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## **Army Educational Outreach Program**

Undergraduate Research Apprenticeship Program (URAP)



## **2017 Annual Program Evaluation Report**

## **PART 1: Executive Summary**



February 2018



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## 2 | Executive Summary

The Army Educational Outreach Program (AEOP) vision is to develop a diverse, agile, and highly competent STEM talent pool. AEOP seeks to fulfill this mission by providing students and teachers nationwide a collaborative and cohesive portfolio of Army-sponsored science, technology, engineering and mathematics (STEM) programs that effectively engage, inspire, and attract the next generation of STEM talent through K-college programs and expose participants to Department of Defense (DoD) STEM careers. AEOP provides this portfolio of programs via a consortium, formed by the Army Educational Outreach Program Cooperative Agreement (AEOP CA), that engages non-profit, industry, and academic partners with aligned interests. The consortium provides 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.

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

Apprentices receive an educational stipend equivalent to \$15 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 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 apprentices prepare abstracts for submission to the US Army Research Office Youth Science programs office.



2017 URAP Fast Facts	
	STEM Apprenticeship Program – Summer,
	in Army-funded labs at
	colleges/universities nationwide, with
Description	college/university S&E mentors
Participant Population	College undergraduate students
No. of Applicants	239
No. of Students (Apprentices)	59
Placement Rate	25%
No. of Adults (Mentors)	49
No. of Army-Funded College/University Laboratories	41
No. of HBCU/MSIs	17
Total Cost	\$251,679
Administrative Costs	\$49,512
Total Stipends	\$199,843
Other Operational Costs	\$2,324
Cost Per Student Participant	\$4,000

### **Summary of Findings**

The 2017 evaluation of URAP collected data about participants; participants' perceptions of program processes, resources, and activities; and indicators of achievement in outcomes related to AEOP and program objectives. A summary of findings is provided in the following table.

2017 URAP Evaluation Findings	
Participant Profiles	
URAP continues to serve students from groups traditionally underrepresented and underserved in STEM.	A substantial percentage of enrolled apprentices (44%) attended Historically Black Colleges and Universities or other Minority Serving institutions (HBCUs/MSIs). Seventeen of the 39 participating institutions were HBCUs/MSIs, an increase from the 14 HBCUs/MSIs that participated in 2016.
	Over half (53%) of apprentice were White, a slight decrease from 2016 when 58% were White. The program also served students from racial/ethnic groups historically underserved and underrepresented in STEM fields. Of the 59 apprentices, 8% were Black or African American (compared to 10% in 2016) and 15% were Hispanic or Latino (compared to 13% in 2016). Nearly a quarter (24%) of apprentices met the AEOP definition of underserved students.
URAP received a substantially larger number of applications than in 2016 and exceeded its 2017 goal for apprentice enrollment.	URAP surpassed its 2017 goal of 55 apprentice participants, enrolling a total of 59 apprentices (a 12% increase compared to the 52 apprentices enrolled in 2016). These apprentices were selected from among 239 applicants, a 25% increase from 2016 when 177 applications were received.



Actionable Program Evaluation	
URAP apprentices learned about AEOP in a variety of ways	The most frequently mentioned way that participants learned about URAP and/or AEOP was someone who works at a school or university apprentice attends (57%). Other sources mentioned relatively frequently were someone who works with the program (23%), and a school or university newsletter, email, or website (20%).
URAP participants were motivated to participate by the opportunities to gain experience and learn.	The most common motivators for participating in URAP were related to STEM interest and learning, including the desire to learn something new or interesting (93%) and interest in STEM (93%). A large majority of apprentices also reported being motivated to participate in URAP because of the laboratory experience, including the opportunity to use advanced laboratory technology (87%) and desire to expand laboratory or research skills (80%).
URAP apprentices learned about STEM careers, both in general and, to a lesser extent, within the DoD, during their apprenticeships.	A large majority of apprentices (81%) reported learning about at least one STEM job during URAP, and 38% reported learning about 4 or more. Although 72% of apprentices reported being more aware of DoD STEM careers as a result of URAP, fewer apprentices reported hearing about STEM careers within the DoD during their apprenticeships, with half (50%) learning about no DoD STEM jobs or careers, and half (50%) reporting that they learned about at least one. Only 22% of apprentices reported hearing about 4 or more DoD STEM jobs or careers during URAP.
	Approximately half or more of apprentices indicated that participation in URAP (56%) and presentations or information shared during URAP (50%) were at least somewhat helpful in informing them about DoD STEM careers. Nearly half (47%) reported that their mentors were at least somewhat helpful for this purpose.
	A large majority of mentors (86%) indicated that participation in URAP somewhat or very much useful to inform students about DoD STEM careers. Other resources reported frequently as being at least somewhat useful included the AEOP website (62%) and the program administrator or site coordinator (62%). More than half of mentors reported that they did not experience AEOP social media (68%).
URAP apprentices engaged in a variety of STEM practices and reported significantly higher levels of engagement in STEM practices in URAP as compared to their typical school experiences.	Apprentices reported engaging in a wide array of STEM practices while in URAP. The practices most frequently engaged in (weekly or every day) included interacting with STEM researchers (91%) and identifying questions or problems to investigate (91%). Over half of apprentices reported that they did not present their STEM research to a panel of judges from industry or the military (69%) and over a third reported that they did not building a computer model (38%). Students reported significantly higher STEM Engagement while in URAP over school (effect size is large with d = 0.75).



URAP mentors used strategies to establish the relevance of the apprenticeship with students' backgrounds.	Mentors helped make learning activities relevant to students by using strategies such as becoming familiar with their students' backgrounds and interests at the beginning of URAP (94%) and giving students real-life problems to investigate (85%). Approximately two-thirds or more (65% - 94%) of mentors reported using each strategy to establish the relevance of learning activities in URAP.
Mentors utilized strategies to support diversity and grow apprentice understanding of issues regarding underrepresentation in STEM areas.	Mentors supported the diverse needs of students as learners by using strategies such as using a variety of teaching and/or mentoring activities to meet needs of all students (94%) and directing students to other individuals or programs for additional support as needed (91%). Nearly two-thirds of mentors (65%) reported highlighting the underrepresentation of women and racial and ethnic minority population in STEM; this is an increase in the use of this strategy compared to past years (38% in 2015; 46% in 2016). Nearly two-thirds or more (65% - 91%) of responding mentors also reported using all strategies related to supporting the diverse needs of students as learners.
Mentor reported use of strategies to develop collaboration and other skills as well as engaging students in authentic STEM activities was frequent.	Mentors supported students' development of collaboration and interpersonal skills by using strategies such as having students work on collaborative activities as a member of a team (94%), having students listen to the ideas of others with an open mind (91%), and having students explain difficult ideas to others (91%). More than three-quarters (77% - 91%) of mentors reported using all strategies presented in this domain. Mentors supported students' engagement in authentic STEM activities by using strategies such as supervising their students while they practiced STEM research skills (97%), and providing their students with constructive feedback to improve their STEM competencies (97%). Nearly all (88% - 94%) mentors indicated they used all strategies to support student engagement in authentic STEM activities.
Mentors reported frequent use of strategies to develop apprentice career aspirations and to learn more about DoD STEM careers.	Mentors supported students' STEM educational and career pathways by using strategies such as asking their students about their educational and/or career goals (97%) and providing guidance about educational pathways that will prepare students for a STEM career (94%). Fewer mentors (56%) reported using strategies such as recommending AEOPs that align with students' goals and recommending extracurricular programs that align with students' goals. There was, however, an increase in the use of strategies related to communicating with apprentices about AEOP and DoD STEM career opportunities as compared to 2016. In 2016, only 39% of mentors recommended other AEOP programs to apprentices while 56% did so in 2017. Likewise, in 2016 a little more than half of the responding mentors (57%) reported discussing STEM careers within the DOD or government with apprentices, while nearly three-quarters (74%) reported doing this in 2017.
Apprentices reported high levels of satisfaction with their experience in URAP.	Approximately two-thirds or more of apprentices indicated being "somewhat" or "very much" satisfied with all URAP features about which they were asked. All apprentices were at least somewhat satisfied with the physical location of URAP (100%), and nearly all were at least somewhat satisfied with their communication with their host site organizers (97%).



	Approximately 85% or more of apprentices indicated they were somewhat or very much satisfied with all aspects of their mentor relationships, suggesting that strong mentor-apprentice relationships are built in URAP. For example, 97% of apprentices were at least somewhat satisfied with their working relationship with their mentors, and 91% with the amount of time they spent with their mentors. Apprentices also reported high levels of satisfaction with other components of their research experiences. For example, 94% were at least somewhat satisfied with their research experience overall and 91% with the amount of time they spent doing meaningful research.
Mentors reported high levels of satisfaction with their experience in URAP.	Two-thirds or more (68% - 94%) of mentors reported being somewhat or very much satisfied with all features with the exception of communication with AAS (56% had not experienced this; 35% were at least somewhat satisfied). Nearly all mentors were at least somewhat satisfied with features such as the research abstract preparation requirements (94%), the application or registration process (91%), and support for instruction or mentorship during program activities (91%). Few mentors expressed dissatisfaction with any URAP program features, although 3 mentors (9%) indicated that they were "not at all" satisfied with stipends.
Apprentices and mentors had some suggestions for improving URAP.	Apprentices' most commonly suggested areas of improvements included: communication with the program, including general suggestions for better communication, more information about the apprenticeship requirements, and more information about AEOP; improvements to stipends, including suggestions for larger stipends, more frequent payment, and on-time payment of stipends; and mentors, including suggestions that mentors be more available, that mentors complete progress reports for apprentices, that there be more diverse research interests represented among mentors, and that mentors be better prepared for apprentices prior to their arrival. Mentors' most commonly suggested improvements included providing opportunities for apprentices to present their research and suggestions for a longer program and/or more program opportunities throughout the year.
Outcomes Evaluation	
URAP had a positive impact on apprentices' STEM knowledge and competencies, with males reporting higher gains in STEM competencies than females.	More than 80% of apprentices reported medium or large gains in each area (of STEM knowledge. Large majorities of apprentices reported medium or large gains in areas such as knowledge of what everyday research work is like in STEM (88%), knowledge of what everyday research work is like in STEM (88%), and knowledge of research conducted in a STEM topic or field (85%). Over three-quarters (75% - 84%) of apprentices reported medium to large gains for all areas of STEM competencies. For example, large majorities of apprentices reported medium or large gains in designing procedures for an experiment (84%), carrying out procedures for an experiment and recording data accurately (84%), communicating about experiments in different ways (84%), and supporting an explanation for an observation with an experiment (84%). Males reported significantly greater gains across STEM competency items compared to females (large effect size; d = 1.16).



URAP apprentices demonstrated observable gains in their 21 <sup>st</sup> Century Skills, and apprentices self- reported growth in these skills.	Participants in URAP demonstrated significant gains in their 21 <sup>st</sup> Century Skills assessment from pre-to post as assessed by their mentors in the domains of Creativity & Innovation (0.79 gain); Critical Thinking and Problem Solving (0.88 gain); Communication, Collaboration, Social and Cross-Cultural skills (0.61 gain); Flexibility, Adaptability, Initiative, and Self-Direction (0.68 gain), and Productivity, Accountability, Leadership, and Responsibility (0.79 gain). These findings were also supported by apprentice self-reports on the questionnaire. More than three-quarter of apprentices reported medium to large gains on all items associated with their 21 <sup>st</sup> Century Skills. For example, large majorities of apprentices reported medium or large gains in making changes when things do not go as planned (97%), and setting goals and reflecting on performance (94%).
URAP apprentices experienced gains in their STEM identities and confidence as a result of their apprenticeship experiences.	Nearly three-quarters or more (72% - 88%) of apprentices reported medium or large gains on all items associated with STEM identity. For example, large majorities of apprentices reported at least medium gains on their confidence to try out new ideas or procedures on their own in a STEM project (88%) and their desire to build relationships with mentors who work in STEM (88%).
URAP apprentices were more likely to engage in STEM activities outside of regular school activities as a result of their apprenticeship experiences.	Approximately two-thirds or more (63% - 91%) of apprentices reported being more likely or much more likely to participate in all STEM activities about which they were asked. For example, apprentices reported being more, or much more, likely to work on a STEM project or experiment in a university or professional setting (91%), take a STEM elective (81%), and talk with family or friends about STEM (78%).
Apprentices expressed interest in participating in AEOPs in the future, although many had not heard of AEOPs for which they currently are or will soon be eligible.	A large majority of apprentices (88%) reported being more interested in participating in other AEOPs in the future, and a majority of apprentices (63%) indicated being at least somewhat interested in participating in URAP again. Fewer apprentices reported specific interest in other programs, although 41% indicated they were at least somewhat interested in NDSEG and SMART. In spite of the fact that a large majority of apprentices (84%) reported being more aware of other AEOPs after URAP, relatively large proportions of apprentices reported not having heard of programs for which they are currently, or will soon be, eligible. For example, 50% had not heard of CQL, 63% had not heard of GEMS Near Peer Mentors, and 44% had not heard of NDSEG and SMART.
URAP participation and mentors were the most useful resources for apprentices to learn about AEOPs, however few mentors discussed specific AEOPs with their apprentices.	Participating in URAP (72%) and URAP mentors (72%) were most likely to be rated as impacting apprentices' awareness of AEOPs "somewhat" or "very much." More than half of participants (56%) indicated they had not experienced AEOP on social media while 31% had not experienced the AEOP brochure.
	Over three-quarters (77%) of mentors discussed AEOP with their apprentices, but without reference to any specific program. Of the programs, which were explicitly discussed, the most commonly mentioned was NDSEG (discussed by 32% of mentors), followed by SMART (discussed by 24% of mentors).



	Mentors reported that participation in URAP was the most useful resource for exposing apprentices to AEOPs (91% reported that this was somewhat or very much useful). Mentors also indicated the URAP Program administrator or site coordinator was at least somewhat useful for exposing apprentices to AEOPs (71%). More than half of mentors reported that they did not experience AEOP on social media (71%) and over a third (35%) had not experienced the AEOP brochure.
URAP apprentices had positive opinions about DoD research and DoD researchers.	A large majority (84%) of apprentices reported that they had a greater appreciation of Army or DoD STEM research as a result of their URAP apprenticeships.
	More than 80% of participants agreed or strongly agreed with various positive statements about DoD STEM research and researchers. For example, 91% agreed that DoD research is valuable to society and 88% agreed that DoD researchers solve real-world problems.
URAP positively impacted apprentices' aspirations for STEM careers and education.	A large majority (91%) of apprentices reported aspiring to earn a graduate degree (master's or higher) after their URAP experiences, and over a third (34%) reported that they aspired to a Ph.D. after URAP. Over half (57%) reported being more interested in earning a STEM degree after URAP. Over half (63%) of apprentices reported being more interested in pursuing a career in STEM after URAP and 69% indicated that they were more interested in pursuing a STEM career with the Army or DoD as a result of their URAP experiences.

### **Responsiveness to FY17 Evaluation Recommendations**

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

**FY16 Finding:** AEOP objectives include expanding participation of historically underrepresented and underserved populations. URAP has made some progress in this area, as it was noted as an area for improvement, particularly in recruiting female mentors, in the FY16 evaluation report. Between 2014 and 2016, URAP has engaged more female mentors, which is a positive trend. 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.

**URAP FY17 Efforts and Outcomes:** The number of HBCU/MSI universities participating in URAP in FY17 is 19, an increase of 11 from FY16. The apprenticeship flyer has been updated and reflects more diversity, and will be distributed in FY18. Initial meetings have been held with ARO program managers to assist in this effort.

**FY16 Finding:** A second area that was noted for improvement in FY14 and FY15 was the need to focus more on recruiting students from underrepresented populations. Similar to past years in URAP,



recruitment of apprentices is largely accomplished with personal interactions, either by knowing a professor, peer who attended URAP previously, using professional or academic connections, or mechanisms available to the university or college site. However, in 2016 there was a slight increase in recruitment through websites, which is promising in encouraging a more diverse apprentice pool. It should be noted that URAP was successful in recruiting more Historically Black Colleges and Universities and other Minority Serving Institutions as research sites. Continued efforts in recruiting mentors from HBCUs and MSIs in addition to maintaining communications through websites could offer more diversity in the future.

**URAP FY17 Efforts and Outcomes:** The apprenticeship flyer has been updated and reflects more diversity, and will be distributed in FY18. Initial meetings have been held with ARO program managers to assist in this effort.

**FY16 Finding:** Only a few mentors were aware of specific AEOP programs and even fewer mentors explicitly discussed other AEOP opportunities with their apprentices. This lack of awareness is a barrier in communicating about other AEOP opportunities. It would be beneficial to create a resource that profiles AEOP opportunities and the relationship they have to ongoing education, on-the-job training, and related research activities of Army careers. Such a resource could not only start the conversation about AEOP programs and motivate further exploration beyond the resource itself, but could be used to train the mentors to learn more about specific AEOP opportunities.

**URAP FY17 Efforts and Outcomes:** Approximately 300 universities posted apprenticeship opportunities on career assistance pages for all apprenticeship programs. Program specific mentor assistance in this effort will enhance mentor recruitment efforts.

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

**FY16 Finding:** URAP 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. 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. Most of the apprentices who completed the survey reported that they did not learn about any DoD STEM jobs/careers during URAP. 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.



**URAP FY17 Efforts and Outcomes:** A DoD STEM Career flyer was created in FY16, and updated in FY17. The flyer was sent to mentors and students with website links and descriptions of career opportunities. Mentors and students participated in a newly created DoD STEM Career webinar to gain first-hand knowledge from Army scientists and researchers.

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

**FY16 Finding:** Efforts should be undertaken to improve participation in evaluation activities, as the low response rates for both the apprentice and mentor questionnaires raise questions about the representativeness of the results. Low response rates were also a concern during the 2013, 2014, 2015 and 2016 questionnaire administration. The evaluation instruments may need to be streamlined as the questionnaires are quite lengthy (estimated response time 45 minutes) and response burden can affect participation. It is recommended that program sites provide time on-site for participants to complete the AEOP evaluation survey.

**URAP FY17 Efforts and Outcomes:** Several contacts were made to increase evaluation participation. Mentors were sent an email with a link to register for the 21<sup>st</sup> Century Skills Assessment webinar, which informed them on how to complete the 21st Century pre-and post-survey. The mentors were also sent calendar appointments and email reminders. Apprentices and mentors were also sent promotional materials with links to surveys in communications during the program.

### **Recommendations for FY18 Program Improvement/Growth**

Evaluation findings indicate that FY17 was a successful year for the URAP program. There was an increase in participation from 52 in FY16 to 59 apprentices in FY17. URAP had nearly 50% participation from HBCU/MSI sites (17 of 39) an increase of three sites from FY16. Participants and mentors reported their satisfaction with the program and apprentices reported growth in their STEM knowledge, interests, and competencies. Mentors indicated they consistently use innovative and research-based strategies to engage apprentices in STEM activities, and the apprentices similarly report increased ability to engage in STEM activities and have STEM habits of mind, due to the URAP experience. URAP participants increased their mastery of 21<sup>st</sup> Century Skills as assessed by their mentors during the FY17 program.

While the successes for URAP 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 FY18 and beyond.

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



- 1. AEOP Priority #1 is focused on growing the diversity of the pool of STEM talent in deep and meaningful ways. AEOP programs are charged with making this a primary focus of their recruitment and enrollment for the program. In FY17, the URAP program had only 24% of participants that were from underrepresented groups as defined by the AEOP. Additionally, while participation of White students decreased slightly, African American participation decreased by 2% (8% of total in FY17) while Hispanic/Latino apprentices grew to 15% in FY17 (from 13% in FY16). It is recommended that URAP invest considerable effort in FY18 in continuing to reach out to underrepresented populations to encourage their applications and participation in the program. It may be worthwhile to work with REAP, another AEOP apprentice program that has had great results in reaching diverse participant groups.
- 2. Findings from the FY16 evaluation suggested that URAP develop a resource for mentors to utilize to promote AEOP opportunities, as well as other resources within the DoD. It does not appear that URAP followed this guidance, as the only mention of activities aligned with this was having universities post apprenticeship opportunities on their career assistance pages, which isn't related at all. In FY17, mentors did not report going beyond discussing AEOP in general with apprentices (77%). Only 32% of mentors discussed NDSEG and only 24% shared information about SMART. Therefore, it is again recommended that URAP (or apprenticeship programs collectively) develop tools for mentors to use to teach or inform their participants about AEOP programs including specific information on each opportunity.

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

In FY17, URAP apprentices and mentors both echoed findings that have been prevalent across the AEOP portfolio. Only a very few number of participants and mentors are accessing and/or utilizing AEOP social media, including the website. In regards to URAP, 68% of mentors and 56% of apprentices did not experience AEOP social media at all. Therefore, the evaluation team recommends that URAP work with the consortium members to determine a plan for the future utilization and marketing of AEOP social media and the website.

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

1. The FY17 evaluation findings indicate collective desire of the apprentices and mentors to improve communication across the program. This includes improving the delivery of information from the program leadership to the mentors and site directors, as well as information (program requirements, stipend payments, that is transmitted between AAS/ARO and the apprentices directly. It is recommended that AAS and ARO take steps to examine communication channels and determine how communication can be improved for URAP.



2. URAP participants were not made cognizant of other applicable AEOP opportunities during the program in FY17. In fact, 50% of URAP apprentices had not heard of CQL, the other college level apprenticeship program within AEOP. Further, less than 50% had been made aware of important scholarship programs including NDSG and SMART. It is strongly recommended that URAP work with their staff and the consortium to develop a plan for marketing and informing participants frequently about other AEOP opportunities and resources.

