 percent of the times people who work in my lab feel very satisfied and excited about the research. And learn quite a bit. From a mentoring point of view it's a great experience to mentor high school students and undergraduate students. (HSAP Mentor)

To summarize, findings from the Actionable Program Evaluation indicate that the program is having success in actively engaging apprentices in authentic STEM experiences. There was a 5-fold increase in mentors and apprentices from 2014, and they both report valuable experiences because of HSAP. Students typically work collaboratively on research projects and get experience reporting on these projects to undergraduates, graduate students, and STEM professionals. The vast majority of apprentices are consistently interacting with STEM professionals, learning about new STEM topics, applying STEM to real life situations, and learning about cutting-edge STEM research. Apprentices are also learning about STEM jobs/careers with apprentices most often crediting participation in HSAP, their mentors, and the AEOP website with impacting their awareness of DoD STEM jobs/careers. The HSAP program actively engages apprentices in learning about STEM and in STEM practices. Apprentices were actively involved in doing STEM during the program, including practicing laboratory/field techniques, procedures, and tools; participating in hands-on activities; and carrying out investigations. Overall, apprentices and mentors were satisfied with the HSAP program.

Outcomes Evaluation

Several outcome variables were measured by the evaluation of HSAP including measurement of relating to AEOP and program objectives, including impacts on apprentices' STEM competencies (e.g., knowledge and skills), STEM identity and confidence, interest in and intent for future STEM engagement (e.g., further education, careers), attitudes towards research, and knowledge of and interest in participating in additional AEOP opportunities.[10] STEM competencies are

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

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

necessary for a STEM-literate citizenry. STEM competencies include foundational knowledge, skills, and abilities in STEM, as well as the confidence to apply them appropriately. STEM competencies are important for those engaging in STEM enterprises, but also for all members of society as critical consumers of information and effective decision makers in a world that is heavily reliant on STEM. The evaluation of HSAP measured apprentices' self-reported gains in STEM competencies and engagement in opportunities intended to develop what is considered to be a critical STEM skill in the 21st century—collaboration and teamwork.

"In my opinion, it was the best summer I have had during high school. I really enjoyed being exposed in that environment where people are not only creative but also investigative, where people are pursuing all sorts of interests, and are immersed into science, the scientific method."-- HSAP Apprentice

STEM Knowledge and Skills

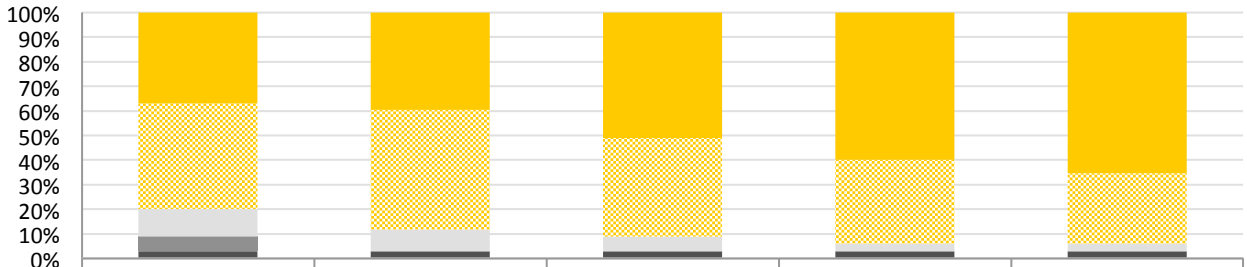
Apprentices were asked about how the HSAP impacted their STEM knowledge on the questionnaire. Chart 15 shows that HSAP had a great deal of influence on apprentice STEM knowledge. Between 80-95% of apprentices reported a large or extreme gain on all aspects of STEM knowledge asked in the questionnaire. Ninety-five percent of apprentices reported a large or extreme gain in their knowledge of what everyday research is like in STEM and 94% of apprentices reported that their knowledge of research conducted in a STEM topic or field had a large or extreme gain.

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

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

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

Chart 15: Apprentice Report of Impacts on STEM Knowledge (n = 35)



	Knowledge of research processes, ethics, and rules for conduct in STEM	Knowledge of a STEM topic or field in depth	Knowledge of how professionals work on real problems in STEM	Knowledge of research conducted in a STEM topic or field	Knowledge of what everyday research work is like in STEM
Extreme gain	37%	40%	51%	60%	66%
Large gain	43%	49%	40%	34%	29%
Some gain	11%	9%	6%	3%	3%
A little gain	6%	0%	0%	0%	0%
No gain	3%	3%	3%	3%	3%

The apprentices were also asked about perceived impacts on STEM skills, i.e., apprentices' abilities to use STEM practices on the questionnaire. Depending on the focus of their HSAP experience (science vs. technology, engineering, or mathematics) apprentices were presented with different sets of items in the questionnaire. In general, the majority of responding apprentices indicated large or extreme gains across all science-related or engineering practices except for modeling practices. For example, 91% of responding apprentices reported large or extreme gains in carrying out procedures for an experiment and recording data accurately, and 81% reported large or extreme gains in identifying the limitations of the methods and tools used for data collection.

The apprentice questionnaire items were combined into a composite variable[11] to test for differential impacts across subgroups of apprentices. There were no significant differences between males and females, or between minority and non-minority apprentices.

[11] The Cronbach's alpha reliability for these 5 items was 0.861.

Table 20. Apprentices Reporting Large or Extreme Gains in their STEM Competencies – Science Practices (n = 21)	
Item	**Questionnaire Respondents**
Carrying out procedures for an experiment and recording data accurately	91%
Identifying the limitations of the methods and tools used for data collection	81%
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	67%
Organizing data in charts or graphs to find patterns and relationships	62%
Considering different interpretations of data when deciding how the data answer a question	62%
Supporting an explanation for an observation with data from experiments	62%
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	62%
Asking a question that can be answered with one or more scientific experiments	57%
Designing procedures for an experiment that are appropriate for the question to be answered	57%
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	57%
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	57%
Integrating information from technical or scientific texts and other media to support your explanation of an observation	57%
Defending an argument that conveys how an explanation best describes an observation	52%
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	52%
Making a model of an object or system showing its parts and how they work	43%
Using computer models of objects or systems to test cause and effect relationships	38%

The apprentices who engaged in engineering, technology or mathematics oriented environments were asked similar questions about their STEM competencies, as appropriate for the setting. Of the reporting apprentices, 64% had large or extreme gains in organizing data in charts or graphs to find patterns and relationships, and in communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations). The apprentices in engineering, technology or mathematics oriented environments reported slightly less gains in their STEM competencies than did the apprentices in science environments.

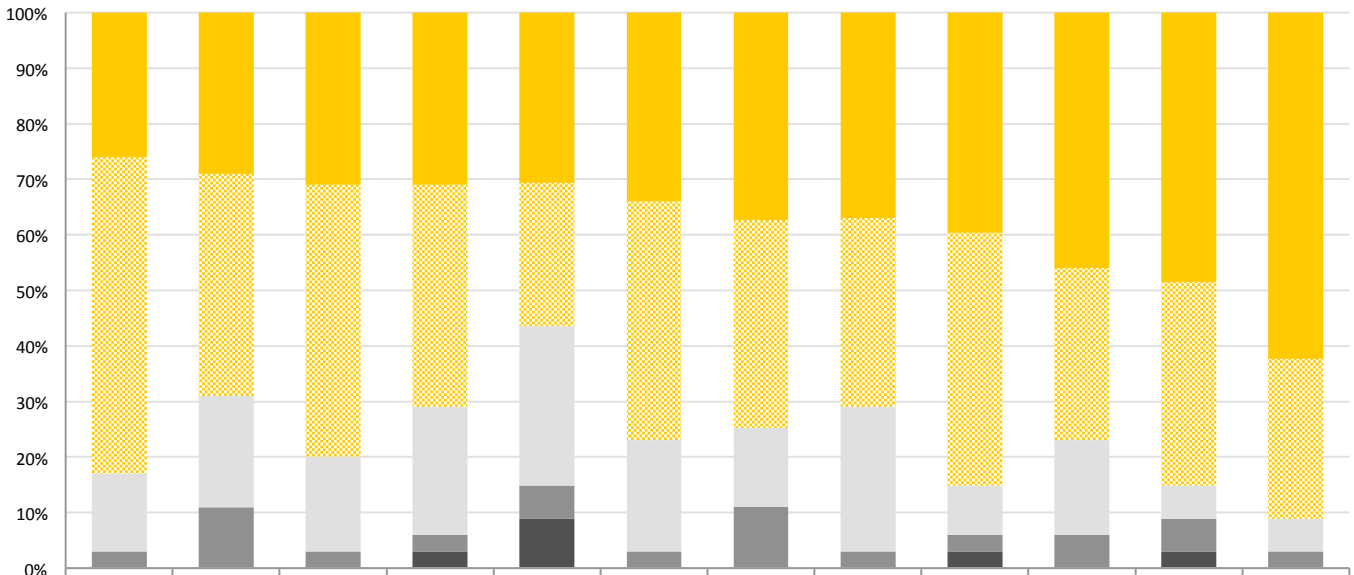
Table 21. Apprentices Reporting Large or Extreme Gains in their STEM Competencies – Engineering Practices (n = 14)	
Item	**Questionnaire Respondents**
Organizing data in charts or graphs to find patterns and relationships	64%
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations)	64%
Using computer models of an object or system to investigate cause and effect relationships	57%
Defining a problem that can be solved by developing a new or improved object, process, or system	50%
Using knowledge and creativity to propose a testable solution for a problem	50%
Making a model of an object or system to show its parts and how they work	50%
Considering different interpretations of the data when deciding if a solution works as intended	50%
Identifying the limitations of the methods and tools used for data collection	43%
Supporting a solution with relevant scientific, mathematical, and/or engineering knowledge	43%
Designing procedures for an experiment that are appropriate for the question to be answered	36%
Supporting a solution for a problem with data from experiments	36%
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	36%
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	36%
Carrying out procedures for an experiment and recording data accurately	29%
Defend an argument that conveys how a solution best meets design criteria	29%
Integrating information from technical or scientific texts and other media to support your solution to a problem	29%

Composite scores were calculated for each set of science and engineering practices items[12] on the student questionnaire to examine whether the HSAP program had differential impacts on subgroups of apprentices. There were no significant differences between genders or racial/ethnic groups on either composite.

Twenty-first Century Skills, such as communication and collaboration, are widely used in STEM practices as well as in daily life. Apprentices were asked about the impact of HSAP on their "21st Century Skills." Chart 16 shows that most responding apprentices reported large or extreme gains on each of these skills, including those vital to being life-long learners such as learning to work independently and having patience for the slow pace of research.

[12] The science practices composite has a Cronbach's alpha reliability of 0.973; the engineering practices composite has a Cronbach's alpha reliability of 0.956.

Chart 16: Apprentice Report of Impacts on 21st Century Skills (n = 35)



	Learning to work independently	Including others' perspectives when making decisions	Setting goals and reflecting on performance	Sense of contributing to a body of knowledge	Connecting a topic or field and my personal values	Sense of being part of a learning community	Working collaboratively with a team	Communicating effectively with others	Sticking with a task until it is complete	Building relationships with professionals in a field	Making changes when things do not go as planned	Patience for the slow pace of research
Extreme gain	26%	29%	31%	31%	31%	34%	37%	37%	40%	46%	49%	63%
Large gain	57%	40%	49%	40%	26%	43%	37%	34%	46%	31%	37%	29%
Some gain	14%	20%	17%	23%	29%	20%	14%	26%	9%	17%	6%	6%
A little gain	3%	11%	3%	3%	6%	3%	11%	3%	3%	6%	6%	3%
No gain	0%	0%	0%	3%	9%	0%	0%	0%	3%	0%	3%	0%

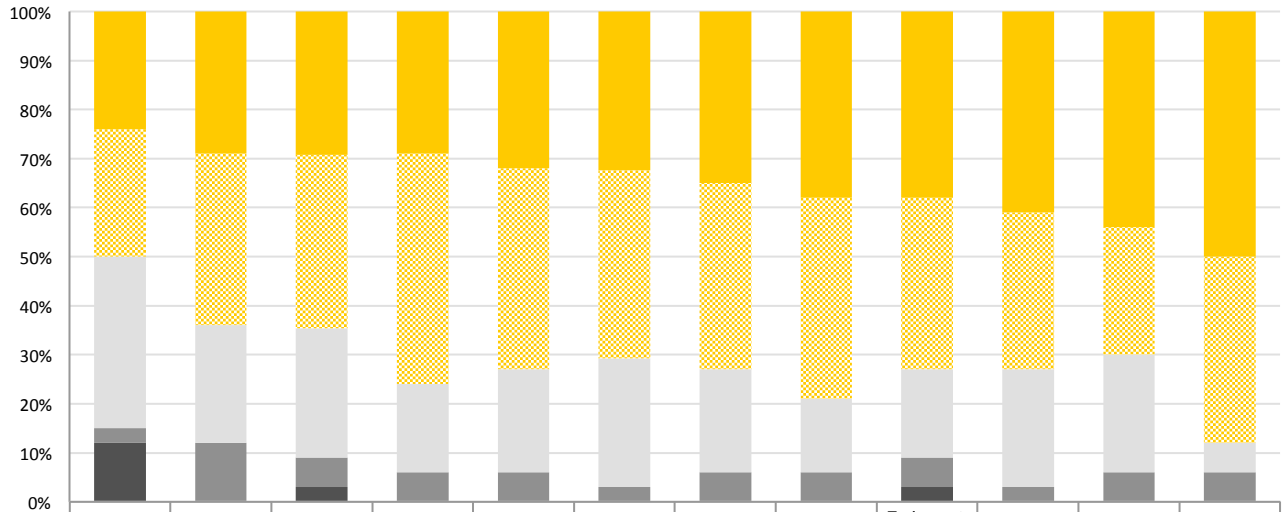
STEM Identity and Confidence

Students who pursue STEM further in their education and/or careers are more positioned for success with deeper backgrounds in STEM knowledge and skills. However, they are unlikely to explore STEM degrees or careers if they do not see themselves as capable of succeeding in STEM.[13] Consequently, the apprentice questionnaire included a series of items intended to measure the impact of HSAP on apprentices' STEM identity. As seen in Chart 17, the apprentices strongly suggest that the program has had a positive impact in this area. For example, the majority of the 34 responding apprentices reported a large or extreme gain in feeling prepared for more challenging STEM activities, confidence to do well in future STEM courses, feeling like part of a STEM community, feeling responsible for a STEM project or activity, and sense of accomplishing something in STEM.

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

Comparing results on the composite created from these items,[14] there were no differences in impact based on gender. However, there was a significant difference based on race/ethnicity with minority apprentices expressing greater impacts on STEM Identity compared to non-minority apprentices; $t(33) = 4.89$, $p < .05$, two-tailed, large effect size (Cohen's d = 1.69).

Chart 17: Apprentice Report of Impacts on STEM Identity (n = 34)



	Clarifying a STEM career path	Interest in a new STEM topic or field	Sense of accomplishing something in STEM	Building academic or professional credentials in STEM	Feeling prepared for more challenging STEM activities	Confidence to contribute to STEM	Feeling like a STEM professional	Confidence to do well in future STEM courses	Trying out new ideas or procedures on my own in a STEM project or activity	Feeling like part of a STEM community	Thinking creatively about a STEM project or activity	Feeling responsible for a STEM project or activity
Extreme gain	24%	29%	29%	29%	32%	32%	35%	38%	38%	41%	44%	50%
Large gain	26%	35%	35%	47%	41%	38%	38%	41%	35%	32%	26%	38%
Some gain	35%	24%	26%	18%	21%	26%	21%	15%	18%	24%	24%	6%
A little gain	3%	12%	6%	6%	6%	3%	6%	6%	6%	3%	6%	6%
No gain	12%	0%	3%	0%	0%	0%	0%	0%	3%	0%	0%	0%

[14] The Cronbach's alpha reliability for these 8 items was 0.857.

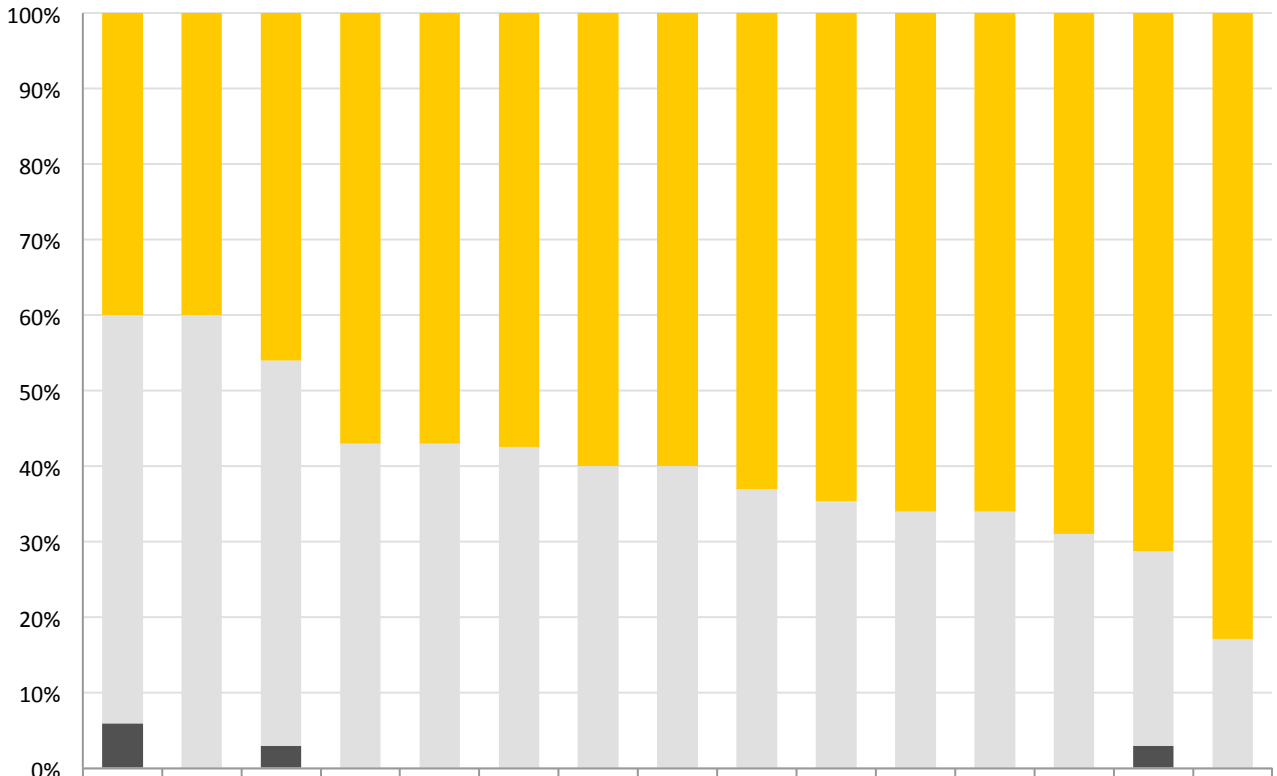
Interest and Future Engagement in STEM

The HSAP program strives to contribute to the development of a STEM-literate citizenry. School STEM experiences are enhanced and built upon when students engage in out of school with high quality STEM activities. In order to examine the impact of HSAP on apprentices' interest in future engagement in STEM, the questionnaire asked them to reflect on whether the likelihood of their engaging in STEM activities outside of school changed as a result of their experience, as well as their interest level in participating in future AEOP programs. Chart 18 demonstrates that the majority of apprentices indicated they were more likely or much more likely to engage in many of these activities as a result of HSAP, such as working on solving mathematical or scientific puzzles, talking with a friend or family member about STEM, helping with a community service project that relates to STEM, and mentoring or teaching other students about STEM.

A composite score was created from these items,[15] and composite scores were compared across subgroups of apprentices. There were no statistically significant differences for these composites by gender or race/ethnicity.

[15] These 10 items had a Cronbach's alpha reliability of 0.910.

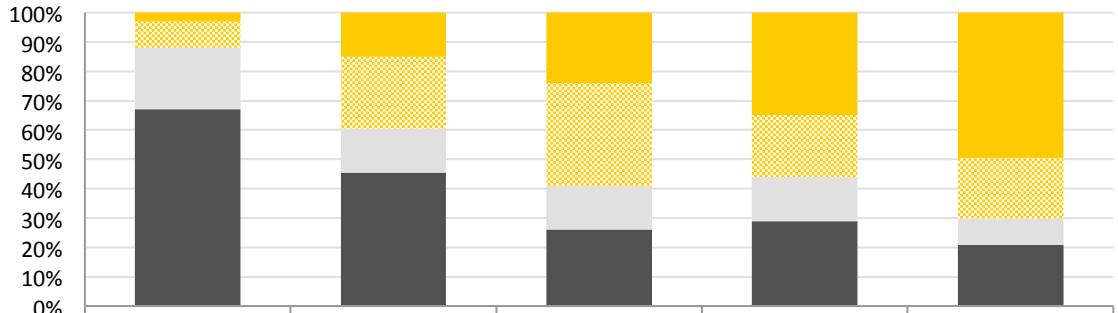
Chart 18: Change in Likelihood Apprentices Will Engage in STEM Activities Outside of School (n = 34-35)



	Visit a science museum or zoo	Design a computer program or website	Watch or read non-fiction STEM	Participate in STEM camp, fair, or competition	Observe things in nature (plant growth, animal behavior, stars or planets, etc.)	Take an elective (not required) STEM class	Tinker with a mechanical or electrical device	Mentor or teach other students about STEM	Participate in a STEM club, etc.	Look up STEM information at a library or on the internet	Receive an award for STEM accomplishments	Work on solving mathematical or scientific puzzles	Help with a service project that relates to STEM	Talk with friends or family about STEM	Work on a STEM project or experiment in a university or STEM lab
More likely	40%	40%	46%	57%	57%	58%	60%	60%	63%	64%	66%	66%	69%	72%	82%
About the same	54%	60%	51%	43%	43%	43%	40%	40%	37%	35%	34%	34%	31%	26%	17%
Less likely	6%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%

When asked how interested they are in participating in future AEOP programs, more than 50% of the apprentices report an interest in URAP (71%), SMART (56%), and NDSEG (59%). A smaller portion of HSAP apprentices are interested in pursuing CQL (39%), and GEMS Near Peers (10%) (see Chart 19).

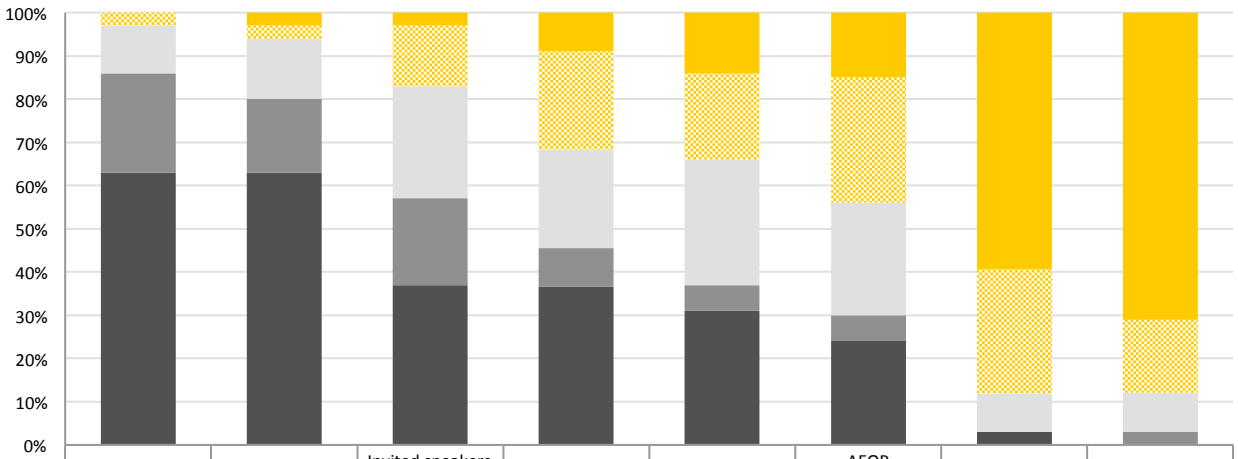
Chart 19: Apprentice Interest in Future AEOP Programs (n = 33-34)



	GEMS Near Peers	College Qualified Leaders (CQL)	National Defense Science & Engineering Graduate (NDSEG) Fellowship	Science Mathematics, and Research for Transformation (SMART) College Scholarship	Undergraduate Research Apprenticeship Program (URAP)
Very Much	3%	15%	24%	35%	50%
Somewhat	9%	24%	35%	21%	21%
A little	21%	15%	15%	15%	9%
Not at all	67%	45%	26%	29%	21%

To build on the at-hand resources of HSAP apprentices for other AEOP opportunities, apprentices were asked which resources impacted their awareness of the various AEOPs. Chart 20 shows that apprentices rated the HSAP program (88%) and their mentors (89%) at somewhat or very much impactful on their awareness of AEOPs. Conversely, the majority of HSAP apprentices reported not experiencing the AEOP brochure and AEOP social media.

Chart 20: Impact of Resources on Apprentice Awareness of AEOPs (n = 35)

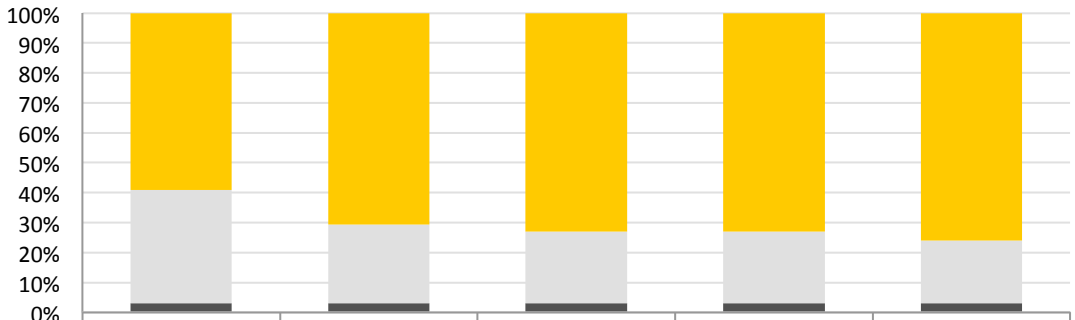


	AEOP social media	AEOP brochure	Invited speakers or "career" events	Army Research Office website	AEOP website	AEOP instructional supplies	My mentor(s)	Participation in HSAP
Very Much	0%	3%	3%	9%	14%	15%	60%	71%
Somewhat	3%	3%	14%	23%	20%	29%	29%	17%
A little	11%	14%	26%	23%	29%	26%	9%	9%
Not at all	23%	17%	20%	9%	6%	6%	0%	3%
Did not experience	63%	63%	37%	37%	31%	24%	3%	0%

Attitudes toward DoD Research

Students' attitudes about the importance of DoD research are an important prerequisite to their continued interest in the field and potential involvement in the future. In order to gauge apprentices' attitudes in this area, the apprentice questionnaire asked about their opinions of what DoD researchers do and the value of DoD research more broadly. The data indicate that most responding apprentices have favorable opinions (see Chart 21). Approximately three-quarters of apprentices agree or strongly agree that DoD researchers develop new, cutting edge technologies, solve real-world problems, advance science and engineering fields, and that their research is valuable to society.

Chart 21: Apprentice Opinions about DoD Researchers and Research (n = 34)



	DoD researchers support non-defense related advancements in science and technology	DoD research is valuable to society	DoD researchers advance science and engineering fields	DoD researchers solve real-world problems	DoD researchers develop new, cutting edge technologies
Strongly agree or agree	59%	70%	73%	73%	76%
Neither agree nor disagree	38%	26%	24%	24%	21%
Strongly disagree or disagree	3%	3%	3%	3%	3%

Education and Career Aspirations

To determine the impact of HSAP on apprentice aspirations for future educational opportunities, the evaluation asked apprentices about the program's impact on their education and career aspirations. In terms of education, the questionnaire asked apprentices how far they wanted to go in school before and after participating in HSAP. As seen in Table 22, more of the responding apprentices indicated wanting to obtain advanced degrees after participating in HSAP than before HSAP, most notably a 27% increase in the desire to obtain a Ph.D.

Table 22. Apprentice Education Aspirations (n = 35)

	Before HSAP	After HSAP
Graduate from high school	0%	0%
Go to a trade or vocational school	0%	0%
Go to college for a little while	0%	0%
Finish college (get a Bachelor's degree)	17%	3%
Get more education after college	6%	6%
Get a master's degree	31%	17%
Get a Ph.D.	26%	51%
Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)	9%	6%
Get a combined M.D. / Ph.D.	11%	14%
Get another professional degree (law, business, etc.)	0%	3%

In terms of career aspirations, apprentices were asked what kind of work they expect to be doing at age 30, reflecting on what their aspiration was before participating in HSAP and after HSAP (see Table 23). Most responding apprentices expressed interest in STEM-related careers both before and after participating in HSAP, and reported a small increase in the more mathematics-based STEM fields.

Table 23. Apprentice Career Aspirations (n = 35)

	Before HSAP	After HSAP
Engineering	23%	29%
Science (no specific subject)	16%	9%
Computer science	16%	18%
Physical science (physics, chemistry, astronomy, materials science)	9%	15%
Biological science	9%	5%
Medicine (doctor, dentist, veterinarian, etc.)	9%	9%
Mathematics or statistics	6%	3%
Undecided	6%	3%
Teaching, non-STEM	3%	0%
Military, police, or security	3%	3%
Earth, atmospheric or oceanic science	0%	0%
Environmental science	0%	0%
Technology	0%	0%
Health (nursing, pharmacy, technician, etc.)	0%	0%
Social science (psychologist, sociologist, etc.)	0%	0%
Teaching, STEM	0%	0%
Business	0%	0%
Law	0%	0%
Art (writing, dancing, painting, etc.)	0%	0%
Skilled trade (carpenter	0%	0%
Other, (specify):	0%	6%

After, other includes “Computer Science/Electrical Engineering”, “forensic toxicology”, and “work for NASA.”

Apprentices were asked about the extent to which they expect to use their STEM knowledge, skills, and/or abilities in their work when they are age 30. As shown in Table 24, 97% of apprentices expect to use their STEM knowledge, skills and abilities at least half of the time, with the remaining 3% using their STEM skills, knowledge, and abilities at least a quarter of the time, indicating a large amount of apprentices who want to pursue a STEM career.

Table 24. Apprentices Expecting to use STEM in Their Work at Age 30 (n = 35)	
	Questionnaire Respondents
Not at all	0%
Less than 25% of the time	0%
26% to 50% of the time	3%
51% to 75% of the time	40%
75% to 100% of the time	57%

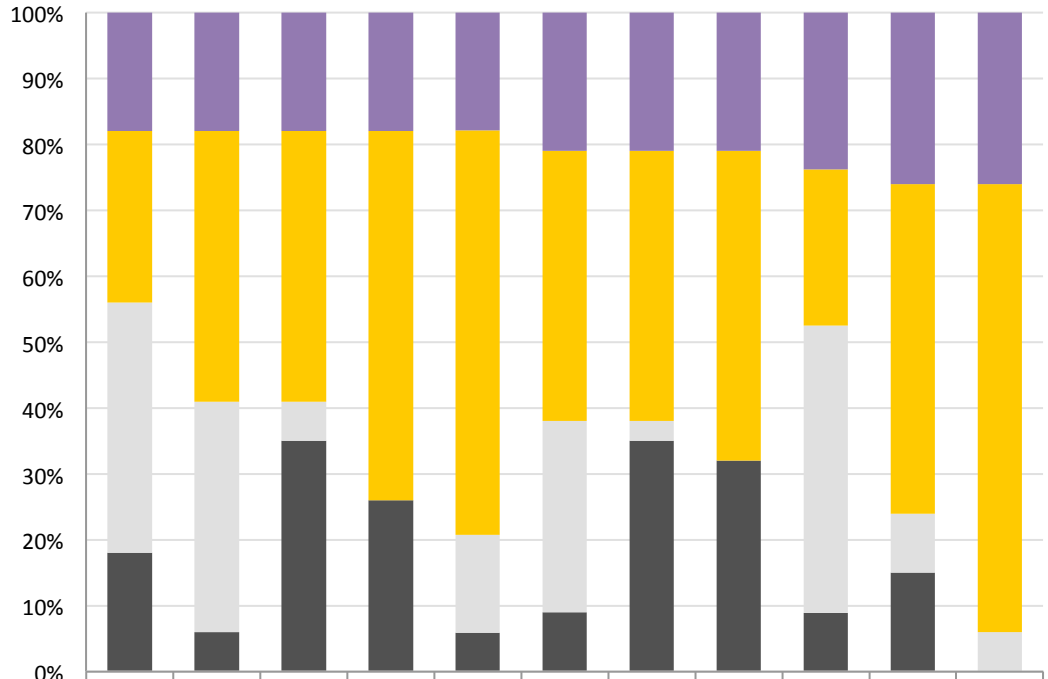
Overall Impact

Finally, apprentices were asked about impacts of participating in HSAP more broadly. From these data, it is clear that apprentices thought the program had substantial impacts on their STEM interests, knowledge and future pursuits (see Chart 18). For example, almost all of the apprentices were more confident in their STEM knowledge, skills and abilities, were more interested in pursuing other AEOP opportunities, and are more interested in participating in STEM activities outside of school.

These items were combined into a composite variable[16] to test for differences among subgroups of students; no significant differences were found by gender or race/ethnicity.

[16] The Cronbach's alpha reliability for these 10 items was 0.806.

Chart 22: Apprentice Opinions of HSAP Impacts (n = 34)



	I am more interested in attending college	I am more interested in pursuing a STEM career	I am more interested in pursuing a STEM career with the DoD	I am more aware of other AEOPs	I am more interested in STEM activities outside of school	I am more interested in taking STEM classes in school	I am more aware of DoD STEM research and careers	I have a greater appreciation of DoD STEM research and careers	I am more interested in earning a STEM degree in college	I am more interested in other AEOPs	I am more confident in my STEM knowledge, skills, and abilities
Agree - HSAP was primary resason	18%	18%	18%	18%	18%	21%	21%	21%	24%	26%	26%
Agree - HSAP contributed	26%	41%	41%	56%	62%	41%	41%	47%	24%	50%	68%
Disagree - happened, but not because of HSAP	38%	35%	6%	0%	15%	29%	3%	0%	44%	9%	6%
Disagree - did not happen	18%	6%	35%	26%	6%	9%	35%	32%	9%	15%	0%

An open-ended item on the apprentice questionnaire asked apprentices to list the three most important ways they benefited from the program; 32 of 34 responding apprentices provided at least one answer to the question. Apprentice responses addressed a variety of themes, including collaborating with STEM professionals and other students, learning about/participating in lab work, and increasing STEM content knowledge.

Comments from the apprentice interviews expand on some of these overall impacts. As one said:

> *I met a lot of graduate students in this program, and they were really motivated people, and it inspired me to actually study science more. They've dedicated so many hours to their research. They were very passionate about their research as well. They mentored me pretty well, and I'm definitely interested in doing research now. (HSAP apprentice.*

> *"There were some people from the Army Research Office, and they were describing all the different things they did there, specifically, like laser development and quantum optics department at the Army Research Office. They were talking about research opportunities and how scientists could help protect homeland security."*-- HSAP Apprentice

Summary of Findings

The FY15 evaluation of HSAP collected data about participants; their perceptions of program processes, resources, and activities; and indicators of achievement in outcomes related to AEOP and program objectives. A summary of findings is provided in Table 25.

Table 25. 2015 HSAP Evaluation Findings	
Participant Profiles	
HSAP continues to be a popular and selective program which serves students of historically underrepresented and underserved populations.	HSAP has been extremely successful in reaching out to more high school students. In 2014, there were only 84 applicants to HSAP, and in 2015 there were 267 applicants – a 318% increase. The ARO office utilized direct email to targeted schools, which produced a significant increase in applications. As a result, there were 10 more participants in HSAP for FY15 and a 6% increase in the placement rate for applicants. Further, the growth in participants yielded inclusion of 10 more high schools in the HSAP program in FY15 and 20 of the participating high schools were Title I.

	HSAP experienced continued success in providing outreach to students from historically underrepresented and underserved race/ethnic and low-income groups. Twenty-one additional sites were added from 2014 with an increase from placing HSAP sites at 7 HBCU/MIs in 2015 (an increase from 2 HBCU/MI sites in 2014).
	Approximately half of the respondents in the HSAP program were from race/ethnicity categories other than White.
HSAP is more cost effective in 2015.	The cost per apprentice decreased over $500 per person in 2015 from the previous year. This may be due to the large increase in applicants and in site proposals.
Actionable Program Evaluation	
HSAP marketing and recruitment continue to be mainly from personal contacts.	Most HSAP apprentices learn about the program from personal contacts such as a teacher. Only after this contact occurs, do the apprentices learn about the program from the website.
	Marketing via social media such as Facebook, Twitter or Pinterest were the least frequently used sources for learning about HSAP specifically and AEOP generally.
HSAP gives apprentices unique and authentic ways to learn about STEM that are not available in school.	Data gathered during registration indicate that apprentices were motivated to participate in HSAP by the desire to learn something new or interesting, because of their interest in STEM, and to learn in ways not possible in school.
HSAP offers opportunities for high school students in authentic STEM learning that provides insight into college and beyond.	Most responding apprentices reported learning about applications of STEM to real-life situations, cutting-edge STEM research, and STEM topics on most days or every day of their HSAP experience. Further, they reported an increased understanding of college-level STEM research
	Apprentices reported their mentors were available for them throughout the HSAP experience.
	Apprentices reported active engagement in doing STEM during the HSAP program. All STEM practices were experienced by the HSAP apprentices the majority of most days or every day.
HSAP mentors were less aware of DoD STEM research and careers than STEM careers/research in general. However, many were interested in participating in other AEOP opportunities.	91% of HSAP apprentices learned about at least one general STEM job/career, but only 62% learned about at least one specific DoD STEM job/career. Apprentices are aware of other AEOP opportunities and are interested in participation. When asked how interested they are in participating in future AEOP programs, more than 50% of the apprentices report an interest in URAP (71%), SMART (56%), and NDSEG (59%). A smaller portion of HSAP apprentices are interested in pursuing CQL (39%), and GEMS Near Peers (10%).
HSAP was highly valued by apprentices and mentors alike.	Most apprentices and mentors reported being satisfied with their HSAP experience, including communications from Army Research Office, and the application/ registration process. Mentors reported in the interview that they felt having high school students in their laboratories was a valuable professional development experience.
Outcomes Evaluation	

HSAP apprentices gained STEM knowledge and skills, and expect to use their STEM knowledge and skills extensively in the future.	Apprentices reported large or extreme gains on their knowledge of how professionals work on real problems in STEM, what everyday research work is like in STEM, a STEM topic or field in depth, and research conducted in a STEM topic or field.
	Apprentices reported increased abilities to do STEM, including such things as communicating information about their design processes and/or solutions in different formats and supporting a proposed explanation with relevant scientific, mathematical, and/or engineering knowledge.
HSAP had positive impacts on apprentices' 21st Century Skills.	The majority of responding apprentices reported large or extreme gains in their ability to work collaboratively with a team and to have patience with the slow pace of research.
HSAP positively impacted apprentices' confidence and identity in STEM, and had a significantly higher impact on minority apprentices STEM identity.	An overwhelming majority of apprentices reported large or extreme gains in their preparedness for more challenging STEM activities, confidence to do well in future STEM courses, feeling like part of a STEM community, and feeling responsible for a STEM project or activity.
	All apprentices reported that HSAP had a positive influence on their STEM identify and confidence in doing STEM, however, there was a significant difference based on race/ethnicity with minority apprentices expressing greater impacts on STEM Identity compared to non-minority apprentices
HSAP raised students' education aspirations and positively career aspirations.	After participating in HSAP, responding apprentices indicated being more likely to go further in their schooling than they would have before HSAP, particularly in the pursuit of a terminal degree such as a Ph.D.
	Apprentices were asked to indicate what kind of work they expected to be doing at age 30, with the majority indicating interest in a STEM-related career, both before and after HSAP. However, more apprentices indicated that after HSAP they were more likely to pursue mathematically oriented careers such as engineering and physical science.
HSAP raised apprentice awareness and appreciation of DoD STEM research and careers and how these careers affect the larger community.	Approximately three-quarters of apprentices agree or strongly agree that DoD researchers develop new, cutting edge technologies, solve real-world problems, advance science and engineering fields, and that their research is valuable to society.

Recommendations

Evaluation findings indicate that 2015 was a successful year for the HSAP program. HSAP had a 318% increase in the number of apprentice applicants and had a very competitive 19% acceptance rate of the apprentice applicants, which indicates there is great interest in this program. From the high quality applicants (mentors and apprentices), there were 38 mentors and 49 apprentices selected. HSAP has experienced some success in recruiting diverse apprentices, as half of the respondents to the questionnaire reported a race/ethnicity category other than White. Apprentices and mentors overwhelmingly reported satisfaction with HSAP experience. Mentors indicated they use innovative and research-based strategies to engage apprentices in STEM activities, and by engaging the apprentices; they help graduate students

become better educators. The apprentices similarly report increased ability to engage in STEM activities and have STEM identities, due to the HSAP experience. Notably, there was a significant increase based on race/ethnicity with minority apprentices expressing greater impacts on STEM Identity compared to non-minority apprentice. Additionally, engaging in more hands-on STEM experiences motivated the apprentices, which was delivered by their HSAP experience.

While the successes for HSAP 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 FY16 and beyond.

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

1. AEOP objectives include expanding participation of historically underrepresented and underserved populations. Between 2014 and 2015, HSAP has engaged more apprentices who identify with a typically underrepresented group in STEM, which is a positive trend. Additionally, it is positive that the HBCU/MI sites increased from 2 in 2014 to 7 in 2015. Future marketing efforts could focus on the need for a more diverse pool of STEM professionals, and take the opportunity to showcase the diversity of mentors in electronic and printed materials.

2. Similar to past years, in HSAP, recruitment of apprentices is largely accomplished with personal interactions, either by knowing a teacher who is familiar with AEOP or a personal friend who has received an email about HSAP. As a result, the ability of HSAP to recruit underserved or underrepresented populations of students depends upon the diversity of the high schools in which recruitment takes place. Thus, HSAP may want to emphasize recruiting a more diverse pool of mentors and apprentices, perhaps specifically targeting more urban schools or schools who receive Title 1 funding. A focused and strategic plan to engage a more diverse pool of apprentices could ultimately improve the diversity of the STEM pipeline, based on the large impact that HSAP has on STEM knowledge, skills, and identity.

3. HSAP is very effective in giving apprentices authentic opportunities to engage in STEM professional activities, and for mentors to build the next generation of STEM professionals. Mentors are particularly skilled in being able to engage high school students into their laboratory by giving them meaningful learning experiences and asking them to report on their work to graduate students and STEM professionals. Although mentors are particularly skilled in their area of expertise, mentors can be more effecting in helping students understand the big picture of how STEM can improve community. Only 54% of mentors reported communicating how STEM can improve community. Only 52% of the mentors highlighted the under-representation of women and racial and ethnic minority populations in STEM as well. Mentors can be provided ways to incorporate how STEM topics affect the larger community in a systematic way by the program, so that the bigger picture of how STEM fits into society can be explicitly emphasized.

4. Similar to recommendation #3, given the goal of exposing apprentices to Army/DoD STEM research and careers, the program may want to build in systematic opportunities to provide this information to their apprentices.

More than half of apprentices who completed the survey reported that they did not learn about any DoD STEM jobs/careers during HSAP. Perhaps more importantly, only a few mentors were aware of specific Army/DoD STEM research and careers and even fewer mentors explicitly discussed this with their apprentices. This lack of awareness is a barrier in communicating about Army/DoD STEM research and careers. In an effort to increase and standardize the information provided to apprentices, it would be beneficial to create a resource that profiles Army STEM interests and the education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about Army STEM careers and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific Army/DoD STEM research and careers. The application to be a HSAP site or a mentor could ask for their plan to explicitly discuss these resources (e.g., Army and directorate STEM career webpages, online magazines, federal application guidelines), thus developing a network of ongoing opportunities for the apprentices.

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

1. Apprentices and mentors who participate in HSAP are only aware in a general way that other programs in AEOP exist. When asked, the mentors and apprentices could not name many of the other AEOP programs. Apprentices rated the HSAP program (88%) and their mentors (89%) at somewhat or very much impactful on their awareness of AEOPs. However, the majority of HSAP apprentices reported not experiencing the AEOP brochure and AEOP social media. Social media efforts, in particular, require constant updates and focused attention on messaging to gain attention. Since most HSAP applicants hear about the program through another individual, having a social media presence may increase the likelihood that an apprentice or mentor may hear about the program from other person who learned about it on Facebook, Twitter, or Pinterest. A recommendation for the FY16 years and beyond would be for the HSAP program mentors to provide time for apprentices to complete the survey during their apprenticeship meeting time. This will provide a more accurate measure to gauge how effective HSAP activities and communications are in growing awareness of AEOPs.

Appendices

Appendix A

FY15 HSAP Evaluation Plan

Questionnaires

Purpose:

Per the FY15 Army Education Outreach Program (AEOP) Annual Program Plan (APP), Virginia Tech will conduct an evaluation study of the High School Apprenticeship Program (HSAP) that includes two post-program questionnaires:

1. AEOP Youth Questionnaire to be completed by student participants of the HSAP program at all university sites; and
2. AEOP Mentor Questionnaire to be completed by HSAP mentors (typically a University Scientist or Engineer), and/or others who support students as they participate in the HSAP program.

Questionnaires are the primary method of data collection for AEOP evaluation and collect information about participants' experiences with and perceptions of program resources, structures, and activities; potential benefits to participants; and strengths and areas of improvement for programs.

From FY14 to FY15, questionnaire assessments have been revised and shorted while maintaining alignment with:

- Army's strategic plan and AEOP Priorities 1 (STEM Literate Citizenry), 2 (STEM Savvy Educators) and 3 (Sustainable Infrastructure);
- Federal guidance for evaluation of Federal STEM investments (e.g., implementation and outcomes evaluation, outcomes evaluation of STEM-specific competencies, transferrable competencies, identifying with STEM, intentions to engage in STEM-related activities, and educational/career pathways);
- Best practices and published assessment tools in STEM education, informal STEM education, STEM outreach, and evaluation research communities;
- AEOP's vision to improve the quality of the data collected, focusing on changes in intended student outcomes and contributions of AEOPs like HSAP effecting those changes.

Deployment of common questionnaires with items that are appropriate for all AEOP programs allows evaluators to compare findings across AEOPs and, if administered in successive years, to establish longitudinal studies of student outcomes through the pipeline of AEOP programming. Questionnaires incorporate batteries of items from established assessments that have been validated in published research making external comparisons possible.

All AEOPs are expected to administer a Youth and a Mentor questionnaire provided to them by VT. AEOP-wide Youth and Mentor questionnaires have two versions each; an "advanced" version (for JSHS and apprenticeship programs) and a "basic" version (for GEMS, JSS, and UNITE). Similar item sets are used in both versions, with slight modifications to item wording or the number of items used to accommodate the needs of participants from each individual program. Additionally, program-specific questionnaires have been customized to gather information about programmatic structures, resources, and activities that are unique to each AEOP.

Youth Questionnaire Administration Details

- Distribute the survey near or after the conclusion of the students' HSAP experience;
- Please encourage youth participants to participate in AEOP evaluation efforts. Before, during, and after the HSAP program activities please mention that questionnaires are forthcoming. It is also helpful to remind Principal Investigators (PIs) and mentors about questionnaires so they can encourage students to participate as well as a reminder for themselves to participate in the surveys;
- If other, non-AEOP, survey(s) will be administered to HSAP students please encourage them to prioritize the completion of AEOP's HSAP evaluation survey. These data are critical to maintain funding for HSAP. Additionally, evaluators will release de-identified data from these assessments to individual HSAP sites to help them focus program improvement efforts;
- The HSAP survey will be distributed using the CVENT registration system so please inform students and mentors that their registration with CVENT is crucial for the AEOPs records and to look for further communication from the Army Research Office (ARO) and the AEOP through the CVENT portal:

Youth Participants – Evaluation Questionnaire Invitation

Dear HSAP participant,

Evaluators from Virginia Tech are conducting a study to learn about student experiences in the High School Apprenticeship Program (HSAP). We are asking you to fill out this survey because you participated in HSAP. Your feedback will be used to help us improve HSAP for students in the future. The sponsor of HSAP, the Army Educational Outreach Program (AEOP), is paying for this study. In 2015, more than 100 apprentices and 90 mentors will participate in HSAP or URAP programs and evaluators from Virginia Tech want to hear from you and your mentor.

Here's how you can help:

1) *Complete the HSAP Student Survey using the hyperlink below. Your parent or guardian has already provided permission for us to ask you to participate in the survey. Now, it is up to you to decide whether you want to participate or not. The survey takes 25-30 minutes to complete on average.*

   HSAP Student Survey Link: Unique URL generated by CVENT

2) *Pass this email along to the mentor(s) who supported you as you as you participated in HSAP. Ask them to complete the* ***HSAP Mentor Survey.*** *The survey will take 25-30 minutes.*

If you have any questions about these surveys or your participation in the evaluation study please contact the AEOP Evaluation team at Virginia Tech: Tanner Bateman – tbateman@vt.edu.

Thank you so much for your participation in the evaluation of HSAP!

Mentor Questionnaire Administration Details

- Distribute the survey near or after the conclusion of the mentors' HSAP experience;
- Encourage all adults serving as HSAP mentors (typically a University Scientist or Engineer), and others who supported students as they participated in HSAP, to complete the survey;
- Encourage mentor participation in the evaluation study before, during, and after program activities;
- If other, non-AEOP, survey(s) will be administered to adults please encourage them to prioritize the completion of AEOP's HSAP evaluation survey. These data are critical to maintain funding for HSAP. Additionally, evaluators

will release de-identified data from these assessments to HSAP sites to help them focus program improvement efforts;

- The HSAP survey will be distributed using the CVENT registration records so please inform students and mentors that their registration is crucial for the AEOPs records and to look for further communication from ARO and the AEOP through the CVENT portal:

Adult Participants – Evaluation Questionnaire Invitation

Dear Colleague:

You are receiving this email because you participated in the 2015 High School Apprenticeship Program (HSAP) program in support of one or more students' learning experience(s).

Evaluators from Virginia Tech are conducting program evaluation on behalf of the Army Research Office (ARO) and U.S. Army. The purpose of evaluation is to determine how well the Army Educational Outreach Program (AEOP) is achieving its primary mission – promoting student interest and engagement in science, technology, engineering, and mathematics (STEM). Virginia Tech is surveying adults who participated in HSAP in support of students as they participated in the HSAP program (HSAP Mentors – University Scientists or Engineers). More than 100 students and 90 adults participated in the HSAP and URAP programs this year and Virginia Tech wants to hear from you!

Here's how you can help:

1) *Click on the link below and complete the **HSAP Mentor Survey**. The survey will take about 25-30 minutes.*
   ***HSAP Mentor Survey Link** provided by the CVENT system*
2) *Pass an email along to those students you supported in HSAP and ask them to complete the appropriate survey. Their survey also takes about 25-30 minutes to complete.*

If you have any questions about the evaluation, these surveys, or your participation in the evaluation, please contact the AEOP Evaluation team: Tanner Bateman at tbateman@vt.edu.

Thank you so much for your participation in the evaluation of HSAP.

Regards,

Telephone Interviews

Purpose

Per the FY15 Army Education Outreach Program (AEOP) Annual Program Plan (APP), Virginia Tech will conduct an evaluation study of HSAP that includes telephone interviews with HSAP mentors and apprentices.

Interviews provide the evaluation team first-hand opportunities to speak with youth and adult HSAP participants. The contextual information gleaned from these interviews help evaluators understand the nuance of the evaluation data collected from questionnaires, adding depth to evaluative findings. VT's interview assessment efforts focus on program successes and attempt to inform useful program changes so that HSAP can improve in the future.

Evaluation activities during Virginia Tech's Phone Interview

- 8 – 12 one-on-one phone interviews with HSAP apprentices (approx. 15-20 min. each);
- 5 – 8 one-on-one phone interviews with HSAP mentors (approx. 15-20 min each);

Selecting Interview Participants

VT will purposefully sample from HSAP participants using CVENT enrollment data (site name, apprentice/mentor participant names, gender, & race/ethnicity). The IPA and VT will "invite" selected participants that comprise the desired sample to participate via email through the CVENT portal. Participants will each RSVP prior to the scheduled interview date so that an alternate may be identified if needed.

Purposeful sampling is an attempt to assemble a sample of participants that are likely to provide information about the full range of experiences possible in HSAP. The interview sample will be selected using the following information:

- Gender
- Grade level
- Racial/ethnic group
- Socio-economic status indicators (e.g., qualification for free or reduced-price lunches)

Scheduling and Technology:

VT will establish dates and times for each interview that accommodate the program activities for each site. The majority of these dates will occur in mid to late July – the purpose of which is to speak with participants after they have experienced the majority of experiences available in their HSAP program. VT will attempt to convene interviews between 10 a.m. and 2 p.m. in each site's time zone to minimize disruption to the program.

A simple telephone will be used to conduct each interview. Evaluators at Virginia Tech will also use a recording device to record the interview. All recordings are used for note-taking and transcription purposes only. After transcription, audio files will be destroyed.

Obtaining Informed Assent/Consent: Prior to the Interview

Apprentice and mentor participants should be informed of the evaluation interview *before* it is conducted. This ensures that individuals do not feel pressured to participate. It would be ideal if VT, the IPA, and/or site coordinators work together to invite apprentices and mentors to participate and provide them with demographic surveys and consent/assent forms:

- Use the recruitment email text below to invite apprentices and mentors to volunteer for interviews.
- Be sure to include the date and time of the interview as well as the location of the telephone that they can use for the interview call (if needed).
- Attach the appropriate assent/consent form to the email
  - **"2015.HSAP.AdultConsent.PhoneInterview.pdf"**
  - **"2015.HSAP.MinorAssent.PhoneInterview.pdf"**
- Attach the appropriate demographic survey for participants to fill out and email to the evaluators
  - **"2015.HSAP.Adult PhoneInterveiw.DemoSurvey.pdf"**
  - **"2015.HSAP.Student PhoneInterview.DemoSurvey.pdf"**
- VT evaluators will also provide and review the assent/consent forms with participants just prior to conducting the Interview. Interviews will be audio-recorded for note taking purposes.

Interview Invitation Email:

Dear [participant],

I would like to inform you that evaluators from Virginia Tech will be carrying out interviews with High School Apprenticeship Program (HSAP) participants on behalf of the Army Research Office (ARO) and the Army Educational Outreach Program (AEOP). Virginia Tech is very interested in hearing your opinions about HSAP and would like to formally invite you to participate in one of the interviews, on the telephone, at a time listed below.

Purpose of the Interview:

Evaluators from Virginia Tech are conducting the evaluation study to determine if HSAP is achieving its objective(s) as a program, the results of which will be used by one of the primary sponsors of HSAP (U.S. Army) to ensure funding for the program in the future. Interviews provide evaluators the opportunity to speak with students and mentors about their experiences in HSAP which helps them illustrate and understanding how the HSAP program affects participants. In the end, Virginia Tech's findings will demonstrate HSAP's success as a program and to make HSAP better for future participants.

Interview Logistics:

We are working with the VT evaluation team to organize an interview during your HSAP experience. Interviews are being conducted across the HSAP program with student participants and with mentors (anyone who supervises, guides, or supports HSAP students) Please look at the dates, times, and locations of the interviews and decide which one you are available to attend:

1. ***Student Interview #1: Date, Time, Location of telephone or quiet room***
2. ***Student Interview #2: Date, Time, Location of telephone or quiet room***
3. ***Mentor Interview: Date, Time, Location of telephone or quiet room***

Participating in the Interview:

Interviews will be conducted with students across all HSAP sites and evaluators will ask all participants the same series of questions. The interview will take 15 – 20 minutes of your time. If you do not volunteer, Virginia Tech evaluators would still like to hear from you so they will send you an evaluation questionnaire after HSAP.

If you volunteer, please fill out the appropriate forms attached to this message – one for minors (17 yrs. or younger) and one for adults.

If you have questions about the HSAP interviews, please contact the VT evaluation team:

Tanner Bateman - tbateman@vt.edu.

Appendix B

FY15 HSAP Apprentice Data Summaries

2015 HSAP Youth Data Summary

So that we can determine how diverse students respond to participation in AEOP programs, please tell us about yourself and your school. What grade will you start in the fall? (select one)		
	Freq.	**%**
9th	0	0%
10th	1	3%
11th	21	60%
12th	11	31%
College freshman	0	0%
Other, (specify)	0	0%
Choose not to report	2	6%
Total	**35**	**100%**

What is your gender?		
	Freq.	**%**
Male	14	40%
Female	19	54%
Choose not to report	2	6%
Total	**35**	**100%**

What is your race or ethnicity?		
	Freq.	**%**
Hispanic or Latino	8	23%
Asian	2	6%
Black or African American	4	11%
Native American or Alaska Native	0	0%
Native Hawaiian or Other Pacific Islander	1	3%
White	17	48%
Other race or ethnicity, (specify):	1	6%
Choose not to report	2	3%
Total	**35**	**100%**

Note. Other = "White and Asian", and "Mixed".

Do you qualify for free or reduced lunches at school?		
	Freq.	**%**
Yes	8	16%
No	37	76%
Choose not to report	4	8%
Total	**8**	**100%**

Which best describes the location of your school?		
	Freq.	**%**
Frontier or tribal school	0	0%
Rural (country)	3	6%
Suburban	27	55%
Urban (city)	14	28%
Online School	0	0%
Total	**8**	**100%**

Where was the HSAP program located?		
	Freq.	%
Alabama State University*	1	2%
Brown University	1	2%
City University of New York	1	2%
Duke University	3*	6%
Hampton University*---	0	0%
Marshall	1	2%
Michigan State University	1	2%
North Carolina A&T*	6	12%
Rutgers	1	2%
Purdue	1	2%
San Diego State University*	1	2%
Stony Brook University	2	4%
Tufts University	2	4%
University of California, Berkeley	1	2%
University of California, Irvine	1	2%
University of California, Riverside*	4*	8%
University of California, Santa Barbara	4	8%
University of Alabama	1	2%
University of Arizona	1	2%
University of Central Florida	5*	10%
University of Houston, Victoria*	1	2%
University of Maryland, College Park	1	2%
University of Miami	2	4%
University of Missouri	2	4%
University of New Hampshire	1	2%
University of Notre Dame	1	2%
University of Puerto Rico*	1*	2%
University of Rochester	1	2%
University of the Incarnate Word*	1	2%
Total	49	100%

How often do you do each of the following in STEM classes at school this year?								
	1	**2**	**3**	**4**	**5**	**n**	**Avg.**	**SD**
Learn about science, technology, engineering, or mathematics (STEM) topics that are new to you	0.0%	0.0%	14.3%	42.9%	42.9%	35	4.29	.710
	0	0	5	15	15			
Apply STEM learning to real-life situations	0.0%	8.6%	48.6%	34.3%	8.6%	35	3.43	.778
	0	3	17	12	3			
Learn about new discoveries in STEM	5.7%	11.4%	51.4%	28.6%	2.9%	35	3.11	.867
	2	4	18	10	1			
Learn about different careers that use STEM	0.0%	14.3%	57.1%	20.0%	8.6%	35	3.23	.808
	0	5	20	7	3			
Interact with scientists or engineers	17.1%	31.4%	37.1%	5.7%	8.6%	35	2.57	1.119
	6	11	13	2	3			
Communicate with other students about STEM	0.0%	5.9%	23.5%	35.3%	35.3%	34	4.00	.921
	0	2	8	12	12			

Note. Response scale: **1** = "Not at all," **2** = "At least once," **3** = "A few times," **4** = "Most days," **5** = "Every day".

How often do you do each of the following in HSAP this year?								
	1	**2**	**3**	**4**	**5**	**n**	**Avg.**	**SD**
Learn about science, technology, engineering, or mathematics (STEM) topics that are new to you	0.0%	0.0%	0.0%	40.0%	60.0%	35	4.60	.497
	0	0	0	14	21			
Apply STEM learning to real-life situations	0.0%	2.9%	5.7%	22.9%	68.6%	35	4.57	.739
	0	1	2	8	24			
Learn about new discoveries in STEM	2.9%	0.0%	28.6%	45.7%	22.9%	35	3.86	.879
	1	0	10	16	8			
Learn about different careers that use STEM	0.0%	5.7%	31.4%	40.0%	22.9%	35	3.80	.868
	0	2	11	14	8			
Interact with scientists or engineers	0.0%	2.9%	8.6%	11.4%	77.1%	35	4.63	.770
	0	1	3	4	27			
Communicate with other students about STEM	0.0%	2.9%	5.7%	22.9%	68.6%	35	4.57	.739
	0	1	2	8	24			

Note. Response scale: **1** = "Not at all," **2** = "At least once," **3** = "A few times," **4** = "Most days," **5** = "Every day".

How often do you do each of the following in STEM classes at school this year?								
	1	2	3	4	5	n	Avg.	SD
Use laboratory procedures and tools	2.9%	5.7%	51.4%	34.3%	5.7%	35	3.34	.802
	1	2	18	12	2			
Participate in hands-on STEM activities	0.0%	5.7%	45.7%	37.1%	11.4%	35	3.54	.780
	0	2	16	13	4			
Work as part of a team	0.0%	2.9%	44.1%	44.1%	8.8%	34	3.59	.701
	0	1	15	15	3			
Identify questions or problems to investigate	2.9%	2.9%	51.4%	25.7%	17.1%	35	3.51	.919
	1	1	18	9	6			
Design an investigation	20.0%	17.1%	40.0%	20.0%	2.9%	35	2.69	1.105
	7	6	14	7	1			
Carry out an investigation	11.4%	17.1%	37.1%	31.4%	2.9%	35	2.97	1.043
	4	6	13	11	1			
Analyze data or information	0.0%	2.9%	34.3%	51.4%	11.4%	35	3.71	.710
	0	1	12	18	4			
Draw conclusions from an investigation	2.9%	8.6%	45.7%	34.3%	8.6%	35	3.37	.877
	1	3	16	12	3			
Come up with creative explanations or solutions	8.6%	20.0%	25.7%	37.1%	8.6%	35	3.17	1.124
	3	7	9	13	3			
Build or make a computer model	51.4%	25.7%	17.1%	0.0%	5.7%	35	1.83	1.098
	18	9	6	0	2			

Note. Response scale: **1** = "Not at all," **2** = "At least once," **3** = "A few times," **4** = "Most days," **5** = "Every day".

How often do you do each of the following in STEM classes at school this year?								
	Not at all	At least once	A few times	Most days	Every day	n	Avg.	SD
Learn about science, technology, engineering, or mathematics (STEM) topics that are new to you	0.0%	3.7%	3.7%	51.9%	40.7%	27	4.30	.724
	0	1	1	14	11			
Apply STEM learning to real-life situations	0.0%	7.4%	33.3%	44.4%	14.8%	27	3.67	.832
	0	2	9	12	4			
Learn about new discoveries in STEM	0.0%	7.4%	44.4%	40.7%	7.4%	27	3.48	.753
	0	2	12	11	2			
Learn about different careers that use STEM	3.7%	7.4%	55.6%	33.3%	0.0%	27	3.19	.736
	1	2	15	9	0			
Interact with scientists or engineers	7.4%	18.5%	22.2%	22.2%	29.6%	27	3.48	1.312
	2	5	6	6	8			
Communicate with other students about STEM	0.0%	0.0%	11.1%	44.4%	44.4%	27	4.33	.679
	0	0	3	12	12			

How much did each of the following resources help you learn about Army Educational Outreach Programs (AEOPs)?								
	Did not experience	Not at all	A little	Somewhat	Very much	n	Avg.	SD
Army Research Office (ARO) website	57.1%	0.0%	14.3%	8.6%	20.0%	35	2.34	1.679
	20	0	5	3	7			
Army Educational Outreach Program (AEOP) website	28.6%	0.0%	11.4%	28.6%	31.4%	35	3.34	1.626
	10	0	4	10	11			
AEOP on Facebook, Twitter, Pinterest or other social media	94.3%	0.0%	2.9%	2.9%	0.0%	35	1.14	.601
	33	0	1	1	0			
AEOP brochure	94.1%	0.0%	0.0%	0.0%	5.9%	34	1.24	.955
	32	0	0	0	2			
It Starts Here! Magazine	97.1%	0.0%	0.0%	2.9%	0.0%	35	1.09	. 507
	34	0	0	1	0			
My HSAP mentor(s)	28.6%	2.9%	8.6%	14.3%	45.7%	35	3.46	1.738
	10	1	3	5	16			
Invited speakers or "career" events during URAP	55.9%	8.8%	2.9%	23.5%	8.8%	34	2.21	1.533
	19	3	1	8	3			
Participation in HSAP	5.7%	0.0%	8.6%	28.6%	57.1%	35	4.31	1.051
	2	0	3	10	20			

How much did each of the following resources help you learn about STEM careers in the Army or Department of Defense (DoD)?								
	Did not experience	Not at all	A little	Somewhat	Very much	n	Avg.	SD
Army Research Office (ARO) website	57.1%	2.9%	8.6%	14.3%	17.1%	35	2.31	1.659
	20	1	3	5	6			
Army Educational Outreach Program (AEOP) website	31.4%	2.9%	22.9%	22.9%	20.0%	35	2.97	1.543
	11	1	8	8	7			
AEOP on Facebook, Twitter, Pinterest or other social media	88.2%	2.9%	5.9%	2.9%	0.0%	34	1.24	.699
	30	1	2	1	0			
AEOP brochure	91.4%	0.0%	2.9%	2.9%	2.9%	35	1.26	.886
	32	0	1	1	1			
It Starts Here! Magazine	94.3%	0.0%	2.9%	2.9%	0.0%	35	1.14	.601
	33	0	1	1	0			
My HSAP mentor(s)	14.3%	2.9%	25.7%	31.4%	25.7%	35	3.51	1.314
	5	1	9	11	9			
Invited speakers or "career" events during HSAP	57.1%	0.0%	17.1%	11.4%	14.3%	35	2.26	1.578
	20	0	6	4	5			
Participation in HSAP	11.4%	0.0%	25.7%	28.6%	34.3%	35	3.74	1.268
	4	0	9	10	12			

How SATISFIED were you with each of the following HSAP program features?	Did not experience	Not at all	A little	Somewhat	Very much	n	Avg.	SD
Applying or registering for the program	0.0%	0.0%	5.7%	37.1%	57.1%	35	4.51	.612
	0	0	2	13	20			
Other administrative tasks (in-processing, network access, etc.)	0.0%	0.0%	17.1%	40.0%	42.9%	35	4.26	.741
	0	0	6	14	15			
Communicating with your HSAP host site organizers	2.9%	0.0%	0.0%	40.0%	57.1%	35	4.49	.781
	1	0	0	14	20			
The physical location(s) of HSAP activities	0.0%	0.0%	5.7%	20.0%	74.3%	35	4.69	.583
	0	0	2	7	26			
The variety of STEM topics available to you in HSAP	0.0%	0.0%	5.7%	28.6%	65.7%	35	4.60	.604
	0	0	2	10	23			
Teaching or mentoring provided during HSAP activities	0.0%	0.0%	8.6%	14.3%	77.1%	35	4.69	.631
	0	0	3	5	27			
Stipends (payment)	0.0%	0.0%	0.0%	14.3%	85.7%	35	4.86	.355
	0	0	0	5	30			
Research abstract preparation requirements	0.0%	0.0%	5.7%	42.9%	51.4%	35	4.46	.611
	0	0	2	15	18			

How much input did you have in selecting your HSAP research project?	Freq.	%
I did not have a project	1	2.86%
I was assigned a project by my mentor	15	42.86%
I worked with my mentor to design a project	4	11.43%
I had a choice among various projects suggested by my mentor	7	20.00%
I worked with my mentor and members of a research team to design a project	7	20.00%
I designed the entire project on my own	1	2.86%
Total	**35**	**100%**

How often was your mentor available to you during HSAP?		
	Freq.	**%**
I did not have a mentor	0	0.00%
The mentor was never available	0	0.00%
The mentor was available less than half of the time	1	2.86%
The mentor was available about half of the time of my project	2	5.71%
The mentor was available more than half of the time	5	14.29%
The mentor was always available	27	77.14%
Total	**35**	**100%**

To what extent did you work as part of a group or team during HSAP?		
	Freq.	**%**
I worked alone (or alone with my research mentor)	2	5.71%
I worked with others in a shared laboratory or other space, but we work on different projects	11	31.43%
I worked alone on my project and I met with others regularly for general reporting or discussion	3	8.57%
I worked alone on a project that was closely connected with projects of others in my group	7	20.00%
I work with a group who all worked on the same project	12	34.29%
Total	**35**	**100%**

How SATISFIED were you with each of the following?								
	Did not experience	**Not at all**	**A little**	**Somewhat**	**Very much**	**n**	**Avg.**	**SD**
My working relationship with my mentor	0.0%	0.0%	5.7%	20.0%	74.3%	35	4.69	.583
	0	0	2	7	26			
My working relationship with the group or team	0.0%	0.0%	5.7%	25.7%	68.6%	35	4.63	.598
	0	0	2	9	24			
The amount of time I spent doing meaningful research	0.0%	0.0%	8.6%	25.7%	65.7%	35	4.57	.655
	0	0	3	9	23			
The amount of time I spent with my research mentor	0.0%	0.0%	14.3%	22.9%	62.9%	35	4.49	.742
	0	0	5	8	22			
The research experience overall	0.0%	0.0%	8.6%	17.1%	74.3%	35	4.66	.639
	0	0	3	6	26			

The list below describes mentoring strategies that are effective ways to support STEM learners. From the list below, please indicate which strategies that your mentor(s) used when working directly with you for HSAP:					
		Yes - my mentor used this strategy with me		No - my mentor did not use this strategy with me	
	n	Freq.	%	Freq.	%
Helped me become aware of STEM in my everyday life	34	24	70.6%	10	29.4%
Helped me understand how I can use STEM to improve my community	35	22	62.9%	13	37.1%
Used a variety of strategies to help me learn	35	32	91.4%	3	8.6%
Gave me extra support when I needed it	35	31	88.6%	4	11.4%
Encouraged me to share ideas with others who have different backgrounds or viewpoints than I do	35	20	57.1%	15	42.9%
Allowed me to work on a team project or activity	35	32	91.4%	3	8.6%
Helped me learn or practice a variety of STEM skills	35	30	85.7%	5	14.3%
Gave me feedback to help me improve in STEM	35	33	94.3%	2	5.7%
Talked to me about the education I need for a STEM career	35	23	65.7%	12	34.3%
Recommended Army Educational Outreach Programs that match my interests	35	10	28.6%	25	71.4%
Discussed STEM careers with the DoD or government	35	16	45.7%	19	54.3%

Which of the following statements apply to your research experience in HSAP? (Choose ALL that apply) (n = 29)						
	Freq.	%			Freq.	%
I presented a talk or poster to other students or faculty	11	37.93%		I will present a talk or poster to other students or faculty	12	41.38%
I presented a talk or poster at a professional symposium or conference	2	6.90%		I will present a talk or poster at a professional symposium or conference	3	10.34%
I attended a symposium or conference	12	41.38%		I will attend a symposium or conference	3	10.34%
I wrote or co-wrote a paper that was/will be published in a research journal	6	20.69%		I will write or co-write a paper that was/will be published in a research journal	11	37.93%
I wrote or co-wrote a technical paper or patent	3	10.34%		I will write or co-write a technical paper or patent	6	20.69%
				I won an award or scholarship based on my research	1	3.45%

AS A RESULT OF YOUR HSAP EXPERIENCE, how much did you GAIN in the following areas?								
	No gain	A little gain	Some gain	Large gain	Extreme gain	n	Avg.	SD
In depth knowledge of a STEM topic(s)	0.0%	0.0%	28.6%	42.9%	28.6%	35	4.00	.767
	0	0	10	15	10			
Knowledge of research conducted in a STEM topic or field	0.0%	0.0%	5.7%	57.1%	37.1%	35	4.31	.583
	0	0	2	20	13			
Knowledge of research processes, ethics, and rules for conduct in STEM	0.0%	8.6%	14.3%	40.0%	37.1%	35	4.06	.938
	0	3	5	14	13			
Knowledge of how scientists and engineers work on real problems in STEM	0.0%	0.0%	22.9%	28.6%	48.6%	35	4.26	.817
	0	0	8	10	17			
Knowledge of what everyday research work is like in STEM	0.0%	0.0%	17.1%	20.0%	62.9%	35	4.46	.780
	0	0	6	7	22			

Which category best describes the focus of your HSAP experience?		
	Freq.	%
Science	21	60.00%
Technology	6	17.14%
Engineering	7	20.00%
Mathematics	1	2.86%
Total	**35**	**100%**

AS A RESULT OF YOUR HSAP EXPERIENCE, how much did you GAIN in the following areas?								
	No gain	A little gain	Some gain	Large gain	Extreme gain	n	Avg.	SD
Asking a question that can be answered with one or more scientific experiments	4.8%	0.0%	38.1%	28.6%	28.6%	21	3.76	1.044
	1	0	8	6	6			
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	4.8%	4.8%	38.1%	19.0%	33.3%	21	3.71	1.146
	1	1	8	4	7			
Making a model of an object or system showing its parts and how they work	28.6%	14.3%	14.3%	19.0%	23.8%	21	2.95	1.596
	6	3	3	4	5			
Designing procedures for an experiment that are appropriate for the question to be answered	14.3%	4.8%	23.8%	23.8%	33.3%	21	3.57	1.399
	3	1	5	5	7			
Identifying the limitations of the methods and tools used for data collection	0.0%	0.0%	19.0%	42.9%	38.1%	21	4.19	.750
	0	0	4	9	8			
Carrying out procedures for an experiment and recording data accurately	0.0%	4.8%	4.8%	47.6%	42.9%	21	4.29	.784
	0	1	1	10	9			
Using computer models of objects or systems to test cause and effect relationships	38.1%	9.5%	14.3%	14.3%	23.8%	21	2.76	1.670
	8	2	3	3	5			
Organizing data in charts or graphs to find patterns and relationships	9.5%	9.5%	19.0%	23.8%	38.1%	21	3.71	1.347
	2	2	4	5	8			
Considering different interpretations of data when deciding how the data answer a question	4.8%	9.5%	23.8%	23.8%	38.1%	21	3.81	1.209
	1	2	5	5	8			
Supporting an explanation for an observation with data from experiments	0.0%	9.5%	28.6%	23.8%	38.1%	21	3.90	1.044
	0	2	6	5	8			
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	0.0%	9.5%	33.3%	23.8%	33.3%	21	3.81	1.030
	0	2	7	5	7			
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	0.0%	19.0%	19.0%	33.3%	28.6%	21	3.71	1.102
	0	4	4	7	6			
Defending an argument that conveys how an explanation best describes an observation	0.0%	33.3%	14.3%	28.6%	23.8%	21	3.43	1.207
	0	7	3	6	5			
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	4.8%	19.0%	19.0%	33.3%	23.8%	21	3.52	1.209
	1	4	4	7	5			
Integrating information from technical or scientific texts and other media to support your explanation of an observation	0.0%	19.0%	23.8%	33.3%	23.8%	21	3.62	1.071
	0	4	5	7	5			
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	9.5%	19.0%	4.8%	38.1%	28.6%	21	3.57	1.363
	2	4	1	8	6			

AS A RESULT OF YOUR HSAP EXPERIENCE, how much did you GAIN in the following areas?	No gain	A little gain	Some gain	Large gain	Extreme gain	n	Avg.	SD
Defining a problem that can be solved by developing a new or improved object, process, or system	0.0%	14.3%	35.7%	35.7%	14.3%	14	3.50	.941
	0	2	5	5	2			
Using knowledge and creativity to propose a testable solution for a problem	7.1%	7.1%	35.7%	35.7%	14.3%	14	3.43	1.089
	1	1	5	5	2			
Making a model of an object or system to show its parts and how they work	21.4%	14.3%	14.3%	28.6%	21.4%	14	3.14	1.512
	3	2	2	4	3			
Designing procedures for an experiment that are appropriate for the question to be answered	7.1%	14.3%	42.9%	21.4%	14.3%	14	3.21	1.122
	1	2	6	3	2			
Identifying the limitations of the methods and tools used for data collection	0.0%	14.3%	35.7%	35.7%	14.3%	14	3.43	.938
	0	2	5	5	2			
Carrying out procedures for an experiment and recording data accurately	7.1%	7.1%	35.7%	35.7%	14.3%	14	3.21	1.051
	1	1	5	5	2			
Using computer models of an object or system to investigate cause and effect relationships	21.4%	14.3%	14.3%	28.6%	21.4%	14	3.57	1.555
	3	2	2	4	3			
Considering different interpretations of the data when deciding if a solution works as intended	7.1%	14.3%	42.9%	21.4%	14.3%	14	3.29	1.069
	1	2	6	3	2			
Organizing data in charts or graphs to find patterns and relationships	0.0%	14.3%	42.9%	28.6%	14.3%	14	3.86	1.292
	0	2	6	4	2			
Supporting a solution for a problem with data from experiments	7.1%	7.1%	57.1%	14.3%	14.3%	14	3.29	1.069
	1	1	8	2	2			
Supporting a solution with relevant scientific, mathematical, and/or engineering knowledge	14.3%	14.3%	14.3%	14.3%	42.9%	14	3.36	1.082
	2	2	2	2	6			
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	7.1%	14.3%	28.6%	42.9%	7.1%	14	3.21	1.122
	1	2	4	6	1			
Defend an argument that conveys how a solution best meets design criteria	7.1%	7.1%	21.4%	21.4%	42.9%	14	2.86	1.231
	1	1	3	3	6			
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	7.1%	7.1%	50.0%	21.4%	14.3%	14	3.29	1.069
	1	1	7	3	2			
Integrating information from technical or scientific texts and other media to support your solution to a problem	7.1%	7.1%	42.9%	28.6%	14.3%	14	3.21	1.251
	1	1	6	4	2			
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations)	7.1%	14.3%	42.9%	21.4%	14.3%	14	3.71	1.069
	1	2	6	3	2			

AS A RESULT OF YOUR HSAP EXPERIENCE, how much did you GAIN in the following areas?								
	No gain	A little gain	Some gain	Large gain	Extreme gain	n	Avg.	SD
Learning to work independently	0.0%	0.0%	25.7%	42.9%	31.4%	35	4.06	.765
	0	0	9	15	11			
Setting goals and reflecting on performance	2.9%	5.7%	17.1%	42.9%	31.4%	35	3.94	.998
	1	2	6	15	11			
Sticking with a task until it is finished	0.0%	2.9%	35.3%	26.5%	35.3%	34	3.94	.919
	0	1	12	9	12			
Making changes when things do not go as planned	2.9%	2.9%	17.1%	37.1%	40.0%	35	4.09	.981
	1	1	6	13	14			
Working well with people from all backgrounds	5.7%	2.9%	28.6%	20.0%	42.9%	35	3.91	1.173
	2	1	10	7	15			
Including others' perspectives when making decisions	2.9%	8.6%	28.6%	20.0%	40.0%	35	3.86	1.141
	1	3	10	7	14			
Communicating effectively with others	2.9%	2.9%	22.9%	31.4%	40.0%	35	4.03	1.014
	1	1	8	11	14			
Viewing failure as an opportunity to learn	2.9%	5.7%	22.9%	25.7%	42.9%	35	4.00	1.085
	1	2	8	9	15			

AS A RESULT OF YOUR HSAP EXPERIENCE, how much did you GAIN in the following areas?								
	No gain	A little gain	Some gain	Large gain	Extreme gain	n	Avg.	SD
Interest in a new STEM topic	8.6%	0.0%	20.0%	40.0%	31.4%	35	3.86	1.141
	3	0	7	14	11			
Deciding on a path to pursue a STEM career	2.9%	5.7%	28.6%	28.6%	34.3%	35	3.86	1.061
	1	2	10	10	12			
Sense of accomplishing something in STEM	2.9%	2.9%	22.9%	34.3%	37.1%	35	4.00	1.000
	1	1	8	12	13			
Feeling prepared for more challenging STEM activities	2.9%	5.7%	17.1%	31.4%	42.9%	35	4.06	1.056
	1	2	6	11	15			
Confidence to try out new ideas or procedures on my own in a STEM project	2.9%	5.7%	22.9%	25.7%	42.9%	35	4.00	1.085
	1	2	8	9	15			
Patience for the slow pace of STEM research	2.9%	2.9%	26.5%	32.4%	35.3%	34	3.94	1.013
	1	1	9	11	12			
Desire to build relationships with mentors who work in STEM	5.7%	5.7%	8.6%	34.3%	45.7%	35	4.09	1.147
	2	2	3	12	16			
Connecting a STEM topic or field to my personal values	5.7%	0.0%	31.4%	25.7%	37.1%	35	3.89	1.105
	2	0	11	9	13			

AS A RESULT OF YOUR HSAP experience, how much MORE or LESS likely are you to engage in the following activities in science, technology, engineering, or mathematics (STEM) outside of school requirements or activities?								
	Much less likely	Less likely	About the same before and after	More likely	Much more likely	n	Avg.	SD
Watch or read non-fiction STEM	2.9%	0.0%	54.3%	22.9%	20.0%	35	3.57	.917
	1	0	19	8	7			
Tinker (play) with a mechanical or electrical device	2.9%	2.9%	42.9%	31.4%	20.0%	35	3.63	.942
	1	1	15	11	7			
Work on solving mathematical or scientific puzzles	0.0%	0.0%	37.1%	42.9%	20.0%	35	3.83	.747
	0	0	13	15	7			
Use a computer to design or program something	5.7%	2.9%	31.4%	28.6%	31.4%	35	3.77	1.114
	2	1	11	10	11			
Talk with friends or family about STEM	0.0%	2.9%	25.7%	48.6%	22.9%	35	3.91	.781
	0	1	9	17	8			
Mentor or teach other students about STEM	0.0%	2.9%	14.3%	48.6%	34.3%	35	4.14	.772
	0	1	5	17	12			
Help with a community service project related to STEM	0.0%	0.0%	31.4%	40.0%	28.6%	35	3.97	.785
	0	0	11	14	10			
Participate in a STEM camp, club, or competition	0.0%	2.9%	31.4%	37.1%	28.6%	35	3.91	.853
	0	1	11	13	10			
Take an elective (not required) STEM class	0.0%	0.0%	34.3%	34.3%	31.4%	35	3.97	.822
	0	0	12	12	11			
Work on a STEM project or experiment in a university or professional setting	0.0%	2.9%	8.6%	25.7%	62.9%	35	4.49	.781
	0	1	3	9	22			

Before you participated in HSAP, how far did you want to go in school?		
	Freq.	%
Go to a trade or vocational school	0	0.00%
Go to college for a little while	0	0.00%
Finish college (get a Bachelor's degree)	0	0.00%
Get more education after college	6	17.14%
Get a master's degree	2	5.71%
Get a Ph.D.	11	31.43%
Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)	9	25.71%
Get a combined M.D. / Ph.D.	3	8.57%
Get another professional degree (law, business, etc.)	4	11.43%
Total	**35**	**100%**

After you have participated in HSAP, how far do you want to go in school?		
	Freq.	**%**
Go to a trade or vocational school	0	0.00%
Go to college for a little while	0	0.00%
Finish college (get a Bachelor's degree)	0	0.00%
Get more education after college	1	2.86%
Get a master's degree	2	5.71%
Get a Ph.D.	6	17.14%
Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)	18	51.43%
Get a combined M.D. / Ph.D.	2	5.71%
Get another professional degree (law, business, etc.)	5	14.29%
Total	**35**	**100%**

When you are 30, to what extent do you expect to use your STEM knowledge, skills, and/or abilities in your work?		
	Freq.	**%**
not at all	0	0.00%
less than 25% of the time	0	0.00%
26% to 50% of the time	1	2.86%
51% to 75% of the time	14	40.00%
76% to 100% of the time	20	57.14%
Total	**35**	**100%**

BEFORE HSAP, what kind of work did you expect to be doing when you are 30 years old (select the ONE answer that best describes your career goals BEFORE HSAP)

	Freq.	%		Freq.	%
Other, (specify):	2	5.71%	Mathematics or statistics	2	5.71%
Undecided	6	17.14%	Medicine (doctor, dentist, veterinarian, etc.)	3	8.57%
Science (no specific subject)	3	8.57%	Health (nursing, pharmacy, technician, etc.)	0	0.00%
Physical science (physics, chemistry, astronomy, materials science)	3	8.57%	Social science (psychologist, sociologist, etc.)	0	0.00%
Biological science	0	0.00%	Teaching, STEM	0	0.00%
Earth, atmospheric or oceanic science	0	0.00%	Teaching, non-STEM	1	2.86%
Environmental science	6	17.14%	Business	0	0.00%
Computer science	0	0.00%	Law	0	0.00%
Technology	8	22.86%	Military, police, or security	1	2.86%
Engineering	2	5.71%	Art (writing, dancing, painting, etc.)	0	0.00%
			Skilled trade (carpenter, electrician, plumber, etc.)	0	0.00%
			Total	35	100%

AFTER HSAP, what kind of work do you expect to be doing when you are 30 years old? (select the ONE answer that best describes your career goals AFTER HSAP)

	Freq.	%		Freq.	%
Undecided	1	2.94%	Medicine (doctor, dentist, veterinarian, etc.)	3	8.82%
Science (no specific subject)	3	8.82%	Health (nursing, pharmacy, technician, etc.)	0	0.00%
Physical science (physics, chemistry, astronomy, materials science)	5	14.71%	Social science (psychologist, sociologist, etc.)	0	0.00%
Biological science	2	5.88%	Teaching, STEM	0	0.00%
Earth, atmospheric or oceanic science	0	0.00%	Teaching, non-STEM	0	0.00%
Environmental science	0	0.00%	Business	0	0.00%
Computer science	6	17.65%	Law	0	0.00%
Technology	0	0.00%	Military, police, or security	1	2.94%
Engineering	10	29.41%	Art (writing, dancing, painting, etc.)	0	0.00%
Mathematics or statistics	1	2.94%	Skilled trade (carpenter, electrician, plumber, etc.)	0	0.00%
			Other, (specify):	2	5.88%
			Total	34	100%

How interested are you in participating in the following programs in the future?

	I've never heard of this program	Not at all	A little	Somewhat	Very much	n	Avg.	SD
UNITE	94.3%	0.0%	0.0%	2.9%	2.9%	35	1.20	.833
	33	0	0	1	1			
Junior Science & Humanities Symposium (JSHS)	85.7%	0.0%	2.9%	2.9%	8.6%	35	1.49	1.245
	30	0	1	1	3			
Science & Engineering Apprenticeship Program (SEAP)	45.7%	2.9%	8.6%	28.6%	14.3%	35	2.63	1.629
	16	1	3	10	5			
Research & Engineering Apprenticeship Program (REAP)	51.4%	0.0%	14.3%	20.0%	14.3%	35	2.46	1.615
	18	0	5	7	5			
College Qualified Leaders (CQL)	85.7%	0.0%	0.0%	5.7%	8.6%	35	1.51	1.292
	30	0	0	2	3			
GEMS Near Peer Mentor Program	82.4%	0.0%	5.9%	2.9%	8.8%	34	1.56	1.284
	28	0	2	1	3			
Undergraduate Research Apprenticeship Program (URAP)	11.4%	0.0%	8.6%	25.7%	54.3%	35	4.11	1.301
	4	0	3	9	19			
Science Mathematics, and Research for Transformation (SMART) College Scholarship	48.6%	0.0%	2.9%	17.1%	31.4%	35	2.83	1.855
	17	0	1	6	11			
National Defense Science & Engineering Graduate (NDSEG) Fellowship	62.9%	0.0%	2.9%	14.3%	20.0%	35	2.29	1.742
	22	0	1	5	7			

How many jobs/careers in science, technology, engineering, or math (STEM) did you learn about during HSAP?

	Freq.	%
None	3	8.57%
1	3	8.57%
2	7	20.00%
3	5	14.29%
4	2	5.71%
5 or more	15	42.86%
Total	**35**	**100%**

How many Department of Defense (DoD) STEM jobs/careers did you learn about during HSAP?		
	Freq.	**%**
None	13	37.14%
1	7	20.00%
2	5	14.29%
3	5	14.29%
4	0	0.00%
5 or more	5	14.29%
Total	**35**	**100%**

Rate how much you agree or disagree with each of the following statements about Department of Defense (DoD) researchers and research:								
	Strongly Disagree	**Disagree**	**Neither Agree nor Disagree**	**Agree**	**Strongly Agree**	**n**	**Avg.**	**SD**
DoD researchers advance science and engineering fields	0.0%	0.0%	5.7%	48.6%	45.7%	35	4.40	.604
	0	0	2	17	16			
DoD researchers develop new, cutting edge technologies	0.0%	0.0%	5.7%	54.3%	40.0%	35	4.34	.591
	0	0	2	19	14			
DoD researchers solve real-world problems	0.0%	0.0%	5.7%	45.7%	48.6%	35	4.43	.608
	0	0	2	16	17			
DoD research is valuable to society	0.0%	0.0%	5.7%	37.1%	57.1%	35	4.51	.612
	0	0	2	13	20			

Which of the following statements describe you after participating in HSAP?							
	1	2	3	4	n	Avg.	SD
I am more confident in my STEM knowledge, skills, and abilities	0.0%	5.7%	62.9%	31.4%	35	3.26	.561
	0	2	22	11			
I am more interested in participating in STEM activities outside of school requirements	5.7%	14.3%	48.6%	31.4%	35	3.06	.838
	2	5	17	11			
I am more aware of other AEOPs	34.3%	8.6%	28.6%	28.6%	35	2.51	1.245
	12	3	10	10			
I am more interested in participating in other AEOPs	11.4%	5.7%	45.7%	37.1%	35	3.09	.951
	4	2	16	13			
I am more interested in taking STEM classes in school	5.7%	25.7%	48.6%	20.0%	35	2.83	.822
	2	9	17	7			
I am more interested in earning a STEM degree	2.9%	22.9%	51.4%	22.9%	35	2.94	.765
	1	8	18	8			
I am more interested in pursuing a career in STEM	5.7%	14.3%	60.0%	20.0%	35	2.94	.765
	2	5	21	7			
I am more aware of Army or DoD STEM research and careers	31.4%	0.0%	34.3%	34.3%	35	2.71	1.250
	11	0	12	12			
I have a greater appreciation of Army or DoD STEM research	8.6%	2.9%	48.6%	40.0%	35	3.20	.868
	3	1	17	14			
I am more interested in pursuing a STEM career with the Army or DoD	34.3%	5.7%	31.4%	28.6%	35	2.54	1.245
	12	2	11	10			

Note. Response scale: 1 = "Disagree – This did not happen," 2 = "Disagree – This happened but not because of HSAP," 3 = "Agree – HSAP contributed," 4 = "Agree – HSAP was the primary reason".

How did you learn about HSAP? (n = 50)						
	Freq.	%				
Army Educational Outreach Program (AEOP) website	9	18%				
AEOP on Facebook, Twitter, Pinterest, or other social media	1	2%				
School or university newsletter, email, or website	10	**20%**				
Past participant of HSAP	0	0%				
Friend	9	18%				
Family member	5	10%				
Friend or co-worker of a family member	3	6%				
Someone who works at the school or university I attend	24	**48%**				
Someone who works with HSAP	13	**26%**				
Someone who works with the Department of Defense (Army, Navy, Air Force)	0	0%				
Community group or program	1	2%				
Other	1	2%				
Choose not to report	0	0%				

*Note - data from HSAP registration/application records

How motivating were the following factors in your decision to participate in HSAP? (n=50)	
Teacher or professor encouragement	1 (2%)
An academic requirement or school grade	0 (0%)
Desire to learn something new or interesting	23 (46%)
The program mentor(s)	1 (2%)
Building college application or resume	10 (20%)
Networking opportunities	2 (4%)
Interest in science, technology, engineering, or mathematics (STEM)	35 (70%)
Interest in STEM careers with the Army	6 (12%)
Having fun	3 (6%)
Earning stipends or awards for doing STEM	2 (4%)
Opportunity to do something with friends	0 (0%)
Opportunity to use advanced laboratory technology	11 (22%)
Desire to expand laboratory or research skills	22 (44%)
Learning in ways that are not possible in school	16 (32%)
Serving the community or country	3 (6%)
Recommendations of past participants	0 (0%)

Figuring out education or career goals	8 (16%)
Exploring a unique work environment	5 (10%)
Seeing how school learning applies to real life	2 (4%)
Other	0 (0%)

*Note - data from HSAP registration/application records

Appendix C

FY15 HSAP Mentor Data Summaries

2015 HSAP Mentor Data Summary

What is your gender?		
	Freq.	%
Female	7	17%
Male	34	83%
No Response	0	0%
Total	16	100%

What is your race or ethnicity?		
	Freq.	%
Asian	16	39%
Black or African American	2	5%
Hispanic or Latino	3	7%
Native American or Alaska Native	0	0%
Native Hawaiian or Other Pacific Islander	0	0%
White	20	49%
No Response	0	0%
Total	41	100%

Which of the following BEST describes your current occupation? (select ONE)		
	Freq.	%
Teacher	0	0.00%
Other school staff	0	0.00%
University educator	15	60.00%
Scientist, Engineer, or Mathematician in training (undergraduate or graduate student, etc.)	4	16.00%
Scientist, Engineer, or Mathematics professional	5	20.00%
Other, (specify):	1	4.00%
Total	25	100%

Which of the following BEST describes the organization you work for? (select ONE)		
	Freq.	%
No organization	0	0.00%
School or district (K-12)	0	0.00%
State educational agency	0	0.00%
Institution of higher education (vocational school, junior college, college, or university)	25	100.00%
Industry	0	0.00%
Department of Defense or other government agency	0	0.00%
Non-profit	0	0.00%
Other, (specify):	0	0.00%
Total	25	100%

Which of the following best describes your primary area of research?						
	Freq.	**%**			**Freq.**	**%**
Physical science (physics, chemistry, astronomy, materials science, etc.)	13	52.00%		**Technology**	0	0.00%
Biological science	1	4.00%		**Engineering**	7	28.00%
Earth, atmospheric, or oceanic science	0	0.00%		**Mathematics or statistics**	1	4.00%
Environmental science	0	0.00%		**Medical, health, or behavioral science**	0	0.00%
Computer science	2	8.00%		**Social Science (psychology, sociology, anthropology)**	0	0.00%
				Other, (specify):	1	4.00%
				Total	**25**	**100%**

Which of the following BEST describes your role during HSAP?		
	Freq.	%
Research Mentor	23	92.00%
Research Team Member but not a Principal Investigator (PI)	2	8.00%
Other, (specify)	0	0.00%
Total	25	100%

How many HSAP students did you work with this year?		
# of Students	Freq.	%
1	13	52%
2	9	36%
3	2	8%
4	1	4%
5	0	0%
6	0	0%
Total	25	100%

Where was the HSAP program located? (Select ONE)

	Freq.	%		Freq.	%
Alabama State University*	1	3%	University of California, Irvine	1	3%
Brown University	1	3%	University of California, Riverside*	3	3%
City University of New York	1	3%	University of California, Santa Barbara	2	3%
Duke University	1	3%	University of Alabama	1	3%
Hampton University*---	0	0%	University of Arizona	1	3%
Marshall	1	3%	University of Central Florida	2	6%
Michigan State University	1	3%	University of Houston, Victoria*	1	3%
North Carolina A&T*	4	11%	University of Maryland, College Park	1	3%
Rutgers	1	3%	University of Miami	1	3%
Purdue	1	3%	University of Missouri	1	3%
San Diego State University*	1	3%	University of New Hampshire	1	3%
Stony Brook University	1	3%	University of Notre Dame	1	3%
Tufts University	1	3%	University of Puerto Rico*	1	3%
University of California, Berkeley	1	3%	University of Rochester	1	3%
			University of the Incarnate Word*	1	3%
			Total	35	100%

How did you learn about HSAP? (Check all that apply) (n = 25)						
	Freq.	%			Freq.	%
Army Research Office (ARO) website	13	0%		A colleague	0	0.00%
Army Educational Outreach Program (AEOP) website	6	0%		My supervisor or superior	5	20.00%
AEOP on Facebook, Twitter, Pinterest, or other social media	0	0%		A HSAP site host or director	3	12.00%
A STEM conference or STEM education conference	0	0%		Workplace communications	0	0.00%
An email or newsletter from school, university, or a professional organization	3	0%		Someone who works with the Department of Defense (Army, Navy, Air Force)	6	24.00%
Past HSAP participant	0	0%		Other, (specify):	1	4.00%
A student	0	0%				

Which of the following were used for the purpose of recruiting your student(s) for apprenticeships? (select ALL that apply) (n = 24						
	Freq.	%			Freq.	%
Applications from Army Research Office (ARO) or the AEOP	20	83.33%		Communication(s) generated by a university or faculty (newsletter, email blast, website)	3	12.50%
Personal acquaintance(s) (friend, family, neighbor, etc.)	10	41.67%		STEM or STEM Education conference(s) or event(s)	2	8.33%
Colleague(s) in my workplace	12	50.00%		Organization(s) that serve underserved or underrepresented populations	1	4.17%
K-12 school teacher(s) outside of my workplace	13	54.17%		The student contacted me (the mentor) about the program	5	20.83%
University faculty outside of my workplace	5	20.83%		I do not know how student(s) were recruited for HSAP	0	0.00%
Informational materials sent to K-12 schools or Universities outside of my workplace	10	41.67%		Other, (specify):	0	0.00%
Communication(s) generated by a K-12 school or teacher (newsletter, email blast, website)	1	4.17%				

How many times have YOU PARTICIPATED in any of the following Army Educational Outreach Programs (AEOPs) in any capacity?								
	Not at all	At least once	A few times	Most days	Every day	n	Avg.	SD
Camp Invention	42.9%	0.0%	0.0%	0.0%	57.1%	21	4.50	0.63
	9	0	0	0	12			
eCYBERMISSION	33.3%	0.0%	0.0%	0.0%	66.7%	21	4.00	0.73
	7	0	0	0	14			
Junior Solar Sprint (JSS)	33.3%	0.0%	0.0%	0.0%	66.7%	21	3.94	0.93
	7	0	0	0	14			
Junior Science & Humanities Symposium (JSHS)	38.1%	0.0%	0.0%	0.0%	61.9%	21	3.56	0.96
	8	0	0	0	13			
Gains in the Education of Mathematics and Science (GEMS)	38.1%	0.0%	0.0%	0.0%	61.9%	21	4.25	0.86
	8	0	0	0	13			
GEMS Near Peers	38.1%	0.0%	0.0%	0.0%	61.9%	21	4.25	0.86
	8	0	0	0	13			
UNITE	42.9%	0.0%	0.0%	0.0%	57.1%	21	4.63	0.81
	9	0	0	0	12			
Science & Engineering Apprenticeship Program (SEAP)	47.6%	4.8%	0.0%	0.0%	47.6%	21	4.63	0.81
	10	1	0	0	10			
Research & Engineering Apprenticeship Program (REAP)	47.6%	4.8%	4.8%	0.0%	42.9%	21	4.25	1.18
	10	1	1	0	9			
High School Apprenticeship Program (HSAP)	4.3%	73.9%	4.3%	13.0%	4.3%	21	4.19	0.66
	1	17	1	3	1			
College Qualified Leaders (CQL)	50.0%	0.0%	0.0%	0.0%	50.0%	23	4.06	0.77
	10	0	0	0	10			
Undergraduate Research Apprenticeship Program (URAP)	36.4%	54.5%	4.5%	0.0%	4.5%	22	4.56	0.51
	8	12	1	0	1			
Science Mathematics, and Research for Transformation (SMART) College Scholarship	47.6%	4.8%	0.0%	0.0%	47.6%	21	4.31	0.87
	10	1	0	0	10			
National Defense Science & Engineering Graduate (NDSEG) Fellowship	57.1%	14.3%	0.0%	0.0%	28.6%	21	4.31	0.79
	12	3	0	0	6			

Note. Response scale: 1 = "Not at all," 2 = "At least once," 3 = "A few times," 4 = "Most days," 5 = "Every day".

How SATISFIED were you with each of the following HSAP program features?

	Did not experience	Not at all	A little	Somewhat	Very much	n	Avg.	SD
Application or registration process	12.5%	0.0%	0.0%	50.0%	37.5%	**24**	4.00	1.25
	3	0	0	12	9			
Other administrative tasks (in-processing, network access, etc.)	4.2%	0.0%	12.5%	20.8%	62.5%	**24**	4.38	1.01
	1	0	3	5	15			
Communicating with Army Research Office (ARO)	8.3%	0.0%	4.2%	12.5%	75.0%	**24**	4.46	1.18
	2	0	1	3	18			
Communicating with HSAP organizers	4.2%	0.0%	8.3%	12.5%	75.0%	**24**	4.54	0.98
	1	0	2	3	18			
Support for instruction or mentorship during program activities	16.7%	4.2%	0.0%	20.8%	58.3%	**24**	4.00	1.53
	4	1	0	5	14			
Stipends (payment)	16.7%	4.2%	0.0%	16.7%	62.5%	**24**	4.04	1.55
	4	1	0	4	15			
Research abstract preparation requirements	4.2%	0.0%	4.2%	25.0%	66.7%	**24**	4.50	0.93
	1	0	1	6	16			

The list below describes mentoring strategies that are effective ways to establish the relevance of learning activities for students. From the list below, please indicate which strategies you used when working with your student(s) in HSAP.

		Yes – I used this strategy		No – I did not use this strategy	
	n	Freq.	%	Freq.	%
Become familiar with my student(s) background and interests at the beginning of the HSAP experience	24	24	100.0%	0	0.0%
Giving students real-life problems to investigate or solve	25	23	92.0%	2	8.0%
Selecting readings or activities that relate to students' backgrounds	24	21	87.5%	3	12.5%
Encouraging students to suggest new readings, activities, or projects	25	20	80.0%	5	20.0%
Helping students become aware of the role(s) that STEM plays in their everyday lives	24	18	75.0%	6	25.0%
Helping students understand how STEM can help them improve their own community	24	13	54.2%	11	45.8%
Asking students to relate real-life events or activities to topics covered in HSAP	24	17	70.8%	7	29.2%

The list below describes mentoring strategies that are effective ways to support the diverse needs of students as learners. From the list below, please indicate which strategies you used when working with your student(s) in HSAP.					
		Yes – I used this strategy		No – I did not use this strategy	
	n	Freq.	%	Freq.	%
Identify the different learning styles that my student (s) may have at the beginning of the HSAP experience	24	20	83.3%	4	16.7%
Interact with students and other personnel the same way regardless of their background	25	22	88.0%	3	12.0%
Use a variety of teaching and/or mentoring activities to meet the needs of all students	25	24	96.0%	1	4.0%
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	24	13	54.2%	11	45.8%
Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	25	25	100.0%	0	0.0%
Directing students to other individuals or programs for additional support as needed	25	21	84.0%	4	16.0%
Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	25	13	52.0%	12	48.0%

The list below describes mentoring strategies that are effective ways to support students' development of collaboration and interpersonal skills. From the list below, please indicate which strategies you used when working with your student(s) in HSAP.					
		Yes – I used this strategy		No – I did not use this strategy	
	n	Freq.	%	Freq.	%
Having my student(s) tell other people about their backgrounds and interests	25	18	72.0%	7	28.0%
Having my student(s) explain difficult ideas to others	25	24	96.0%	1	4.0%
Having my student(s) listen to the ideas of others with an open mind	25	24	96.0%	1	4.0%
Having my student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	25	20	80.0%	5	20.0%
Having my student(s) give and receive constructive feedback with others	25	25	100.0%	0	0.0%
Having students work on collaborative activities or projects as a member of a team	25	25	100.0%	0	0.0%
Allowing my student(s) to resolve conflicts and reach agreement within their team	25	22	88.0%	3	12.0%

The list below describes mentoring strategies that are effective ways to support students' engagement in "authentic" STEM activities. From the list below, please indicate which strategies you used when working with your student(s) in HSAP.

		Yes – I used this strategy		No – I did not use this strategy	
	n	Freq.	%	Freq.	%
Teaching (or assigning readings) about specific STEM subject matter	25	24	96.0%	1	4.0%
Having my student(s) search for and review technical research to support their work	25	24	96.0%	1	4.0%
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	25	25	100.0%	0	0.0%
Supervising my student(s) while they practice STEM research skills	25	25	100.0%	0	0.0%
Providing my student(s) with constructive feedback to improve their STEM competencies	25	25	100.0%	0	0.0%
Allowing students to work independently to improve their self-management abilities	25	25	100.0%	0	0.0%
Encouraging students to learn collaboratively (team projects, team meetings, journal clubs, etc.)	25	24	96.0%	1	4.0%
Encouraging students to seek support from other team members	25	24	96.0%	1	4.0%

The list below describes mentoring strategies that are effective ways to support students' STEM educational and career pathways. The list also includes items that reflect AEOP and Army priorities. From the list below, please indicate which strategies you used when working with your student(s) in HSAP.

		Yes – I used this strategy		No – I did not use this strategy	
	n	Freq.	%	Freq.	%
Asking my student(s) about their educational and/or career goals	25	24	96.0%	1	4.0%
Recommending extracurricular programs that align with students' goals	24	18	75.0%	6	25.0%
Recommending Army Educational Outreach Programs that align with students' goals	24	12	50.0%	12	50.0%
Providing guidance about educational pathways that will prepare my student(s) for a STEM career	24	24	100.0%	0	0.0%
Discussing STEM career opportunities within the DoD or other government agencies	25	15	60.0%	10	40.0%
Discussing STEM career opportunities in private industry or academia	25	23	92.0%	2	8.0%
Discussing the economic, political, ethical, and/or social context of a STEM career	25	16	64.0%	9	36.0%
Recommending student and professional organizations in STEM to my student(s)	25	15	60.0%	10	40.0%
Helping students build a professional network in a STEM field	25	18	72.0%	7	28.0%
Helping my student(s) with their resume, application, personal statement, and/or interview preparations	25	15	60.0%	10	40.0%

How USEFUL were each of the following in your efforts to expose student(s) to Army Educational Outreach Programs (AEOPs) during HSAP?

	Did not experience	Not at all	A little	Somewhat	Very much	n	Avg.	SD
Army Research Office (ARO) website	32.0%	0.0%	4.0%	32.0%	32.0%	**25**	3.32	1.70
	8	0	1	8	8			
Army Educational Outreach Program (AEOP) website	33.3%	0.0%	4.2%	33.3%	29.2%	**24**	3.25	1.70
	8	0	1	8	7			
AEOP on Facebook, Twitter, Pinterest or other social media	76.0%	12.0%	8.0%	4.0%	0.0%	**25**	1.40	0.82
	19	3	2	1	0			
AEOP brochure	48.0%	8.0%	8.0%	24.0%	12.0%	**25**	2.44	1.58
	12	2	2	6	3			
It Starts Here! Magazine	76.0%	8.0%	4.0%	8.0%	4.0%	**25**	1.56	1.16
	19	2	1	2	1			
HSAP Program administrator or site coordinator	24.0%	0.0%	16.0%	16.0%	44.0%	**25**	3.56	1.64
	6	0	4	4	11			
Invited speakers or "career" events	60.0%	8.0%	16.0%	12.0%	4.0%	**25**	1.92	1.29
	15	2	4	3	1			
Participation in HSAP	12.5%	0.0%	12.5%	12.5%	62.5%	**24**	4.13	1.39
	3	0	3	3	15			

Which of the following AEOPs did you EXPLICITLY DISCUSS with your student(s) during HSAP?					
		Yes - I discussed this program with my student(s)		No - I did not discuss this program with my student(s)	
	n	Freq.	%	Freq.	%
Gains in the Education of Mathematics and Science (GEMS)	14	5	20.8%	19	79.2%
UNITE	14	0	0.0%	24	100.0%
Junior Science & Humanities Symposium (JSHS)	14	1	4.2%	23	95.8%
Science & Engineering Apprenticeship Program (SEAP)	14	4	16.7%	20	83.3%
Research & Engineering Apprenticeship Program (REAP)	14	6	25.0%	18	75.0%
High School Apprenticeship Program (HSAP)	14	19	79.2%	5	20.8%
College Qualified Leaders (CQL)	14	2	8.7%	21	91.3%
GEMS Near Peer Mentor Program	14	2	8.3%	22	91.7%
Undergraduate Research Apprenticeship Program (URAP)	14	16	66.7%	8	33.3%
Science Mathematics, and Research for Transformation (SMART) College Scholarship	14	4	16.7%	20	83.3%
National Defense Science & Engineering Graduate (NDSEG) Fellowship	15	4	16.7%	20	83.3%
I discussed AEOP with my student(s) but did not discuss any specific program	14	11	47.8%	12	52.2%

How USEFUL were each of the following in your efforts to expose your student(s) to Department of Defense (DoD) STEM careers during HSAP?

	Did not experience	Not at all	A little	Somewhat	Very much	n	Avg.	SD
Army Research Office (ARO) website	29.2%	0.0%	0.0%	29.2%	41.7%	**25**	3.54	1.72
	7	0	0	7	10			
Army Educational Outreach Program (AEOP) website	33.3%	0.0%	0.0%	33.3%	33.3%	**24**	3.33	1.74
	8	0	0	8	8			
AEOP on Facebook, Twitter, Pinterest or other social media	83.3%	8.3%	4.2%	0.0%	4.2%	**25**	1.33	0.92
	20	2	1	0	1			
AEOP brochure	62.5%	4.2%	4.2%	20.8%	8.3%	**25**	2.08	1.53
	15	1	1	5	2			
It Starts Here! Magazine	75.0%	4.2%	12.5%	4.2%	4.2%	**25**	1.58	1.14
	18	1	3	1	1			
HSAP Program administrator or site coordinator	37.5%	0.0%	12.5%	20.8%	29.2%	**25**	3.04	1.73
	9	0	3	5	7			
Invited speakers or "career" events	66.7%	4.2%	12.5%	8.3%	8.3%	**25**	1.88	1.39
	16	1	3	2	2			
Participation in HSAP	21.7%	0.0%	8.7%	17.4%	52.2%	**24**	3.78	1.62
	5	0	2	4	12			

Rate how much you agree or disagree with each of the following statements about Department of Defense (DoD) researchers and research:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	n	Avg.	SD
DoD researchers advance science and engineering fields	4.2%	0.0%	4.2%	20.8%	70.8%	**24**	4.54	0.93
	1	0	1	5	17			
DoD researchers develop new, cutting edge technologies	4.2%	0.0%	8.3%	8.3%	79.2%	**24**	4.58	0.97
	1	0	2	2	19			
DoD researchers solve real-world problems	4.2%	0.0%	0.0%	16.7%	79.2%	**24**	4.67	0.87
	1	0	0	4	19			
DoD research is valuable to society	4.2%	0.0%	4.2%	12.5%	79.2%	**24**	4.63	0.92
	1	0	1	3	19			

How often did YOUR STUDENT(S) have opportunities do each of the following in HSAP?	Not at all	At least once	A few times	Most days	Every day	n	Avg.	SD
Learn new science, technology, engineering, or mathematics (STEM) topics	0.0%	0.0%	4.2%	41.7%	54.2%	24	4.50	0.59
	0	0	1	10	13			
Apply STEM knowledge to real-life situations	0.0%	4.2%	25.0%	37.5%	33.3%	24	4.00	0.88
	0	1	6	9	8			
Learn about new discoveries in STEM	0.0%	0.0%	37.5%	33.3%	29.2%	24	3.92	0.83
	0	0	9	8	7			
Learn about different careers that use STEM	0.0%	12.5%	33.3%	41.7%	12.5%	24	3.54	0.88
	0	3	8	10	3			
Interact with STEM professionals	0.0%	0.0%	4.2%	25.0%	70.8%	24	4.67	0.56
	0	0	1	6	17			
Communicate with other students about STEM	0.0%	0.0%	4.2%	41.7%	54.2%	24	4.29	0.75
	0	0	1	10	13			
Use laboratory or field techniques, procedures, and tools	0.0%	4.2%	25.0%	37.5%	33.3%	24	4.75	0.44
	0	1	6	9	8			
Participate in hands-on STEM activities	0.0%	0.0%	37.5%	33.3%	29.2%	24	4.58	0.65
	0	0	9	8	7			
Work as part of a team	0.0%	12.5%	33.3%	41.7%	12.5%	24	4.63	0.65
	0	3	8	10	3			
Identify questions or problems to investigate	0.0%	0.0%	4.2%	25.0%	70.8%	24	4.33	0.76
	0	0	1	6	17			
Design an investigation	0.0%	0.0%	16.7%	37.5%	45.8%	24	3.83	0.82
	0	0	4	9	11			
Carry out an investigation	0.0%	0.0%	0.0%	25.0%	75.0%	24	4.33	0.70
	0	0	0	6	18			
Analyze data or information	0.0%	0.0%	8.3%	25.0%	66.7%	24	4.42	0.65
	0	0	2	6	16			
Draw conclusions from an investigation	0.0%	0.0%	8.3%	20.8%	70.8%	24	4.17	0.76
	0	0	2	5	17			
Come up with creative explanations or solutions	0.0%	0.0%	16.7%	33.3%	50.0%	24	4.04	0.91
	0	0	4	8	12			
Build or make a computer model	0.0%	4.2%	29.2%	45.8%	20.8%	24	2.67	1.66
	0	1	7	11	5			

Which category best describes the focus of your student's HSAP project?		
	Freq.	%
Science	12	48.00%
Technology	3	12.00%
Engineering	8	32.00%
Mathematics	2	8.00%
Total	25	100%

AS A RESULT OF THE HSAP EXPERIENCE, how much did your student(s) GAIN in the following areas?	No gain	A little gain	Some gain	Large gain	Extreme gain	n	Avg.	SD
In depth knowledge of a STEM topic(s)	0.0%	0.0%	8.3%	70.8%	20.8%	24	4.13	0.54
	0	0	2	17	5			
Knowledge of research conducted in a STEM topic or field	0.0%	0.0%	12.5%	50.0%	37.5%	24	4.25	0.68
	0	0	3	12	9			
Knowledge of research processes, ethics, and rules for conduct in STEM	0.0%	0.0%	20.8%	58.3%	20.8%	24	4.00	0.66
	0	0	5	14	5			
Knowledge of how professionals work on real problems in STEM	0.0%	0.0%	8.3%	41.7%	50.0%	24	4.42	0.65
	0	0	2	10	12			
Knowledge of what everyday research work is like in STEM	0.0%	0.0%	4.2%	29.2%	66.7%	24	4.63	0.58
	0	0	1	7	16			

AS A RESULT OF THE HSAP EXPERIENCE, how much did your student(s) GAIN in the following areas?								
	No gain	A little gain	Some gain	Large gain	Extreme gain	n	Avg.	SD
Asking a question that can be answered with one or more scientific experiments	0.0%	0.0%	33.3%	41.7%	25.0%	12	3.92	0.79
	0	0	4	5	3			
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	0.0%	0.0%	16.7%	66.7%	16.7%	12	4.00	0.60
	0	0	2	8	2			
Making a model of an object or system showing its parts and how they work	16.7%	8.3%	16.7%	50.0%	8.3%	12	3.25	1.29
	2	1	2	6	1			
Designing procedures for an experiment that are appropriate for the question to be answered	0.0%	8.3%	16.7%	50.0%	25.0%	12	3.92	0.90
	0	1	2	6	3			
Identifying the limitations of the methods and tools used for data collection	0.0%	0.0%	33.3%	50.0%	16.7%	12	3.83	0.72
	0	0	4	6	2			
Carrying out procedures for an experiment and recording data accurately	0.0%	16.7%	0.0%	33.3%	50.0%	12	4.17	1.11
	0	2	0	4	6			
Using computer models of objects or systems to test cause and effect relationships	41.7%	33.3%	0.0%	16.7%	8.3%	12	2.17	1.40
	5	4	0	2	1			
Organizing data in charts or graphs to find patterns and relationships	0.0%	8.3%	8.3%	58.3%	25.0%	12	4.00	0.85
	0	1	1	7	3			
Considering different interpretations of data when deciding how the data answer a question	0.0%	0.0%	25.0%	50.0%	25.0%	12	4.00	0.74
	0	0	3	6	3			
Supporting an explanation for an observation with data from experiments	0.0%	0.0%	16.7%	33.3%	50.0%	12	4.33	0.78
	0	0	2	4	6			
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	0.0%	8.3%	8.3%	50.0%	33.3%	12	4.08	0.90
	0	1	1	6	4			
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	0.0%	8.3%	16.7%	50.0%	25.0%	12	3.92	0.90
	0	1	2	6	3			
Defending an argument that conveys how an explanation best describes an observation	0.0%	8.3%	16.7%	50.0%	25.0%	12	3.92	0.90
	0	1	2	6	3			
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	0.0%	8.3%	25.0%	50.0%	16.7%	12	3.75	0.87
	0	1	3	6	2			
Integrating information from technical or scientific texts and other media to support your explanation of an observation	0.0%	8.3%	25.0%	58.3%	8.3%	12	3.67	0.78
	0	1	3	7	1			
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	0.0%	8.3%	0.0%	41.7%	50.0%	12	4.33	0.89
	0	1	0	5	6			

AS A RESULT OF THE HSAP EXPERIENCE, how much did your student(s) GAIN in the following areas?								
	No gain	A little gain	Some gain	Large gain	Extreme gain	n	Avg.	SD
Defining a problem that can be solved by developing a new or improved object, process, or system	0.0%	0.0%	25.0%	58.3%	16.7%	12	3.92	0.67
	0	0	3	7	2			
Using knowledge and creativity to propose a testable solution for a problem	0.0%	0.0%	33.3%	66.7%	0.0%	12	3.67	0.49
	0	0	4	8	0			
Making a model of an object or system to show its parts and how they work	0.0%	8.3%	16.7%	58.3%	16.7%	12	3.83	0.83
	0	1	2	7	2			
Designing procedures for an experiment that are appropriate for the question to be answered	0.0%	8.3%	0.0%	58.3%	33.3%	12	4.17	0.83
	0	1	0	7	4			
Identifying the limitations of the methods and tools used for data collection	0.0%	8.3%	25.0%	50.0%	16.7%	12	3.75	0.87
	0	1	3	6	2			
Carrying out procedures for an experiment and recording data accurately	0.0%	8.3%	16.7%	58.3%	16.7%	12	3.83	0.83
	0	1	2	7	2			
Using computer models of an object or system to investigate cause and effect relationships	0.0%	8.3%	33.3%	25.0%	33.3%	12	3.83	1.03
	0	1	4	3	4			
Considering different interpretations of the data when deciding if a solution works as intended	0.0%	0.0%	16.7%	75.0%	8.3%	12	3.92	0.51
	0	0	2	9	1			
Organizing data in charts or graphs to find patterns and relationships	0.0%	16.7%	8.3%	50.0%	25.0%	12	3.83	1.03
	0	2	1	6	3			
Supporting a solution for a problem with data from experiments	0.0%	16.7%	16.7%	50.0%	16.7%	12	3.67	0.98
	0	2	2	6	2			
Supporting a solution with relevant scientific, mathematical, and/or engineering knowledge	0.0%	0.0%	8.3%	75.0%	16.7%	12	4.08	0.51
	0	0	1	9	2			
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	0.0%	0.0%	16.7%	66.7%	16.7%	12	4.00	0.60
	0	0	2	8	2			
Defend an argument that conveys how a solution best meets design criteria	8.3%	0.0%	25.0%	66.7%	0.0%	12	3.50	0.90
	1	0	3	8	0			
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	0.0%	8.3%	8.3%	58.3%	25.0%	12	4.00	0.85
	0	1	1	7	3			
Integrating information from technical or scientific texts and other media to support your solution to a problem	0.0%	0.0%	58.3%	25.0%	16.7%	12	3.58	0.79
	0	0	7	3	2			
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations)	0.0%	0.0%	16.7%	50.0%	33.3%	12	4.17	0.72
	0	0	2	6	4			

AS A RESULT OF THE HSAP EXPERIENCE, how much did your student(s) GAIN (on average) in the following areas?								
	No gain	A little gain	Some gain	Large gain	Extreme gain	n	Avg.	SD
Learning to work independently	0.0%	0.0%	20.8%	54.2%	25.0%	24	4.04	0.69
	0	0	5	13	6			
Setting goals and reflecting on performance	0.0%	4.2%	25.0%	50.0%	20.8%	24	3.88	0.80
	0	1	6	12	5			
Sticking with a task until it is finished	0.0%	4.2%	25.0%	54.2%	16.7%	24	3.83	0.76
	0	1	6	13	4			
Making changes when things do not go as planned	0.0%	0.0%	25.0%	45.8%	29.2%	24	4.04	0.75
	0	0	6	11	7			
Including others' perspectives when making decisions	4.2%	0.0%	20.8%	58.3%	16.7%	24	3.83	0.87
	1	0	5	14	4			
Communicating effectively with others	0.0%	4.2%	4.2%	66.7%	25.0%	24	4.13	0.68
	0	1	1	16	6			
Confidence with new ideas or procedures in a STEM project	0.0%	0.0%	8.3%	66.7%	25.0%	24	4.17	0.56
	0	0	2	16	6			
Patience for the slow pace of research	0.0%	0.0%	12.5%	66.7%	20.8%	24	4.08	0.58
	0	0	3	16	5			
Desire to build relationships with professionals in a field	0.0%	4.2%	25.0%	50.0%	20.8%	24	3.88	0.80
	0	1	6	12	5			
Connecting a topic or field with their personal values	4.2%	0.0%	33.3%	41.7%	20.8%	24	3.75	0.94
	1	0	8	10	5			

Which of the following statements describe YOUR STUDENT(S) after participating in the HSAP program?							
	1	**2**	**3**	**4**	**n**	**Avg.**	**SD**
More confident in STEM knowledge, skills, and abilities	0.0%	0.0%	70.8%	29.2%	24	3.29	0.46
	0	0	17	7			
More interested in participating in STEM activities outside of school requirements	0.0%	4.2%	62.5%	33.3%	24	3.29	0.55
	0	1	15	8			
More aware of other AEOPs	25.0%	8.3%	37.5%	29.2%	24	2.71	1.16
	6	2	9	7			
More interested in participating in other AEOPs	16.7%	12.5%	41.7%	29.2%	24	2.83	1.05
	4	3	10	7			
More interested in taking STEM classes in school	4.2%	4.2%	66.7%	25.0%	24	3.13	0.68
	1	1	16	6			
More interested in earning a STEM degree	0.0%	4.3%	65.2%	30.4%	23	3.26	0.54
	0	1	15	7			
More interested in pursuing a career in STEM	0.0%	4.3%	73.9%	21.7%	23	3.17	0.49
	0	1	17	5			
More aware of DoD STEM research and careers	4.2%	4.2%	54.2%	37.5%	24	3.25	0.74
	1	1	13	9			
Greater appreciation of DoD STEM research	0.0%	8.3%	50.0%	41.7%	24	3.33	0.64
	0	2	12	10			
More interested in pursuing a STEM career with the DoD	8.3%	4.2%	62.5%	25.0%	24	3.04	0.81
	2	1	15	6			

Note. Response scale: **1** = "Disagree – This did not happen," **2** = "Disagree – This happened but not because of HSAP," **3** = "Agree – HSAP contributed," **4** = "Agree – HSAP was the primary reason".

Appendix D

FY15 HSAP Apprentice and Mentor Focus Group Protocols

2015 HSAP Evaluation Study
Student Interview or Focus Group Protocol

Facilitator: My name is [evaluator] and I'd like to thank you for meeting with us today! We are really excited to learn more about your experiences in HSAP. In case you have not been in an evaluation interview before, I'd like to give you some ground rules that I like to use in interviews. They seem to help the interview move forward and make everyone a little more comfortable:

1. What is shared in the interview stays in the room.
2. It is important for us to hear the positive and negative sides of all issues.
3. Only one person speaks at a time.
4. This is voluntary - you may choose not to answer any question, or stop participating at any time.
5. We will be audio recording the session for note-taking purposes only. Audio will be destroyed.
6. Do you have any questions before we begin?

Key Questions

1. **Why did you choose to participate in HSAP this year?**
    - How did you hear about HSAP?
    - Who did you hear about it from?

The Army Educational Outreach Program (AEOP) is a primary sponsor of HSAP. We do these interviews to help the AEOP create reports and defend funding for the program. They need specific information to defend the money for the program.

2. **We need to understand more about how HSAP is teaching students about STEM career opportunities in the Army and Department of Defense.**
    - During HSAP, did you learn anything about STEM careers in the Army or Department of Defense?
    - How did you learn about them (e.g., field trips, invited speakers, other activities, etc.)?
    - Are you interested in pursuing a career in STEM with the Army or Department of Defense?
3. **The AEOP sponsors a wide range of national STEM outreach programs other than HSAP. You are definitely eligible to participate in some of these programs and we need to know if you learned about them during HSAP**
    - During HSAP, did you learn about any of the outreach programs that the AEOP sponsors? (SMART, NDSEG, URAP, etc.)
    - How did you learn about them?
    - Do you think that you will try to participate in any of those programs?
4. **Tell us about your experiences in HSAP this year.**
    - What, specifically do you think you got out of participating in HSAP?
    - How do your experiences in HSAP compare to your school experiences in STEM?
    - What would you say was the biggest benefit you gained from participating in HSAP?
5. **Do you have any suggestions for improving HSAP for other students in the future?**
6. **Last Chance - Have we missed anything? Tell us anything you want us to know that we didn't ask about.**

2015 HSAP Evaluation Study
Mentor Interview or Focus Group Protocol

Facilitator: My name is [evaluator] and I'd like to thank you for meeting with us today! We are really excited to learn more about your experiences in HSAP. In case you haven't been in a focus group before, I'd like to give you some ground rules that I like to use in focus groups. They seem to help the group move forward and make everyone a little more comfortable:

7. What is shared in the room stays in the room.
8. Only one person speaks at a time.
9. If you disagree please do so respectfully.
10. It is important for us to hear the positive and negative sides of all issues.
11. We will be audio recording the session for note-taking purposes only. Audio will be destroyed.
12. Do you have any questions about participating in the focus group?

Key Questions:

1. **When you think about HSAP, what kind of value does this program add**?
    - How do you think students benefit from participating in HSAP?
    - Can you think of a particular student or group of students that benefit the most from HSAP?
    - How have you benefited from participating in HSAP?

One of the primary sponsors of the HSAP program is the Army Educational Outreach Program (AEOP). The AEOP needs specific information to create reports and defend funding for its outreach programs, HSAP included.

2. **We need to understand more about how HSAP is helping students know more about STEM career opportunities in the Department of Defense, especially civilian positions.**
    - Have you seen any efforts by HSAP to educate participants about the Army, DoD, or careers in the DoD?
    - What strategies seem to be the most effective for HSAP students?
    - Do you have any suggestions for helping HSAP teach students about careers in the DoD?

The AEOP sponsors a wide range of national STEM outreach programs that these students qualify for.

3. **The AEOP needs to know if HSAP is teaching students about the other STEM outreach programs that it sponsors.**
    - First, are you aware of the other programs offered by the AEOP? (e.g., REAP, CQL, CQL, SMART, etc)
    - Have you seen any efforts at HSAP to educate adults or students about the other AEOP programs?
    - What seems to work the best? The worst?
    - Any suggestions for helping the AEOP educate these students about the other programs?

4. **The AEOP is trying to make sure that its programs become more effective at reaching adult and youth participants from underserved and underrepresented groups (racial/ethnic groups, low SES, etc.).**
    - Have you seen any efforts by HSAP to help engage underserved or underrepresented groups of adults and youth?
    - What strategies seem to work the best? The worst?
    - Any suggestions for helping HSAP reach new populations of adult and youth participants?

5. **What suggestions do you have for improving HSAP?**
6. **Last Chance - Have we missed anything? Tell us anything you want us to know that we didn't ask about.**

Appendix E

FY15 HSAP Apprentice Questionnaire

2015 High School Apprenticeship Program (HSAP): HSAP Apprentice Survey

Virginia Tech conducts program evaluation on behalf of the Army Research Office and U.S. Army to determine how well the Army Educational outreach Program (AEOP) is achieving its goals of promoting student interest and engagement in science, technology, engineering, and mathematics (STEM). As part of this study Virginia Tech is surveying students (like you) who have participated in the High School Apprenticeship Program (HSAP). The survey will collect information about you, your experiences in school, and your experiences in HSAP.

About this survey:

- While this survey is not anonymous, your responses are CONFIDENTIAL. When analyzing data and reporting results, your name will not be linked to any item responses or any comments you make.
- Responding to this survey is VOLUNTARY. You are not required to participate, although we hope you do because your responses will provide valuable information for meaningful and continuous improvement.
- If you provide your email address, the AEOP may contact you in the future to ask about your academic and career success.
- The survey takes about 25-30 minutes to complete on average, but it could take less time. In the online survey you can scroll over purple print in the survey to see definitions of words or phrases.

If you have any additional questions or concerns, please contact one of the following people:

Tanner Bateman, Virginia Tech
Senior Project Associate, AEOPCA
(540) 231-4540, tbateman@vt.edu

Rebecca Kruse, Virginia Tech
Evaluation Director, AEOPCA
(703) 336-7922, rkruse75@vt.edu

Contact Information		
Please verify the following information:		
*First Name:		
*Last Name:		
*Email Address:		
All fields with an asterisk (*) are required.		

*1. Do you agree to participate in this survey? (required)(*Required)		
Select one.		
○	Yes, I agree to participate in this survey	(Go to question number 2.)
○	No, I do not wish to participate in this survey	Go to end of chapter

9. How often did you do each of the following in STEM classes at school?

Select one per row.

	Not at all	*At least once*	*A few times*	*Most days*	*Every day*
Learn about science, technology, engineering, or mathematics (STEM) topics that are new to you	○	○	○	○	○
Apply STEM learning to real-life situations	○	○	○	○	○
Learn about new discoveries in STEM	○	○	○	○	○
Learn about different careers that use STEM	○	○	○	○	○
Interact with scientists or engineers	○	○	○	○	○
Communicate with other students about STEM	○	○	○	○	○

10. How often did you do each of the following in HSAP this year?

Select one per row.

	Not at all	*At least once*	*A few times*	*Most days*	*Every day*
Learn about science, technology, engineering, or mathematics (STEM) topics that are new to you	○	○	○	○	○
Apply STEM learning to real-life situations	○	○	○	○	○
Learn about new discoveries in STEM	○	○	○	○	○
Learn about different careers that use STEM	○	○	○	○	○
Interact with scientists or engineers	○	○	○	○	○
Communicate with other students about STEM	○	○	○	○	○

11. How often did you do each of the following in STEM classes at school?

Select one per row.

	Not at all	*At least once*	*A few times*	*Most days*	*Every day*
Use laboratory procedures and tools	○	○	○	○	○
Participate in hands-on STEM activities	○	○	○	○	○
Work as part of a team	○	○	○	○	○
Identify questions or problems to investigate	○	○	○	○	○
Design an investigation	○	○	○	○	○
Carry out an investigation	○	○	○	○	○
Analyze data or information	○	○	○	○	○
Draw conclusions from an investigation	○	○	○	○	○
Come up with creative explanations or solutions	○	○	○	○	○
Build or make a computer model	○	○	○	○	○

12. How often did you do each of the following in HSAP this year?

Select one per row.

	Not at all	*At least once*	*A few times*	*Most days*	*Every day*
Use laboratory procedures and tools	○	○	○	○	○
Participate in hands-on STEM activities	○	○	○	○	○
Work as part of a team	○	○	○	○	○
Identify questions or problems to investigate	○	○	○	○	○
Design an investigation	○	○	○	○	○
Carry out an investigation	○	○	○	○	○
Analyze data or information	○	○	○	○	○
Draw conclusions from an investigation	○	○	○	○	○
Come up with creative explanations or solutions	○	○	○	○	○
Build or make a computer model	○	○	○	○	○

13. How much did each of the following resources help you learn about Army Educational Outreach Programs (AEOPs)?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Army Research Office (ARO) website	○	○	○	○	○
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
My HSAP mentor(s)	○	○	○	○	○
Invited speakers or “career” events during HSAP	○	○	○	○	○
Participation in HSAP	○	○	○	○	○

14. How much did each of the following resources help you learn about STEM careers in the Army or Department of Defense (DoD)?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Army Research Office (ARO) website	○	○	○	○	○
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
My HSAP mentor(s)	○	○	○	○	○
Invited speakers or “career” events during HSAP	○	○	○	○	○
Participation in HSAP	○	○	○	○	○

15. How SATISFIED were you with the following HSAP features?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Applying or registering for the program	○	○	○	○	○
Other administrative tasks (in-processing, network access, etc.)	○	○	○	○	○
Communicating with your HSAP host site organizers	○	○	○	○	○
The physical location(s) of HSAP activities	○	○	○	○	○
The variety of STEM topics available to you in HSAP	○	○	○	○	○
Teaching or mentoring provided during HSAP activities	○	○	○	○	○
Stipends (payment)	○	○	○	○	○
Research abstract preparation requirements	○	○	○	○	○

16. How much input did you have in selecting your HSAP research project?

Select one.

○	I did not have a project
○	I was assigned a project by my mentor
○	I worked with my mentor to design a project
○	I had a choice among various projects suggested by my mentor
○	I worked with my mentor and members of a research team to design a project
○	I designed the entire project on my own

17. How often was your mentor available to you during HSAP?

Select one.

○	I did not have a mentor
○	The mentor was never available
○	The mentor was available less than half of the time
○	The mentor was available about half of the time of my project
○	The mentor was available more than half of the time
○	The mentor was always available

18. To what extent did you work as part of a group or team during HSAP?

Select one.

○	I worked alone (or alone with my research mentor)
○	I worked with others in a shared laboratory or other space, but we work on different projects
○	I worked alone on my project and I met with others regularly for general reporting or discussion
○	I worked alone on a project that was closely connected with projects of others in my group
○	I work with a group who all worked on the same project

19. How SATISFIED were you with each of the following:

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
My working relationship with my mentor	○	○	○	○	○
My working relationship with the group or team	○	○	○	○	○
The amount of time I spent doing meaningful research	○	○	○	○	○
The amount of time I spent with my research mentor	○	○	○	○	○
The research experience overall	○	○	○	○	○

20. The list below includes effective teaching and mentoring strategies. From the list, please indicate which strategies that your mentor(s) used when working with you in HSAP:

Select one per row.

	Yes - my mentor used this strategy with me	*No - my mentor did not use this strategy with me*
Helped me become aware of STEM in my everyday life	○	○
Helped me understand how I can use STEM to improve my community	○	○
Used a variety of strategies to help me learn	○	○
Gave me extra support when I needed it	○	○
Encouraged me to share ideas with others who have different backgrounds or viewpoints than I do	○	○
Allowed me to work on a team project or activity	○	○
Helped me learn or practice a variety of STEM skills	○	○
Gave me feedback to help me improve in STEM	○	○
Talked to me about the education I need for a STEM career	○	○
Recommended Army Educational Outreach Programs that match my interests	○	○
Discussed STEM careers with the DoD or government	○	○

21. Which of the following statements apply to your research experience in HSAP? (Choose ALL that apply)

Select all that apply.

☐	I presented a talk or poster to other students or faculty
☐	I presented a talk or poster at a professional symposium or conference
☐	I attended a symposium or conference
☐	I wrote or co-wrote a paper that was/will be published in a research journal
☐	I wrote or co-wrote a technical paper or patent
☐	I will present a talk or poster to other students or faculty
☐	I will present a talk or poster at a professional symposium or conference
☐	I will attend a symposium or conference
☐	I will write or co-write a paper that was/will be published in a research journal
☐	I will write or co-write a technical paper or patent
☐	I won an award or scholarship based on my research

22. As a result of your HSAP experience, how much did you GAIN in the following areas?

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
In depth knowledge of a STEM topic(s)	○	○	○	○	○
Knowledge of research conducted in a STEM topic or field	○	○	○	○	○
Knowledge of research processes, ethics, and rules for conduct in STEM	○	○	○	○	○
Knowledge of how scientists and engineers work on real problems in STEM	○	○	○	○	○
Knowledge of what everyday research work is like in STEM	○	○	○	○	○

23. Which category best describes the focus of your student(s) HSAP activities?

Select one.

○	Science	(Go to question number 24.)
○	Technology	(Go to question number 25.)
○	Engineering	(Go to question number 25.)
○	Mathematics	(Go to question number 25.)

24. As a result of your HSAP experience, how much did you GAIN in your ability to do each of the following?

Select one per row.

If answered, go to question number 26.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Asking a question that can be answered with one or more scientific experiments	○	○	○	○	○
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	○	○	○	○	○
Making a model of an object or system showing its parts and how they work	○	○	○	○	○
Designing procedures for an experiment that are appropriate for the question to be answered	○	○	○	○	○
Identifying the limitations of the methods and tools used for data collection	○	○	○	○	○
Carrying out procedures for an experiment and recording data accurately	○	○	○	○	○
Using computer models of objects or systems to test cause and effect relationships	○	○	○	○	○
Organizing data in charts or graphs to find patterns and relationships	○	○	○	○	○
Considering different interpretations of data when deciding how the data answer a question	○	○	○	○	○
Supporting an explanation for an observation with data from experiments	○	○	○	○	○
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	○	○	○	○	○
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	○	○	○	○	○
Defending an argument that conveys how an explanation	○	○	○	○	○

best describes an observation					
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	○	○	○	○	○
Integrating information from technical or scientific texts and other media to support your explanation of an observation	○	○	○	○	○
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	○	○	○	○	○

25. As a result of your HSAP experience, how much did you GAIN in your ability to do each of the following?

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Defining a problem that can be solved by developing a new or improved object, process, or system	○	○	○	○	○
Using knowledge and creativity to propose a testable solution for a problem	○	○	○	○	○
Making a model of an object or system to show its parts and how they work	○	○	○	○	○
Designing procedures for an experiment that are appropriate for the question to be answered	○	○	○	○	○
Identifying the limitations of the methods and tools used for data collection	○	○	○	○	○
Carrying out procedures for an experiment and recording data accurately	○	○	○	○	○
Using computer models of an object or system to investigate cause and effect relationships	○	○	○	○	○
Considering different interpretations of the data when deciding if a solution works as intended	○	○	○	○	○
Organizing data in charts or graphs to find patterns and relationships	○	○	○	○	○
Supporting a solution for a problem with data from experiments	○	○	○	○	○
Supporting a solution with relevant scientific, mathematical, and/or engineering knowledge	○	○	○	○	○
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	○	○	○	○	○
Defend an argument that conveys how a solution best meets design criteria	○	○	○	○	○

Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	○	○	○	○	○
Integrating information from technical or scientific texts and other media to support your solution to a problem	○	○	○	○	○
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations)	○	○	○	○	○

26. As a result of your HSAP experience, how much did you GAIN in each of the skills/abilities listed below?

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Learning to work independently	○	○	○	○	○
Setting goals and reflecting on performance	○	○	○	○	○
Sticking with a task until it is finished	○	○	○	○	○
Making changes when things do not go as planned	○	○	○	○	○
Working well with people from all backgrounds	○	○	○	○	○
Including others' perspectives when making decisions	○	○	○	○	○
Communicating effectively with others	○	○	○	○	○
Viewing failure as an opportunity to learn	○	○	○	○	○

27. As a result of your HSAP experience, how much did you GAIN in the following areas?

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Interest in a new STEM topic	○	○	○	○	○
Deciding on a path to pursue a STEM career	○	○	○	○	○
Sense of accomplishing something in STEM	○	○	○	○	○
Feeling prepared for more challenging STEM activities	○	○	○	○	○
Confidence to try out new ideas or procedures on my own in a STEM project	○	○	○	○	○
Patience for the slow pace of STEM research	○	○	○	○	○
Desire to build relationships with mentors who work in STEM	○	○	○	○	○
Connecting a STEM topic or field to my personal values	○	○	○	○	○

28. AS A RESULT OF YOUR HSAP experience, are you MORE or LESS likely to engage in the following activities in science, technology, engineering, or mathematics (STEM) outside of school requirements or activities?

Select one per row.

	Much less likely	*Less likely*	*About the same before and after*	*More likely*	*Much more likely*
Watch or read non-fiction STEM	○	○	○	○	○
Tinker (play) with a mechanical or electrical device	○	○	○	○	○
Work on solving mathematical or scientific puzzles	○	○	○	○	○
Use a computer to design or program something	○	○	○	○	○
Talk with friends or family about STEM	○	○	○	○	○
Mentor or teach other students about STEM	○	○	○	○	○
Help with a community service project related to STEM	○	○	○	○	○
Participate in a STEM camp, club, or competition	○	○	○	○	○
Take an elective (not required) STEM class	○	○	○	○	○
Work on a STEM project or experiment in a university or professional setting	○	○	○	○	○

29. Before you participated in HSAP, how far did you want to go in school?

Select one.

○	Graduate from high school
○	Go to a trade or vocational school
○	Go to college for a little while
○	Finish college (get a Bachelor's degree)
○	Get more education after college
○	Get a master's degree
○	Get a Ph.D.
○	Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)
○	Get a combined M.D. / Ph.D.
○	Get another professional degree (law, business, etc.)

30. After you have participated in HSAP, how far do you want to go in school?

Select one.

○	Graduate from high school
○	Go to a trade or vocational school
○	Go to college for a little while
○	Finish college (get a Bachelor's degree)
○	Get more education after college
○	Get a master's degree
○	Get a Ph.D.
○	Get a medical-related degree (M.D.), veterinary degree (D.V.M), or dental degree (D.D.S)
○	Get a combined M.D. / Ph.D.
○	Get another professional degree (law, business, etc.)

31. When you are 30, to what extent do you expect to use your STEM knowledge, skills, and/or abilities in your job?

Select one.

○	not at all
○	up to 25% of the time
○	up to 50% of the time
○	up to 75% of the time
○	up to 100% of the time

32. Before you participated in HSAP, what kind of work did you want to do when you are 30? (select one)

Select one.

○	Undecided
○	Science (no specific subject)
○	Physical science (physics, chemistry, astronomy, materials science)
○	Biological science
○	Earth, atmospheric or oceanic science
○	Environmental science
○	Computer science
○	Technology
○	Engineering
○	Mathematics or statistics
○	Medicine (doctor, dentist, veterinarian, etc.)
○	Health (nursing, pharmacy, technician, etc.)
○	Social science (psychologist, sociologist, etc.)
○	Teaching, STEM
○	Teaching, non-STEM
○	Business
○	Law
○	Military, police, or security
○	Art (writing, dancing, painting, etc.)
○	Skilled trade (carpenter
○	Other, (specify)::

33. After you participated in HSAP, what kind of work do you want to do when you are 30? (select one)

Select one.

○	Undecided
○	Science (no specific subject)
○	Physical science (physics, chemistry, astronomy, materials science)
○	Biological science
○	Earth, atmospheric or oceanic science
○	Environmental science
○	Computer science
○	Technology
○	Engineering
○	Mathematics or statistics
○	Medicine (doctor, dentist, veterinarian, etc.)
○	Health (nursing, pharmacy, technician, etc.)
○	Social science (psychologist, sociologist, etc.)
○	Teaching, STEM
○	Teaching, non-STEM
○	Business
○	Law
○	Military, police, or security
○	Art (writing, dancing, painting, etc.)
○	Skilled trade (carpenter, electrician, plumber, etc.)
○	Other, (specify)::

34. How interested are you in participating in the following programs in the future?

Select one per row.

	I've never heard of this program	*Not at all*	*A little*	*Somewhat*	*Very much*
UNITE	○	○	○	○	○
Junior Science & Humanities Symposium (JSHS)	○	○	○	○	○
Science & Engineering Apprenticeship Program (SEAP)	○	○	○	○	○
Research & Engineering Apprenticeship Program (REAP)	○	○	○	○	○
College Qualified Leaders (CQL)	○	○	○	○	○
GEMS Near Peer Mentor Program	○	○	○	○	○
Undergraduate Research Apprenticeship Program (URAP)	○	○	○	○	○
Science Mathematics, and Research for Transformation (SMART) College Scholarship	○	○	○	○	○
National Defense Science & Engineering Graduate (NDSEG) Fellowship	○	○	○	○	○

35. How many jobs/careers in STEM did you learn about during HSAP?

Select one.

○	None
○	1
○	2
○	3
○	4
○	5 or more

36. How many Army or Department of Defense (DoD) STEM jobs/careers did you learn about during HSAP?

Select one.

○	None
○	1
○	2
○	3
○	4
○	5 or more

37. How much do you agree or disagree with the following statements about Department of Defense (DoD) researchers and research:

Select one per row.

	Strongly Disagree	*Disagree*	*Neither Agree nor Disagree*	*Agree*	*Strongly Agree*
DoD researchers advance science and engineering fields	○	○	○	○	○
DoD researchers develop new, cutting edge technologies	○	○	○	○	○
DoD researchers solve real-world problems	○	○	○	○	○
DoD research is valuable to society	○	○	○	○	○

38. Which of the following statements describe you after participating in the HSAP program?

Select one per row.

	Disagree - This did not happen	*Disagree - This happened but not because of HSAP*	*Agree - HSAP contributed*	*Agree - HSAP was primary reason*
I am more confident in my STEM knowledge, skills, and abilities	○	○	○	○
I am more interested in participating in STEM activities outside of school requirements	○	○	○	○
I am more aware of other AEOPs	○	○	○	○
I am more interested in participating in other AEOPs	○	○	○	○
I am more interested in taking STEM classes in school	○	○	○	○
I am more interested in earning a STEM degree	○	○	○	○
I am more interested in pursuing a career in STEM	○	○	○	○
I am more aware of Army or DoD STEM research and careers	○	○	○	○
I have a greater appreciation of Army or DoD STEM research	○	○	○	○
I am more interested in pursuing a STEM career with the Army or DoD	○	○	○	○

39. What are the three most important ways that HSAP has helped you?

Benefit #1:	
Benefit #2:	
Benefit #3:	

40. What are the three ways that HSAP should be improved for future participants?

Improvement #1:	
Improvement #2:	
Improvement #3:	

41. Please tell us about your overall satisfaction with your HSAP experience.

Appendix F

FY15 HSAP Mentor Questionnaire

2015 High School Apprenticeship Program (HSAP): HSAP Mentor Survey

Virginia Tech is conducting an evaluation study on behalf of the Army Research Office and the U.S. Army to determine how well HSAP is achieving its goals of promoting student interest and engagement in science, technology, engineering, and mathematics (STEM). As part of this study Virginia Tech is surveying adults who participate in HSAP in the capacity of STEM mentors (e.g., instructors, research mentors, or competition advisors). The questionnaire will collect information about you, your experiences in school, and your experiences in HSAP. The results of this survey will be used to help us improve HSAP and to report to the organizations that support HSAP.

About this survey:

- This research protocol has been approved for use with human subjects by the Virginia Tech IRB office.
- Although this questionnaire is not anonymous, it is CONFIDENTIAL. Prior to analysis and reporting responses will be de-identified and no one will be able to connect your responses to you or your apprentice's name.
- Only AEOP evaluation personnel will have access to completed questionnaires and personal information will be stored securely.
- Responding to this survey is VOLUNTARY. You are not required to participate, although we hope you do because your responses will provide valuable information for meaningful and continuous improvement.
- If you provide your email address, the AEOP may contact you in the future to ask about you or your students.

If you have any additional questions or concerns, please contact one of the following people:

Tanner Bateman, Virginia Tech
Senior Project Associate, AEOPCA
(540) 231-4540, tbateman@vt.edu

Rebecca Kruse, Virginia Tech
Evaluation Director, AEOPCA
(540) 315-5807, rkruse75@vt.edu

Contact Information		
Please verify the following information:		
*First Name:		
*Last Name:		
*Email Address:		
All fields with an asterisk (*) are required.		

*1. Do you agree to participate in this survey? (required)(*Required)
Select one.

○	Yes, I agree to participate in this survey
○	No, I do not wish to participate in this survey

6. Which of the following BEST describes the organization you work for? (select ONE)
Select one.

○	No organization
○	School or district (K-12)
○	State educational agency
○	Institution of higher education (vocational school, junior college, college, or university)
○	Private Industry
○	Department of Defense or other government agency
○	Non-profit
○	Other, (specify):

7. Which of the following BEST describes your current occupation (select ONE)
Select one.

○	Teacher	(Go to question number 8.)
○	Other school staff	(Go to question number 8.)
○	University educator	(Go to question number 13.)
○	Scientist, Engineer, or Mathematician in training (undergraduate or graduate student, etc.)	(Go to question number 13.)
○	Scientist, Engineer, or Mathematics professional	(Go to question number 13.)
○	Other, (specify)::	(Go to question number 13.)

8. What grade level(s) do you teach (select all that apply)?

Select all that apply.

☐	Upper elementary
☐	Middle school
☐	High school

12. Which of the following subjects do you teach? (select ALL that apply)

Select all that apply.

If answered, go to question number 14.

☐	Upper elementary
☐	Physical science (physics, chemistry, astronomy, materials science, etc.)
☐	Biological science
☐	Earth, atmospheric, or oceanic science
☐	Environmental science
☐	Computer science
☐	Technology
☐	Engineering
☐	Mathematics or statistics
☐	Medical, health, or behavioral science
☐	Social Science (psychology, sociology, anthropology)
☐	Other, (specify)::

13. Which of the following best describes your primary area of research?

Select one.

○	Physical science (physics, chemistry, astronomy, materials science, etc.)
○	Biological science
○	Earth, atmospheric, or oceanic science
○	Environmental science
○	Computer science
○	Technology
○	Engineering
○	Mathematics or statistics
○	Medical, health, or behavioral science
○	Social Science (psychology, sociology, anthropology)
○	Other, (specify)::

15. Which of the following BEST describes your role during HSAP?

Select one.

- ○ Research Mentor
- ○ Research Team Member but not a Principal Investigator (PI)
- ○ Other, (specify)::

16. How many HSAP students did you work with this year?

_____ students.

17. How did you learn about HSAP? (Check all that apply)

Select all that apply.

- ☐ Army Research Office (ARO) website
- ☐ Army Educational Outreach Program (AEOP) website
- ☐ AEOP on Facebook, Twitter, Pinterest, or other social media
- ☐ A STEM conference or STEM education conference
- ☐ An email or newsletter from school, university, or a professional organization
- ☐ Past HSAP participant
- ☐ A student
- ☐ A colleague
- ☐ My supervisor or superior
- ☐ A HSAP site host or director
- ☐ Workplace communications
- ☐ Someone who works with the Department of Defense (Army, Navy, Air Force)
- ☐ Other, (specify)::

18. How many times have YOU PARTICIPATED in any of the following Army Educational Outreach Programs (AEOPs) in any capacity? If you have heard of an AEOP but never participated select "Never." If you have not heard of an AEOP select "Never heard of it."

Select one per row.

	Never	*Once*	*Twice*	*Three or more times*	*I've never heard of this program*
Camp Invention	○	○	○	○	○
eCYBERMISSION	○	○	○	○	○
Junior Solar Sprint (JSS)	○	○	○	○	○
Junior Science & Humanities Symposium (JSHS)	○	○	○	○	○
Gains in the Education of Mathematics and Science (GEMS)	○	○	○	○	○
GEMS Near Peers	○	○	○	○	○
UNITE	○	○	○	○	○
Science & Engineering Apprenticeship Program (SEAP)	○	○	○	○	○
Research & Engineering Apprenticeship Program (REAP)	○	○	○	○	○
High School Apprenticeship Program (HSAP)	○	○	○	○	○
College Qualified Leaders (CQL)	○	○	○	○	○
Undergraduate Research Apprenticeship Program (URAP)	○	○	○	○	○
Science Mathematics, and Research for Transformation (SMART) College Scholarship	○	○	○	○	○
National Defense Science & Engineering Graduate (NDSEG) Fellowship	○	○	○	○	○

19. Which of the following were used for the purpose of recruiting your student(s) for apprenticeships? (select ALL that apply)

Select all that apply.

☐	Applications from Army Research Office (ARO) or the AEOP
☐	Personal acquaintance(s) (friend, family, neighbor, etc.)
☐	Colleague(s) in my workplace
☐	K-12 school teacher(s) outside of my workplace
☐	University faculty outside of my workplace
☐	Informational materials sent to K-12 schools or Universities outside of my workplace
☐	Communication(s) generated by a K-12 school or teacher (newsletter, email blast, website)
☐	Communication(s) generated by a university or faculty (newsletter, email blast, website)
☐	STEM or STEM Education conference(s) or event(s)
☐	Organization(s) that serve underserved or underrepresented populations
☐	The student contacted me (the mentor) about the program
☐	I do not know how student(s) were recruited for HSAP
☐	Other, (specify)::

20. How SATISFIED were you with the following HSAP features?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Application or registration process	○	○	○	○	○
Other administrative tasks (in-processing, network access, etc.)	○	○	○	○	○
Communicating with Army Research Office (ARO)	○	○	○	○	○
Communicating with HSAP organizers	○	○	○	○	○
Support for instruction or mentorship during program activities	○	○	○	○	○
Stipends (payment)	○	○	○	○	○
Research abstract preparation requirements	○	○	○	○	○

21. The list below describes mentoring strategies that are effective ways to establish the relevance of learning activities for students. From the list below, please indicate which strategies you used when working with your student(s) in HSAP.

Select one per row.

	Yes - I used this strategy	*No - I did not use this strategy*
Become familiar with my student(s) background and interests at the beginning of the HSAP experience	○	○
Giving students real-life problems to investigate or solve	○	○
Selecting readings or activities that relate to students' backgrounds	○	○
Encouraging students to suggest new readings, activities, or projects	○	○
Helping students become aware of the role(s) that STEM plays in their everyday lives	○	○
Helping students understand how STEM can help them improve their own community	○	○
Asking students to relate real-life events or activities to topics covered in HSAP	○	○

22. The list below describes mentoring strategies that are effective ways to support the diverse needs of students as learners. From the list below, please indicate which strategies you used when working with your student(s) in HSAP.

Select one per row.

	Yes - I used this strategy	*No - I did not use this strategy*
Identify the different learning styles that my student (s) may have at the beginning of the HSAP experience	○	○
Interact with students and other personnel the same way regardless of their background	○	○
Use a variety of teaching and/or mentoring activities to meet the needs of all students	○	○
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	○	○
Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	○	○
Directing students to other individuals or programs for additional support as needed	○	○
Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	○	○

23. The list below describes mentoring strategies that are effective ways to support students development of collaboration and interpersonal skills. From the list below, please indicate which strategies you used when working with your student(s) in HSAP.

Select one per row.

	Yes - I used this strategy	*No - I did not use this strategy*
Having my student(s) tell other people about their backgrounds and interests	○	○
Having my student(s) explain difficult ideas to others	○	○
Having my student(s) listen to the ideas of others with an open mind	○	○
Having my student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	○	○
Having my student(s) give and receive constructive feedback with others	○	○
Having students work on collaborative activities or projects as a member of a team	○	○
Allowing my student(s) to resolve conflicts and reach agreement within their team	○	○

24. The list below describes mentoring strategies that are effective ways to support students' engagement in "authentic" STEM activities. From the list below, please indicate which strategies you used when working with your student(s) in HSAP.

Select one per row.

	Yes - I used this strategy	*No - I did not use this strategy*
Teaching (or assigning readings) about specific STEM subject matter	○	○
Having my student(s) search for and review technical research to support their work	○	○
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	○	○
Supervising my student(s) while they practice STEM research skills	○	○
Providing my student(s) with constructive feedback to improve their STEM competencies	○	○
Allowing students to work independently to improve their self-management abilities	○	○
Encouraging students to learn collaboratively (team projects, team meetings, journal clubs, etc.)	○	○
Encouraging students to seek support from other team members	○	○

25. This list describes mentoring strategies that are effective ways to support students' STEM educational and career pathways. The list also includes items that reflect AEOP and Army priorities. From this list, please indicate which strategies you used when working with your student(s) in HSAP.

Select one per row.

	Yes - I used this strategy	*No - I did not use this strategy*
Asking my student(s) about their educational and/or career goals	○	○
Recommending extracurricular programs that align with students' goals	○	○
Recommending Army Educational Outreach Programs that align with students' goals	○	○
Providing guidance about educational pathways that will prepare my student(s) for a STEM career	○	○
Discussing STEM career opportunities within the DoD or other government agencies	○	○
Discussing STEM career opportunities in private industry or academia	○	○
Discussing the economic, political, ethical, and/or social context of a STEM career	○	○
Recommending student and professional organizations in STEM to my student(s)	○	○
Helping students build a professional network in a STEM field	○	○
Helping my student(s) with their resume, application, personal statement, and/or interview preparations	○	○

26. How useful were each of the following in your efforts to expose student(s) to Army Educational Outreach Programs (AEOPs) during HSAP?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Army Research Office (ARO) website	○	○	○	○	○
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
HSAP Program administrator or site coordinator	○	○	○	○	○
Invited speakers or “career” events	○	○	○	○	○
Participation in HSAP	○	○	○	○	○

27. How USEFUL were each of the following in your efforts to expose your student(s) to Department of Defense (DoD) STEM careers during HSAP.

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Army Research Office (ARO) website	○	○	○	○	○
Army Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
HSAP Program administrator or site coordinator	○	○	○	○	○
Invited speakers or “career” events	○	○	○	○	○
Participation in HSAP	○	○	○	○	○

28. Which of the following AEOPs did YOU EXPLICITLY DISCUSS with your student(s) during HSAP? (check ALL that apply)

Select one per row.

	Yes - I discussed this program with my student(s)	*No - I did not discuss this program with my student(s)*
Gains in the Education of Mathematics and Science (GEMS)	○	○
UNITE	○	○
Junior Science & Humanities Symposium (JSHS)	○	○
Science & Engineering Apprenticeship Program (SEAP)	○	○
Research & Engineering Apprenticeship Program (REAP)	○	○
High School Apprenticeship Program (HSAP)	○	○
College Qualified Leaders (CQL)	○	○
GEMS Near Peer Mentor Program	○	○
Undergraduate Research Apprenticeship Program (URAP)	○	○
Science Mathematics, and Research for Transformation (SMART) College Scholarship	○	○
National Defense Science & Engineering Graduate (NDSEG) Fellowship	○	○
I discussed AEOP with my student(s) but did not discuss any specific program	○	○

29. How much do you agree or disagree with the following statements about Department of Defense (DoD) researchers and research:

Select one per row.

	Strongly Disagree	*Disagree*	*Neither Agree nor Disagree*	*Agree*	*Strongly Agree*
DoD researchers advance science and engineering fields	○	○	○	○	○
DoD researchers develop new, cutting edge technologies	○	○	○	○	○
DoD researchers solve real-world problems	○	○	○	○	○
DoD research is valuable to society	○	○	○	○	○

30. How often did YOUR STUDENT(S) have opportunities to do each of the following in HSAP?

Select one per row.

	Not at all	*At least once*	*A few times*	*Most days*	*Every day*
Learn new science, technology, engineering, or mathematics (STEM) topics	○	○	○	○	○
Apply STEM knowledge to real-life situations	○	○	○	○	○
Learn about new discoveries in STEM	○	○	○	○	○
Learn about different careers that use STEM	○	○	○	○	○
Interact with scientists or engineers	○	○	○	○	○
Communicate with other students about STEM	○	○	○	○	○
Use laboratory or field techniques, procedures, and tools	○	○	○	○	○
Participate in hands-on STEM activities	○	○	○	○	○
Work as part of a team	○	○	○	○	○
Identify questions or problems to investigate	○	○	○	○	○
Design an investigation	○	○	○	○	○
Carry out an investigation	○	○	○	○	○
Analyze data or information	○	○	○	○	○
Draw conclusions from an investigation	○	○	○	○	○
Come up with creative explanations or solutions	○	○	○	○	○
Build or make a computer model	○	○	○	○	○

31. AS A RESULT OF THEIR HSAP EXPERIENCE, how much did your student(s) GAIN in the following areas?

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
In depth knowledge of a STEM topic(s)	○	○	○	○	○
Knowledge of research conducted in a STEM topic or field	○	○	○	○	○
Knowledge of research processes, ethics, and rules for conduct in STEM	○	○	○	○	○
Knowledge of how professionals work on real problems in STEM	○	○	○	○	○
Knowledge of what everyday research work is like in STEM	○	○	○	○	○

32. Which category best describes the focus of your student(s) HSAP activities?

Select one.

○	Science	(Go to question number 33.)
○	Technology	(Go to question number 34.)
○	Engineering	(Go to question number 34.)
○	Mathematics	(Go to question number 34.)

33. AS A RESULT OF THEIR HSAP EXPERIENCE, how much did your student(s) GAIN in their abilities to do each of the following?

Select one per row.

If answered, go to question number 35.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Asking a question that can be answered with one or more scientific experiments	○	○	○	○	○
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	○	○	○	○	○
Making a model of an object or system showing its parts and how they work	○	○	○	○	○
Designing procedures for an experiment that are appropriate for the question to be answered	○	○	○	○	○
Identifying the limitations of the methods and tools used for data collection	○	○	○	○	○
Carrying out procedures for an experiment and recording data accurately	○	○	○	○	○
Using computer models of objects or systems to test cause and effect relationships	○	○	○	○	○
Organizing data in charts or graphs to find patterns and relationships	○	○	○	○	○
Considering different interpretations of data when deciding how the data answer a question	○	○	○	○	○
Supporting an explanation for an observation with data from experiments	○	○	○	○	○
Supporting an explanation with relevant scientific, mathematical, and/or engineering knowledge	○	○	○	○	○
Identifying the strengths and limitations of explanations in terms of how well they describe or predict observations	○	○	○	○	○

Defending an argument that conveys how an explanation best describes an observation	○	○	○	○	○
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	○	○	○	○	○
Integrating information from technical or scientific texts and other media to support your explanation of an observation	○	○	○	○	○
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	○	○	○	○	○

34. **AS A RESULT OF THEIR HSAP EXPERIENCE, how much did your student(s) GAIN in their ability to do each of the following?**

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Defining a problem that can be solved by developing a new or improved object, process, or system	○	○	○	○	○
Using knowledge and creativity to propose a testable solution for a problem	○	○	○	○	○
Making a model of an object or system to show its parts and how they work	○	○	○	○	○
Designing procedures for an experiment that are appropriate for the question to be answered	○	○	○	○	○
Identifying the limitations of the methods and tools used for data collection	○	○	○	○	○
Carrying out procedures for an experiment and recording data accurately	○	○	○	○	○
Using computer models of an object or system to investigate cause and effect relationships	○	○	○	○	○
Considering different interpretations of the data when deciding if a solution works as intended	○	○	○	○	○
Organizing data in charts or graphs to find patterns and relationships	○	○	○	○	○
Supporting a solution for a problem with data from experiments	○	○	○	○	○
Supporting a solution with relevant scientific, mathematical, and/or engineering knowledge	○	○	○	○	○
Identifying the strengths and limitations of solutions in terms of how well they meet design criteria	○	○	○	○	○
Defend an argument that conveys how a solution best	○	○	○	○	○

meets design criteria					
Identifying the strengths and limitations of data, interpretations, or arguments presented in technical or scientific texts	○	○	○	○	○
Integrating information from technical or scientific texts and other media to support your solution to a problem	○	○	○	○	○
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations)	○	○	○	○	○

35. AS A RESULT OF THE HSAP EXPERIENCE, how much did your student(s) GAIN (on average) in the skills/abilities listed below?

Select one per row.

	No gain	*A little gain*	*Some gain*	*Large gain*	*Extreme gain*
Learning to work independently	○	○	○	○	○
Setting goals and reflecting on performance	○	○	○	○	○
Sticking with a task until it is finished	○	○	○	○	○
Making changes when things do not go as planned	○	○	○	○	○
Including others' perspectives when making decisions	○	○	○	○	○
Communicating effectively with others	○	○	○	○	○
Confidence with new ideas or procedures in a STEM project	○	○	○	○	○
Patience for the slow pace of research	○	○	○	○	○
Desire to build relationships with professionals in a field	○	○	○	○	○
Connecting a topic or field with their personal values	○	○	○	○	○

36. Which of the following statements describe YOUR STUDENT(S) after participating in the HSAP program?

Select one per row.

	Disagree - This did not happen	*Disagree - This happened but not because of HSAP*	*Agree - HSAP contributed*	*Agree - HSAP was primary reason*
More confident in STEM knowledge, skills, and abilities	○	○	○	○
More interested in participating in STEM activities outside of school requirements	○	○	○	○
More aware of other AEOPs	○	○	○	○
More interested in participating in other AEOPs	○	○	○	○
More interested in taking STEM classes in school	○	○	○	○
More interested in earning a STEM degree	○	○	○	○
More interested in pursuing a career in STEM	○	○	○	○
More aware of DoD STEM research and careers	○	○	○	○
Greater appreciation of DoD STEM research	○	○	○	○
More interested in pursuing a STEM career with the DoD	○	○	○	○

37. What are the three most important strengths of HSAP?

Strength #1:	
Strength #2:	
Strength #3:	

38. What are the three ways HSAP should be improved for future participants?

Improvement #1:	
Improvement #2:	
Improvement #3:	

39. Please tell us about your overall satisfaction with your HSAP experience.

Appendix G

Army Research Office (ARO)
FY15 Evaluation Report Response

Feedback was received from the ARO office and was incorporated into the report.