Army Educational Outreach Program

Gains in the Education of Mathematics & Science

2015 Annual Program Evaluation Report

ARMY EDUCATIONAL OUTREACH PROGRAM

GEMS_02_04292016

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Contents

Executive Summary

GEMS, administered by the American Society for Engineering Education (ASEE) in FY15 under the VT AEOP cooperative agreement, is a non-residential summer STEM enrichment program for elementary, middle, and high school students hosted at Army laboratories on site or in close coordination off site with the area Army laboratories. The overarching mission that drives the GEMS program is to interest youth in STEM through a hands-on Army laboratory experience that utilizes inquiry-based learning and Near Peer mentoring. Although they operate under a shared mission, GEMS sites are free to include different topics in their curricula that highlight the mission of the laboratory and may set, in addition to the overall program goals, individual laboratory goals. Instead of having a specific model and curriculum forced on individual sites, they are able to design curricula (using the hands-on, experiment-based model) and procedures that make sense considering the specialties of their facility and available resources. GEMS programs run from one to four weeks in length.

In 2015, GEMS provided outreach to 2,270 students and 94 Near-Peer Mentors at 11 different sites. The number of GEMS students in 2015 represents an 8% increase in enrollment over the 2,095 student participants in 2014. Consistent with historical data, many of the GEMS sites received applications from more qualified students than they could serve.

2015 GEMS Fast Facts	
Description	STEM Enrichment Activity - at Army laboratories, hands-on
Participant Population	5th-12th grade students (secondary audience: college undergraduate Near-Peer Mentors, teachers)
No. of Applicants	4,161
No. of Students	2,270
Placement Rate	55%
No. of Adults (incl. NPM, RT, S&Es)	464
No. of Near-Peer Mentors (NPM)	94
No. of Resource Teachers (RT)	51
No. of Army S&Es	272
No. of GEMS sites	11
No. of Army Research Centers & Laboratories[†]	13
No. of K-12 Teachers	42
No. of K-12 Schools	894
No. of K-12 Schools – Title I	184
No. of Colleges/Universities	40
No. of HBCU/MSIs	4
No. of DoDEA Students	N/A
No. of DoDEA Teachers	9

Total Cost	$938,044
Stipend Cost	$679,461
Supplies & Equipment (GEMS sites)	$125,649
Administrative Cost to ASEE	$132,934
Cost Per Student Participant	$413

[†]*The United States Army Medical Research Institute of Chemical Defense (USAMRICD), and the Communications Electronics Research Development and Engineering Center (CERDEC) collaborates with the US Army Research Laboratory (ARL-APG) to host GEMS at Aberdeen Proving Grounds*

This report documents the evaluation of the FY15 GEMS 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 GEMS included questionnaires for students and mentors, 4 focus groups with students and 3 with mentors, and an annual program report compiled by ASEE.

Summary of Findings

The FY15 evaluation of GEMS 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 GEMS Evaluation Findings	
Participant Profiles	
GEMS served students from populations historically underrepresented in STEM, although there is room for growth in this area.	In FY15, 45% of enrolled participants were female, indicating that GEMS successfully attracted participation from female students a population historically underrepresented in engineering fields; this participation rate is comparable to the FY14 female participation rate of 44%. While this rate of female participation is higher than in some other AEOPs (for example JSS, with FY15 female participation of 27%), it still falls short of the approximately 50% rate that would mirror the overall female population.
	Students from historically underrepresented and underserved minority race/ethnicity and low-income groups participated in GEMS. In FY15, 22% of participating students identified themselves as Black or African American, a rate identical to this group's participation in FY14. Participation for students identifying themselves as Hispanic or Latino was 9%, a small increase from the 7% of students identifying with this group in FY14. A small proportion (11% in FY15 versus 12% in FY14) of students continued to report qualifying for free or reduced-price lunch (FRL) – a common indicator of low-income status.
	GEMS served students across a range of school contexts, although no enrolled students identified themselves as attending urban schools, and 81% of participants identified their school setting as suburban.
GEMS attracted more applicants and served more students in FY15 as compared to FY14.	GEMS met and exceeded its FY15 target of receiving 3750 applications (4,161 applications were received in FY15, an increase of 20% over the number of applications in FY14), providing some evidence that the program met its goal of disseminating information about GEMS to a diverse audience. Furthermore, 8% more students were enrolled in FY15 than in FY14.

GEMS increased the number of near-peer mentors in the program but did not attract more resource teachers.	GEMS served the increased population of students with a slight increase in the number of near-peer mentors (NPMs) in the program, although the program failed to meet its FY15 target of 95 NPMs and 55 RTs. In FY15, 94 NPMs participated in GEMS, a 3% increase over FY14 when 92 NPMs participated. The number of RTs remained at 51 for FY15.
Actionable Program Evaluation	
GEMS marketed the program in a number of ways, but there is little evidence of specific outreach efforts to schools and organizations serving groups historically under-represented in STEM.	While ASEE and GEMS sites employed multiple strategies to disseminate information about the GEMS program, there is little evidence of efforts to reach specific groups such as females and other demographic groups historically under-represented in STEM. Outreach efforts included attending the following events: National Summer Learning Conference, 2015 ASEE Annual Conference, and Thomas Jefferson Science and Tech High School. Email blasts were sent to over 4,000 teachers, guidance counselors, and principals in areas near participating GEMS labs, and promotional materials were mailed to teachers upon request.
	Students most frequently learned about the GEMS through personal connections including past participants (28%), family members (27%) and friends (27%). In spite of this, only 3% of students indicated that such personal connections (recommendations from past participants) motivated them to participate once they had learned about the program.
GEMS students reported being motivated to participate by the learning opportunities and fun provided by the program.	Students were most frequently very motivated to participate in GEMS by their interest in STEM (76%), a desire to learn something new and interesting (62%), learning in ways that are not possible in school (30%), and having fun (28%).
GEMS students reported engaging in meaningful STEM learning through team-based and hands-on activities.	Students reported engaging in a number of STEM activities on most days or every day of their GEMS experience. Between 75% and 88% of students reported learning about STEM topics, careers, cutting-edge research, and applications of STEM to real-life situations, communicating with other students about STEM, and interacting with STEM professionals on most days or every day of their GEMS experience.
	Students reported engaging in a variety of STEM practices during their GEMS experience. For example, 94% reported working as part of a team, 92% participating in hands-on activities, and 82% using laboratory procedures and tools on most days or every day.
	Students reported that they had more opportunities to learn about STEM and engage in STEM practices in their GEMS experience than they typically have in school.
	Mentors reported using strategies to help make learning activities relevant to students, support the needs of diverse learners, develop students' collaboration and

	interpersonal skills, and engage students in “authentic” STEM activities.
GEMS informed students about STEM careers in general and, to a lesser extent, about DoD STEM careers specifically.	Nearly all students (98%) reported learning about 1 or more STEM careers during GEMS with 87% reported learning about 3 or more STEM careers. In contrast, 87% of students reported learning about 1 or more DoD STEM career and 62% reported learning about 3 or more. This is a slight increase from FY14 when 84% had heard about at least 1 DoD STEM career and 61% reported hearing about 3 or more of these careers.
	Most responding mentors (86%) reported asking students about their educational and career interests and 90% reported providing guidance about educational pathways that will prepare students for a STEM career. A lesser number, 63%, specifically discussed STEM career opportunities within the DoD or other government agencies.
	Other than simply participating in GEMS, students found their GEMS mentors and invited speakers or career events during GEMS to be the resources most impactful on their awareness of DoD STEM careers. Most students (37%-94%) had not experienced AEOP resources such as the website, brochure, social media, and It Starts Here! magazine.
GEMS has an opportunity to improve student and mentor awareness of other AEOPs.	Mentors reported discussing AEOPs with students although almost half (48%) indicated that they did not discuss specific AEOP initiatives. Besides GEMS and the GEMS Near Peer Mentor program, the most commonly discussed programs were SEAP (66%) and CQL (66%). Fewer than a quarter of mentors discussed any other AEOPs with students, and only 10% discussed UNITE and JSHS, programs for which students are eligible in high school.
	Mentors reported that the most useful resources for exposing students to AEOP were participation in GEMS, program administrators or site coordinators, and invited speakers or career events. A large proportion of mentors had no experience with AEOP on social media (76%) and the It Starts Here! Magazine (91%) although 60% were familiar with the AEOP brochure and 40% found it at least somewhat useful for exposing students to other AEOPs.
Students and mentors value the GEMS experience.	Most students indicated being somewhat or very much satisfied with GEMS program features including the stipend, mentorship, and availability of program topics. Students also offered positive comments about their overall satisfaction with the program, most often describing their learning in GEMS, the personal connections they made with mentors and peers, and having fun.
	Mentors also reported being satisfied with most program features, including stipends, program location, support for instruction and mentorship, and invited

	speakers and career events.
Outcomes Evaluation	
GEMS students reported positive impacts on their STEM knowledge and competencies.	The vast majority of students reported at least some gains in their STEM knowledge as a result of participating in GEMS. These gains were reported in areas such as knowledge of how scientists and engineers work on real problems in STEM, knowledge of what everyday research work is like in STEM, and in depth knowledge of a STEM topic. These impacts were identified for both males and females and across all races/ethnicities.
	Students also reported impacts on their abilities in a number of STEM practices, including carrying out procedures for an investigation and recording data accurately, communicating about experiments and explanations in different ways, and using knowledge and creativity to propose a testable solution for a problem.
GEMS participants reported gains in students' 21st Century Skills.	Nearly all students reported some level of gains in their 21st Century Skills. For instance, 97% reported gains in their ability to work well with students of all backgrounds, make changes when things do not go as planned, and communicate effectively with others. Likewise, 97% of students reported gains in including others' perspectives when making decisions, and 94% gained in viewing failure as an opportunity to learn.
GEMS participants reported gains in their confidence and identity in STEM, and in their interest in engaging in STEM in the future.	The majority of students (89-96%) reported some gain in areas related to their STEM identity, defined as confidence in one's ability to succeed in STEM. Over half of students reported large or extreme gains in their sense of accomplishing something in STEM (69%), their desire to build relationships with mentors who work in STEM (63%), feeling prepared for more challenging STEM activities (71%), thinking creatively about a STEM project or activity (70%), connecting STEM topics to or fields to their personal values (59%), interest in a new STEM topic (63%), and deciding on a path to pursue a STEM career (51%).
	Students also reported gains in the likelihood that they would engage in STEM activities in the future, both in and outside of school. For example, most students indicated that, as a result of GEMS, they were more likely to participate in a STEM camp, club, or competition, work on a STEM project or experiment in a university or professional setting, tinker with a mechanical or electrical device, and take an elective STEM class.

Students reported higher education aspirations after participating in GEMS, although their career aspirations showed little change.	When students were asked to think back on how far they wanted to go in school before participating in GEMS, 40% indicated that they had wanted to finish college, and 53% that they had wanted to get more education after college. After GEMS, there was an upward shift in students' education aspirations, with 29% wishing to finish college and 66% wanting to get more education after college.
	A substantial portion of responding students expressed interest in STEM-related careers both before and after participating in GEMS. For example, 15% indicated aspiring to a career in engineering before GEMS and 17% after, with another 10% interested in becoming a scientist or researcher before GEMS and 12% after.
Although GEMS students are largely unaware of other AEOP initiatives, students showed some interest in future AEOP opportunities.	In spite of results indicating that most students were unaware of other AEOP initiatives, the majority of students indicated interest in participating in future AEOP programs. For example, approximately 1/3 of students responded that they had some level of interest in participating in JSHS, UNITE, CQL, and the GEMS Near Peer Mentor Program. Most participants (91%) credited GEMS with increasing their interest in participating in other programs.
GEMS participants reported positive opinions of DoD research and DoD researchers and reported increases in their awareness of their interest in pursuing a STEM career with the DoD.	A large majority of students had positive opinions of DoD research and researchers. For example, 81% of students agreed that DoD researchers advance science and engineering fields and that DoD research is valuable to society, and 80% agreed that DoD researchers develop new, cutting edge technologies.
	Most students reported that GEMS contributed to their awareness of DoD STEM research and careers (81%) and a greater appreciation of Army of DoD STEM research (83%). Two-thirds of students indicated that they are more interested in pursuing a STEM career with the Army or DoD after participating in GEMS.

Recommendations

Evaluation findings indicate that FY15 was a successful year overall for the GEMS program. Notable successes for the year include increases in participant applications and enrollment, continued participation by groups traditionally under-represented in STEM fields, and high levels of mentor and student satisfaction with the programs. Both students and mentors reported gains in students' STEM knowledge and competencies and gains in students' 21st Century Skills as a result of the GEMS experience, and students emerged from the program more aware of Army and DoD STEM careers.

While these successes are commendable, there are some areas that remain with potential for growth and/or improvement. The evaluation team therefore offers the following recommendations for FY16 and beyond:

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

1. GEMS served 2,270 students in FY15, an 8% increase over FY14. This provides some indication that the program attended to evaluator recommendations that existing sites expand their capacity to accommodate more students in order to meet existing needs and interest in communities that are already served by GEMS programs. In spite of this, however, only 55% of applicants were placed in FY15 as compared to 63% in FY15. This disparity is likely due to the 20% increase in program applications from FY14 to FY15, however this indicates continued unmet need in the program. The large number of applications the program receives provides some evidence that the GEMS program could successfully be expanded to accommodate the considerable amount of unmet need and interest that persists with qualified students. Therefore, the FY14 recommendation that more GEMS sites be identified, recruited, and started in a variety of geographic locations to meet the needs and interest in more communities is repeated. Additionally, evaluators continue to recommend that existing sites expand their capacity to accommodate more students in order to meet existing needs and interest in communities that are already served by GEMS programs. The program should consider increasing the number of existing GEMS sites' administrative staff, teaching staff, physical infrastructure, and mentor participation as this is likely the most effective way to increase existing sites' capacities to meet the very large needs and interest of potential GEMS participants.

2. Both GEMS and AEOP objectives include expanding participation of populations historically underrepresented in STEM, however there was little change in these groups' participation from FY14 to FY15 and little evidence that ASEE targeted marketing of GEMS to these groups in FY15. In FY14, the program reported outreach efforts to organizations that serve these underrepresented groups (for example the Society of Women Engineers and the Hispanic Association for Colleges and Universities), however this sort of targeted outreach was not undertaken in FY15. Additionally, it is notable that no students reported attending a school located in an urban area in FY15. Because of the relationship between urban school enrollment and low-income status, forging partnerships with urban schools may result in expanding the participation of this demographic (operationalized as students receiving free-and-reduced price lunch in the evaluation). It is likely that GEMS will need to expand targeted marketing while implementing more aggressive marketing and recruitment practices. The program may wish to particularly consider targeting outreach to low-income and minority-serving schools, educational networks, community organizations, and professional associations that serve these populations. The program and individual GEMS sites may need to consider practical solutions to help more GEMS students travel to sites that are not close in proximity to their homes. For instance, GEMS may consider offering commuting accommodations (e.g., bus transportation) that make participation more feasible for underrepresented and underserved populations that live further from GEMS sites.

3. Both the FY13 and FY14 evaluation included recommendations to ensure that "connected" applicants (e.g., those with family, family friends, or school-based connections to the site) are not disproportionately selected into the program over other qualified applicants who have no previous association with the GEMS site. Given the large proportions of students who reported learning about GEMS through personal connections, this recommendation is repeated for FY15, and the program is urged to consider strategies to ensure that students without personal connections to sites have access to the GEMS program.

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

1. The GEMS program failed to reach its FY15 target of 55 resource teacher participants in FY15 and fell short of its near-peer mentor goal by one. The program's ability to serve increasing numbers of students is limited by the number of mentors available, and therefore strategies to recruit additional RTs and NPMs and should be considered. It is also noteworthy that nine students (5% of the respondent sample) indicated in an open-ended questionnaire item that they felt the program could be improved by having more teachers, mentors, and/or teaching time. The number of staff that can be hired is, of course, subject to budgetary constraints, and this should be taken into consideration with any plans for program expansion.

2. Given that students were largely unaware of other AEOPs, yet identified their mentors as a key resource for information about AEOP opportunities, mentors should be provided with more comprehensive information about AEOP initiatives. Many mentors reported having no experience with AEOP resources. The program may therefore wish to incorporate information about other AEOPs into mentor orientation materials.

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

1. In order to create a robust pipeline of AEOP programs in which students progress from other AEOPs into GEMS and beyond, the program may want to consider innovative ways to work with other AEOPs to create a more seamless continuum of programs. Although many students expressed interest in participating in other AEOP programs, a substantial proportion had never heard of AEOP initiatives outside of GEMS. Since students reported that their mentors were key resources for learning about AEOPs, the program may want to work with GEMS sites to ensure that all mentors as well as students have access to structured opportunities that both describe the other AEOPs and provide information to students on how they can apply to them. In addition, since many mentors reported not having experienced most AEOP resources, it may be useful for the program to familiarize mentors with these resources and how these can be used to provide students with more information about other AEOPs.

2. Mentors also play a key role in exposing students to Army and DoD STEM careers. Evaluation data indicate 37% of mentors did not discuss Army or DoD STEM career opportunities with students. It may, therefore, be useful for the program to familiarize mentors with resources available to expose students to DoD STEM careers. While students indicated that invited speakers were a key resource for learning about DoD STEM careers, 27% of mentors indicated that they had not experienced this, and substantial percentages of mentors also indicated that they had not experienced AEOP resources such as the AEOP brochure. The program may, therefore, wish to incorporate these resources into orientation materials for mentors. It may also be useful to familiarize mentors with strategies to increase the likelihood that the program will have a long-term impact on students' decisions to pursue STEM. Examples of these strategies include interactions with role models with similar backgrounds as the students and

coaching on the type of 21st Century Skills (for example, communication skills) needed to be successful in STEM careers.

3. The FY15 GEMS participation in the evaluation questionnaire is an area for concern. Response rates for both students and mentors were considerably lower than in FY14, and ongoing low response rates for mentors raise questions about the representativeness of the results. Continued efforts should be undertaken to improve participation in completion of the questionnaire, particularly for mentors. The program may want to consider emphasizing the importance of these evaluations with individual program sites and communicating expectations for evaluation activities. In addition, the evaluation instruments may need to be streamlined as perceived response burden could affect participation.

Introduction

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 them 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.

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 study of one of the AEOP elements, Gains in the Education of Mathematics and Science (GEMS). The American Society for Engineering Education (ASEE) administered the GEMS program in FY15. 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

GEMS, administered in FY15 by the ASEE on behalf of the Army AEOP, is a non-residential summer STEM enrichment program for elementary, middle, and high school students (herein referred to as students). GEMS is hosted by Army laboratories on site or in close coordination off site with the area Army laboratories (herein referred to as GEMS sites). The following overarching mission drives the GEMS program: to interest youth in STEM through a hands-on Army laboratory experience that utilizes inquiry-based learning and Near Peer mentoring. GEMS is an entry point for a pipeline of AEOP opportunities affiliated with the U.S. Army research laboratories. The various GEMS sites are run independently, with ASEE providing support and guidance in program execution to local lab coordinators. Although they operate under a shared mission, GEMS sites are free to include different topics in their curricula that highlight the

mission of the laboratory and may set, in addition to the overall program goals, individual laboratory goals. Instead of having a specific model and curriculum forced on individual sites, they are able to design curricula (using the hands-on, experiment-based model) and procedures that make sense considering the specialties of their facility and available resources. GEMS programs run from one to four weeks in length.

The mentorship model also varies by GEMS site. Many of the GEMS sites use Army scientists and engineers (Army S&Es) to lead GEMS educational activities while other sites use Near Peer Mentors (NPMs) as a key element in their instructional model. NPMs are developing scientists and engineers (college students) who translate and communicate complex STEM content and their own STEM experiences to the young GEMS participant. Many sites also leverage the expertise of in-service Resource Teachers (RTs). RTs assist Army S&Es and NPMs in translating STEM research, STEM concepts, and STEM practices into educational curricula as well as provide coaching and instructional supervision to NPMs. RTs also provide adaptive support to individual student participants to ensure maximal engagement and learning. Herein, Army S&Es, NPMs, and RTs are referred together as GEMS "mentors," except where it is appropriate to differentiate their roles and experiences.

All GEMS programs are designed to meet the following objectives:

1. To nurture interest and excitement in STEM for elementary, middle, and high school participants;
2. To nurture interest and excitement in STEM for mentor participants;
3. To implement STEM-enrichment experiences that are hands-on, inquiry-based, educational modules that enhance in-school learning;
4. To increase participant knowledge in targeted STEM areas and laboratory skills;
5. To increase the number of outreach participants inclusive of youth from groups historically underrepresented and underserved in STEM;
6. To encourage participants to pursue secondary and post-secondary education in STEM;
7. To educate participants about careers in STEM fields with a particular focus on STEM careers in Army laboratories; and
8. To provide information to participants about opportunities for STEM enrichment through advancing levels of GEMS as well as other AEOP initiatives.

GEMS sites involved 13 Army research centers and laboratories operating in 11 sites in 7 states (see Table 1). One site, USAFMES at Dover Air Force Base in Dover, Delaware received applicants but had no enrolled participants.

Table 1. 2015 GEMS Sites		
Laboratory	**Command***	**Location**
U.S. Army Aviation and Missile Research Development and Engineering Center (AMRDEC)	RDECOM	Huntsville, AL
U.S. Army Research Laboratory (ARL-APG)/ US Army Medical Research Institute of Chemical Defense (USAMRICD)	RDECOM/USA MRMC	Aberdeen, MD
U.S. Army Research Laboratory- Adelphi (ARL-Adelphi)	RDECOM	Adelphi, MD
U.S. Army Research Laboratory- White Sands Missile Range (ARL-WSMR)	RDECOM	White Sands, NM
U.S. Army Aeromedical Research Laboratory (USAARL)	USAMRMC	Fort Rucker, AL
U.S. Army Medical Research and Material Command at Fort Detrick (USAMRMC-Ft. Detrick)	USAMRMC	Fort Detrick, MD
U.S. Army Research Institute for Surgical Research (USAISR)	USAMRMC	Fort Sam Houston, TX
U.S. Army Research Institute for Environmental Medicine (USARIEM)	USAMRMC	Natick, MA
Walter Reed Army Institute of Research (WRAIR)	USAMRMC	Silver Spring, MD
Engineer Research & Development Center- Construction Engineering Research Laboratory (ERDC-CERL)	USACE	Champaign, IL
Engineer Research & Development Center - Vicksburg, MS (ERDC-MS)	USACE	Vicksburg, MS

Commands: "USAMRMC" is the Medical Research and Materiel Command, "RDECOM" is the Research Development and Engineering Command, and "USACE" is the U.S. Army Corps of Engineers.

In 2015, GEMS provided outreach to 2,270 students at 11 different sites. This number represents an 8% increase in enrollment from the 2014 when 2,095 students participated in GEMS. Many of the GEMS sites continued to receive applications from more qualified students than they could serve. A total of 4,161 GEMS applications were submitted, an increase of nearly 20% over the 3,343 applications submitted in 2014. Table 2 provides the application and participation data by GEMS site for 2015.

Table 2. 2015 GEMS Site Applicant and Enrollment Numbers			
Command	**2014 GEMS Site**	**Number of Applicants**	**Number of Enrolled Participants**
RDECOM	Army Aviation and Missile Research Development and Engineering Center (AMRDEC)	173	109
	Army Research Laboratory-Aberdeen Proving Ground (ARL-APG)	381	180
	Army Research Laboratory-Adelphi (ARL-Adelphi)	115	99
	Army Research Laboratory-White Sands Missile Range (ARL-WSMR)	193	64
USAMRMC	Armed Forces Medical Examiner System (USAFMES)	39	0
	Army Aeromedical Research Laboratory (USAARL)	427	352
	Army Medical Research and Material Command at Fort Detrick (USAMRMC-Ft. Detrick)	850	466
	Army Medical Research Institute of Chemical Defense (USAMRICD) †	169	96
	Army Research Institute for Surgical Research (USAISR)	145	83
	Army Research Institute for Environmental Medicine (USARIEM)	384	193
	Walter Reed Army Institute of Research (WRAIR)	1156	523
USACE	Engineer Research & Development Center- Construction Engineering Research Laboratory (ERDC-CERL)	43	29
	Engineer Research & Development Center-Mississippi (ERDC-MS)	110	76
TOTAL		**4,161**	**2,270**

† *The United States Army Medical Research Institute of Chemical Defense (USAMRICD) collaborates with the US Army Research Laboratory (ARL-APG) to host GEMS at Aberdeen Proving Grounds*

In addition to student participants, there were 51 RTs, 94 NPMs, 272 Army S&Es, and 47 other mentors working in the program across the various sites.

Table 3 displays demographic information for enrolled GEMS participants in 2015. Overall demographics for 2015 are similar to those of 2014, although enrollment grew from 2,095 to 2,270, an increase of 8%. The percentage of females in 2015 was 45%, compared with 44% in 2014, and 22% of participants identified themselves as Black or African American in both years. Likewise, 45% of students identified themselves as White in both years. There was a slight increase in enrollment of students identifying themselves as Hispanic or Latino (7% in 2014 and 9% in 2015). The proportion of students receiving free or reduced price lunch was also similar (11% in 2015 versus 12% in 2014).

Table 3. 2015 GEMS Enrolled Student Profile		
Demographic Category	GEMS Participants	
Respondent Gender (n=2228)		
Female	1012	45%
Male	1216	54%
Choose not to report	0	0%
Respondent Race/Ethnicity (n=2270)		
Asian	306	14%
Black or African American	492	22%
Hispanic or Latino	197	9%
Native American or Alaska Native	0	0%
Native Hawaiian or Other Pacific Islander	11	<1%
White	1014	45%
Other race or ethnicity, (specify):[†]	39	2%
Choose not to report	211	9%
Respondent (Rising) Grade Level (n=2221)		
Elementary (grades 4-5)	194	9%
Middle school (grades 6-8)	982	44%
High school (grades 9-12)	1027	46%
First-Year College Student	18	1%
Respondent Eligible for Free/Reduced-Price Lunch (n=2206)		
Yes	237	11%
No	1863	84%
Choose not to report	106	5%
School Setting (n=2206)		
Rural (country)	242	11%
Suburban	1778	81%
Urban (city)	0	0%
Department of Defense School (DoDEA or DODDS)	29	1%
Home School	88	4%
Online School	4	<1%
Choose not to report	65	3%

[†] Other = "Bi-racial" (n=2), "mixed" (n=5), "Indian" (n=3), "American Sri Lankan," "Hebrew," "Arab," "Eur2," "mix of backgrounds," "Black and Native American," "Filipino and Cauc2," "White and Jamaican," "Black/East Indian," "Amer2," "multiracial," "2-American," "Russian," "Indian," Cauc2/Central2," "Black/White," "White not Hispanic," "Cauc2/Hispanic," "Filipino" (n=2), "American2," "1/2 Hispanic, ½ White," "Chinese, German, and Jamaican," "Mixed Cauc2 & 2," "Hispanic and White," "two of the above," "Bi-racial (Black and Latino)," "Blended," "2 & Cauc2," "Middle Eastern," "African American / Hispanic"

The total cost of the 2015 GEMS program was $812,395, which includes administrative costs to ASEE, costs to participating labs for supplies, student stipends and RT and NPM stipends. The cost per GEMS student was $358. Aligned with the rates of similar AEOP initiatives, GEMS provides student participants with a stipend of $100 per week. Table 4 summarizes these and other 2015 GEMS program costs.

Table 4. 2015 GEMS Program Costs	
2015 GEMS Students – Cost Per Participant	
Number of Students	2,270
Total Cost	$812,395
Cost Per Participant (Student)	$358
2015 GEMS Students, Near-Peer Mentors, and Resource Teachers – Cost Per Participant	
Number of Students	2,270
Number of NPM	94
Number of RTs	51
Grand Total Participants	2,415
Cost Per Participant (Students, Near-Peer Mentors, Teachers)	**$336**
2015 GEMS Cost Breakdown	
Total Administrative Cost to ASEE	$132,934
Supplies & Equipment (GEMS sites)	$0
Total Stipend Cost (includes Students, Near-Peer Mentors, and Teachers)	$679,461
Weekly Student Stipend	$100

Evidence-Based Program Change

Based on recommendations from the FY13 and FY14 summative evaluation reports, the AEOP identified three key priorities for the AEOP portfolio in 2015: (1) Increase outreach to populations that are historically underrepresented and underserved in STEM; (2) Increase participants' awareness of Army/DoD STEM careers; and (3) Increase participants' awareness of other AEOP opportunities. ASEE initiated the following program changes/additions to the FY15 administration of the GEMS program in light of the key AEOP priorities, the FY14 GEMS evaluation study, and site visits conducted by ASEE and the LO.

I. **Increase outreach to populations that are historically underrepresented and underserved in STEM.**
   a. 2015 activities to support priority:
      i. Sent Email blasts to 4,000+ teachers, guidance counselors, and principals in areas nearby participating GEMS labs.
      ii. Mailed promotional materials (AEOP brochures, rack cards, etc.) when requested by teachers.
      iii. Participated in outreach efforts including:
         a) National Summer Learning Association Conference
         b) 2015 ASEE Annual Conference
         c) School Visit to Thomas Jefferson Science and Tech High School in Alexandria, VA
      iv. Wrote 2015 Timeline for GEMS/SEAP/CQL.
      v. Help-Desk team received 200+ phone calls, 500+ emails, and responded to each request within 72 hours of contact.

vi. Assisted with development of GEMS application through the Cvent Software tool.

II. Increase participants' awareness of Army/DoD STEM careers.

a. Sent information and promotional materials to the lab champions and mentors about the other programs in the AEOP pipeline.

III. Increase participants' awareness of other AEOP opportunities.

a. Performed direct mailing of promotional materials upon request from teachers.

b. Sent information and promotional materials to the lab champions and mentors about the other programs in the AEOP pipeline.

FY15 Evaluation At-A-Glance

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

Inputs	Activities	Outputs	Outcomes (Short term)	Impact (Long Term)
• Army sponsorship • ASEE providing oversight of site programming • Operations conducted by 12 Army research laboratories operating at 11 sites in 8 states • 2,270 Students participating in GEMS programs • Army S&Es, 94 Near Peer Mentors, and 51 Resource Teachers participating in GEMS as mentors • Stipends for students to support meals and travel • Centralized branding and comprehensive marketing • Centralized evaluation	• Students engage in hands-on and experiment-based STEM programs • Army S&Es, Near Peers, and Resource Teachers facilitate hands-on learning experiences for students • 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 GEMS •Number and diversity of Army S&Es serving as mentors in GEMS •Number and diversity of , Near Peers serving as mentors in GEMS •Number and diversity of Resource Teachers serving as mentors in GEMS •Number and Title 1 status of schools served through participant engagement •Students, mentors, site coordinators, and ASEE contributing to evaluation	• Increased participant STEM competencies (confidence, knowledge, skills, and/or abilities to do STEM) • Increased interest in future STEM engagement • Increased participant awareness of and interest in other AEOP opportunities • Increased participant awareness of and interest in STEM research and careers • Increased participant awareness of and interest in Army/DoD STEM research and careers • Implementation of evidence-based recommendations to improve GEMS 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 GEMS

The GEMS evaluation gathered information from multiple participant groups about GEMS 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 GEMS program objectives.

Key Evaluation Questions

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

The assessment strategy for GEMS included student and mentor questionnaires, 4 focus groups with students and 3 with mentors, and 1 Annual Program Report (APR) prepared by ASEE using data from all GEMS sites. Tables 5-9 outline the information collected in student and mentor questionnaires and focus groups, as well as information from the APR that is relevant to this evaluation report.

Table 5. 2015 Student Questionnaires

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

Satisfaction & Suggestions	Benefits to participants, suggestions for improving programs, overall satisfaction

Table 6. 2015 Mentor Questionnaires	
Category	Description
Profile	Demographics: Participant gender, race/ethnicity, occupation, past participation
Satisfaction & Suggestions	Awareness of GEMS, motivating factors for participation, satisfaction with and suggestions for improving GEMS programs, benefits to participants
AEOP Goal 1	Capturing the Student Experience: In-program experiences for students
	STEM Competencies: Gains in Knowledge of STEM, Science & Engineering Practices; contribution of GEMS to gains (impact)
	Transferrable Competencies: Gains in 21st Century Skills
	AEOP Opportunities: Past participation, awareness of other AEOP programs; efforts to expose students to AEOPs, impact of AEOP resources on efforts; contribution of GEMS to gains (impact)
	Army/DoD STEM: Attitudes toward Army/DoD STEM research and careers, efforts to expose students to Army/DoD STEM research/careers, impact of AEOP resources on efforts; contribution of GEMS in changing student Army/DoD career metrics (impact)
AEOP Goal 2 and 3	Mentor Capacity: Perceptions of mentor/teaching strategies (mentors)
	Comprehensive Marketing Strategy: How mentors learn about GEMS, usefulness of AEOP resources on awareness of AEOPs and Army/DoD STEM research and careers

Table 7. 2015 Student Focus Groups	
Category	Description
Profile	Gender, race/ethnicity, grade level, past participation in GEMS, past participation in other AEOP programs
Satisfaction & Suggestions	Awareness of GEMS, motivating factors for participation, involvement in other programs in addition to GEMS, satisfaction with and suggestions for improving GEMS programs, benefits to participants
AEOP Goal 1 and 2 Program Efforts	Army STEM: AEOP Opportunities – Extent to which students were exposed to other AEOP opportunities
	Army STEM: Army/DoD STEM Careers– Extent to which students were exposed to STEM and Army/DoD STEM jobs

Table 8. 2015 Mentor Focus Groups	
Category	Description
Profile	Gender, race/ethnicity, occupation, organization, role in GEMS, past participation in GEMS, past participation in other AEOP programs
Satisfaction & Suggestions	Perceived value of GEMS, benefits to participants, suggestions for improving GEMS programs
AEOP Goal 1 and 2 Program Efforts	Army STEM: AEOP Opportunities – Efforts to expose students to AEOP opportunities
	Army STEM: Army/DoD STEM Careers – Efforts to expose students to STEM and Army/DoD STEM jobs

	Mentor Capacity: Local Educators – Strategies used to increase diversity/support diversity in GEMS

Table 9. 2015 Annual Program Report	
Category	Description
Program	Description of course content, activities, and academic level
AEOP Goal 1 and 2 Program Efforts	Underserved Populations: mechanisms for marketing to and recruitment of students from underserved populations
	Army STEM: Army/DoD STEM Careers – Career day exposure to Army STEM research and careers; Participation of Army engineers and/or Army research facilities in career day activities
	Mentor Capacity: Local Educators - University faculty and student involvement, teacher involvement

Detailed information about methods and instrumentation, sampling and data collection, and analysis are described in 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. Findings of statistical and/or practical significance are noted in the report narrative, with tables and footnotes providing results from tests for significance. Data summaries for the questionnaires are provided in Appendix B (student) and Appendix C (mentor). Focus group protocols are provided in Appendices D (students) and E (mentors) and questionnaires are provided in Appendix F (students) and G (mentors). Major trends in data and analyses are reported herein.

Study Sample

Students from all 11 GEMS sites responded to questionnaires; mentors from 7 of the 11 sites completed questionnaires. As indicated in Table 10, 175 students and 2 mentors did not identify their site. Table 9 shows the number of student and mentor respondents by site.

Table 10. 2015 GEMS Site Survey Respondent Numbers

2015 GEMS Site	Students		Mentors	
	Number of Participants	Number of Survey Respondents	Number of Participants	Number of Survey Respondents
ALABAMA – U.S. Army Aeromedical Research Laboratory (USAARL) – Fort Rucker, AL*	352	317	124	0
ALABAMA – U.S. Army Aviation & Missile Research, Development & Engineering Center (AMRDEC) – Redstone, AL	109	88	5	0
ILLINOIS – U.S. Army Engineer Research & Development Center - Construction Engineering Research Laboratory (ERDC-CERL) – Champaign, IL	29	21	24	4
MARYLAND – Aberdeen Proving Ground (APG) – Aberdeen, MD (ARL-APG and USAMRICID)	276	215	62	10
MARYLAND – U.S. Army Medical Research and Materiel Command (USAMRMC) – Fort Detrick, MD	466	464	49	3
MARYLAND – U.S. Army Medical Research and Materiel Command - Walter Reed Army Institute of Research (WRAIR) – Silver Spring, MD	523	362	24	3
MARYLAND – U.S. Army Research Laboratory - Adelphi (ARL-A) – Adelphi, MD	99	68	28	4
MASSACHUSETTS – U.S. Army Institute of Environmental Medicine (USARIEM) – Natick, MA	193	193	9	0
MISSISSIPPI – U.S. Army Engineer Research & Development Center - Vicksburg (ERDC-MS) – Vicksburg, MS	76	31	46	2
NEW MEXICO – White Sands Missile Range (WSMR) – White Sands, NM*	64	62	60	2
TEXAS – U.S. Army Institute of Surgical Research (USAISR) – San Antonio, TX*	83	82	33	0
Did not identify GEMS site		215		2
TOTAL	**2270**	**2118**	**464**	**30**

*These sites all have restrictions on LANS, hotspots, and Internet access for participants.

Table 11 provides an analysis of student and mentor participation in the GEMS questionnaires, the response rate, and the margin of error at the 95% confidence level (a measure of how representative the sample is of the population). The margin of error for the mentor survey is larger than generally acceptable, indicating that the sample may not be representative of the population of GEMS mentors. Mentor response rates for the 2015 questionnaires are substantially lower than in 2014 22% of mentors responded. However, student response rate for 2015 continued to be very satisfactory and was even higher at 93% in comparison to 91% in 2014.

Table 11. 2015 GEMS Questionnaire Participation

Participant Group	Respondents (Sample)	Total Participants (Population)	Participation Rate	Margin of Error @ 95% Confidence[1]
Students	2,118	2,270	93%	±0.55%
Mentors	30	464	6%	±17.3%

The student questionnaire response rate of 93% and corresponding margin of error of ±0.55% provide evidence that the questionnaire results are generalizable to the population of participants. In contrast, the response rate for the mentor survey was only 6%, with a larger than acceptable margin of error. Because of the small number of responses to the mentor survey, caution is warranted when interpreting these data, as the responses may not be representative of the mentor populations participating in the GEMS program.

Four student focus groups were conducted at 2 of the 11 GEMS sites. Student focus groups included 25 students (13 females, 12 males) ranging from grades 4 to 11. Three mentor focus groups were also conducted at 2 sites and included 13 mentors (9 females, 4 males). The participating mentors included 6 NPMs, 1 assistant NPM, 4 RTs, 1 classroom assistant, and 1 instructor. Focus groups were not intended to yield generalizable findings; rather they were intended to provide additional evidence of, explanation for, or illustrations of questionnaire data. They add to the overall narrative of GEMS' efforts and impact, and highlight areas for future exploration in programming and evaluation.

Respondent Profiles

Student demographics. The group of students who responded to the questionnaire showed similarities in demographic makeup to the population of enrolled participants. For instance, middle school students made up 41% of the survey respondent group and 41% of the overall population, and 7% of the survey sample indicated that the were eligible for free and reduced-price lunch (FRL) – a common indicator of low-income status - while 11% of all participants fell into this category. There are, however, some differences between the group of responding students and the overall

[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.

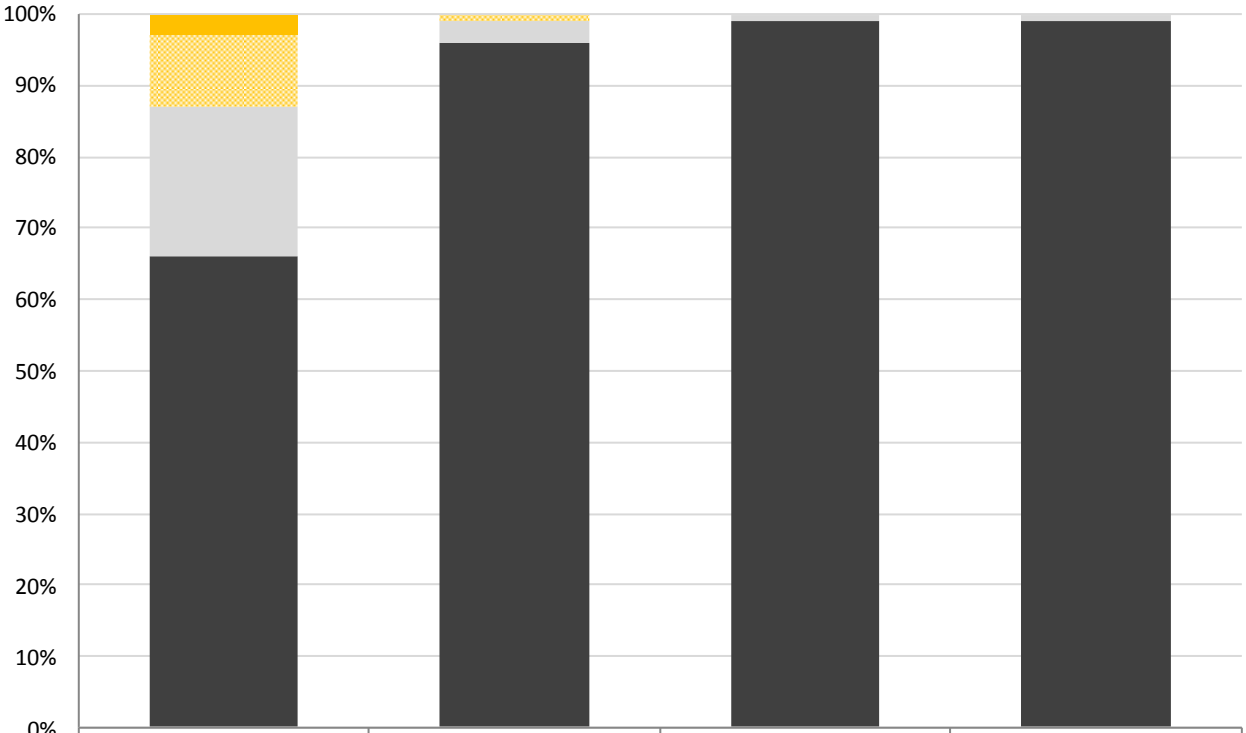
population. While 45% of all participants were female, only 35% of respondents identified themselves as female. Similarly, while 46% of all participants were in high school, only 20% of respondents indicated that they were in high school. It is important to note, however, that approximately one-third of student respondents chose not to report their demographic information on the questionnaire, creating difficulty in comparing this group to the overall population of enrolled GEMS students.

Table 12. 2015 GEMS Student Respondent Profile		
Demographic Category	Questionnaire Respondents	
Respondent Gender (n = 2118)		
Female	731	35%
Male	665	31%
Choose not to report	722	34%
Respondent Race/Ethnicity (n = 2118)		
Asian	210	10%
Black or African American	304	14%
Hispanic or Latino	122	6%
Native American or Alaska Native	5	<1%
Native Hawaiian or Other Pacific Islander	5	<1%
White	625	30%
Other race or ethnicity	74	3%
Choose not to report	773	37%
Respondent Grade Level (n = 2118)		
3rd	31	2%
4th	89	4%
5th	135	6%
6th	200	9%
7th	258	12%
8th	266	13%
9th	203	10%
10th	132	6%
11th	68	3%
12th	13	1%
First-Year College Student	0	0%
Choose not to report	724	34%
Respondent Eligible for Free/Reduced-Price Lunch (n = 2118)		
Yes	143	7%
No	1179	56%
Choose not to report	796	37%

Table 13. 2015 GEMS Student Respondent School Information		
Demographic Category	Questionnaire Respondents	
Respondent School Location (n = 2118)		
Urban (city)	0	0%
Suburban	1097	52%
Frontier or tribal school	0	0%
Rural (country)	172	8%
Home school	53	3%
Online school	3	<1%
Department of Defense school (DoDDS or DoDEA)	18	1%
Choose not to report	775	36%

At enrollment, students were asked how many times they participated in each of the AEOP programs. Chart 1 displays the results for all enrolled participants and shows that 34% of responding students reported participating in GEMS at least once. Very few students reported participating in any of the other AEOP programs.

Chart 1: Student Participation in AEOP Programs (n = 2241)



	GEMS	Camp Invention	eCybermission	GEMS Near Peer Mentors
Three or more times	3%	0%	0%	0%
Twice	10%	1%	0%	0%
Once	21%	3%	1%	1%
Never	66%	96%	99%	99%

Note: WPBDC = West Point Bridge Design Contest; JSS = Junior Solar Sprint; JSHS = Junior Science and Humanities Symposium; SEAP = Science & Engineering Apprenticeship Program; REAP = Research & Engineering Apprenticeship Program: HSAP = High School Apprenticeship Program

Mentor respondents. Table 14 summarizes mentor occupations and roles in GEMS. About a third of respondents were teachers (34%) and another 30% identified themselves as scientists, engineers, or mathematicians in training. Similar to the responding students, the majority of mentors identified themselves as white (68%). Accordingly, 37% of these respondents served as RTs and 33% as NPMs in the program. Mentors responded working with an average of 66 students (range of 6 to 100). Additional characteristics of the mentors are included in Appendix C.

Table 14. 2015 GEMS Mentor Respondent Profile		
Demographic Category	Questionnaire Respondents	
Respondent Occupation (n = 30)		
Teacher	10	34%
Other school staff	3	10%
University educator	0	0%
Scientist, Engineer, or Mathematician in training (undergraduate or graduate student, etc.)	9	30%
Scientist, Engineer, or Mathematics professional	4	13%
Other, (specify): †	4	13%
Respondent Role in GEMS (n = 30)		
Instructor (typically a University or Army Scientist or Engineer)	3	10%
Classroom Assistant	2	7%
Resource teacher (RT)	11	37%
Near peer mentor (NPM)	10	33%
Assistant Near peer mentor	1	3%
Other, (specify) ‡	3	10%

† Other = "retired scientist," "camp counselor," "Near Peer Mentor," "Administrator"
‡ Other = "GEMS teacher for group of students," "Program Director," "GEMS Coordinator"

Actionable Program Evaluation

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 and AEOP Goal 1 & 2 Program Efforts sections of Tables 4-8.

A focus of the Actionable Program Evaluation is efforts toward the long-term goal of GEMS and all of the AEOP to increase and diversify the future pool of talent capable of contributing to the nation's scientific and technology progress. GEMS sites reach out to students of traditionally underrepresented and underserved populations. Thus, it is important to consider how GEMS is marketed and ultimately recruits student participants, the factors that motivate students to participate in GEMS, 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 students, mentors, and site program coordinators (from the APR) that pertain to current

programmatic efforts, as well as recommendations for evidence-based improvements to help GEMS achieve its desired outcomes.

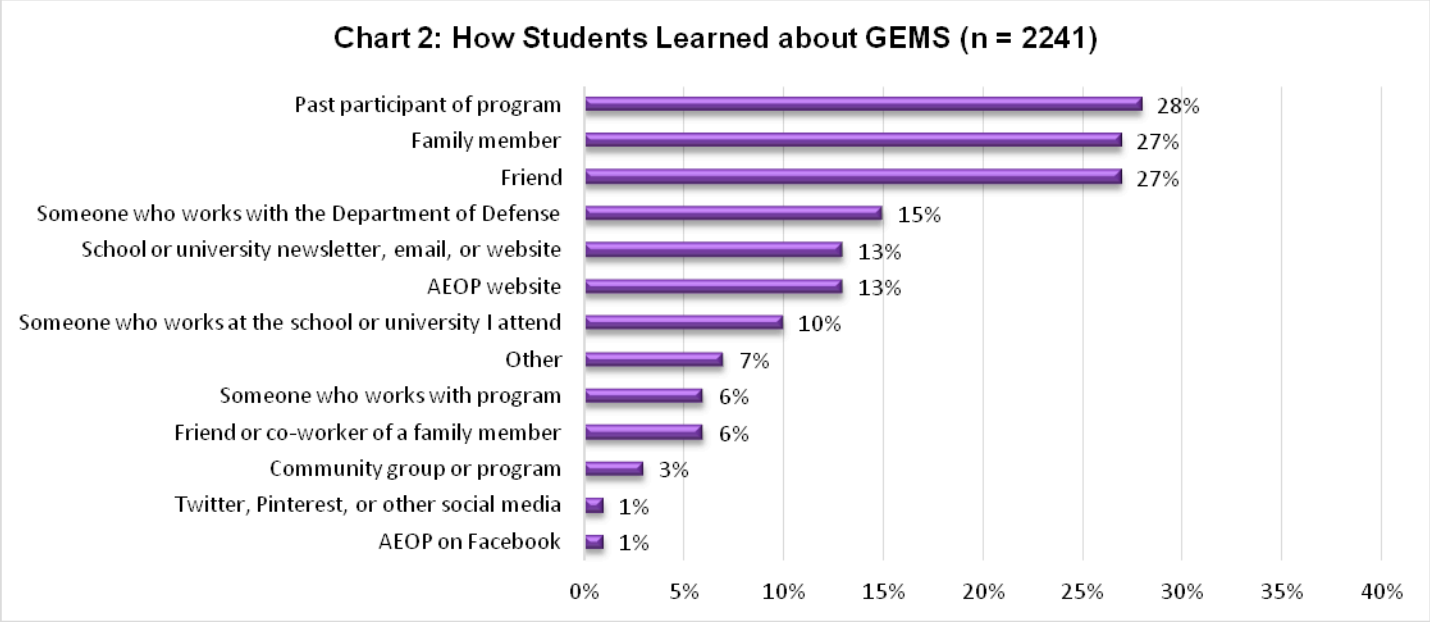
Marketing and Recruiting

The FY15 Annual Program Report details several strategies that were used to disseminate information about the GEMS program. Email blasts were sent to over 4,000 teachers, guidance counselors, and principals in areas near participating GEMS labs and promotional materials including AEOP brochures and rack cards were mailed to teachers upon request. Outreach efforts included promoting GEMS at the following events:

- National Summer Learning Association Conference;
- 2014 ASEE Annual Conference; and
- School visit to Thomas Jefferson Science and Tech High School in Alexandria, VA

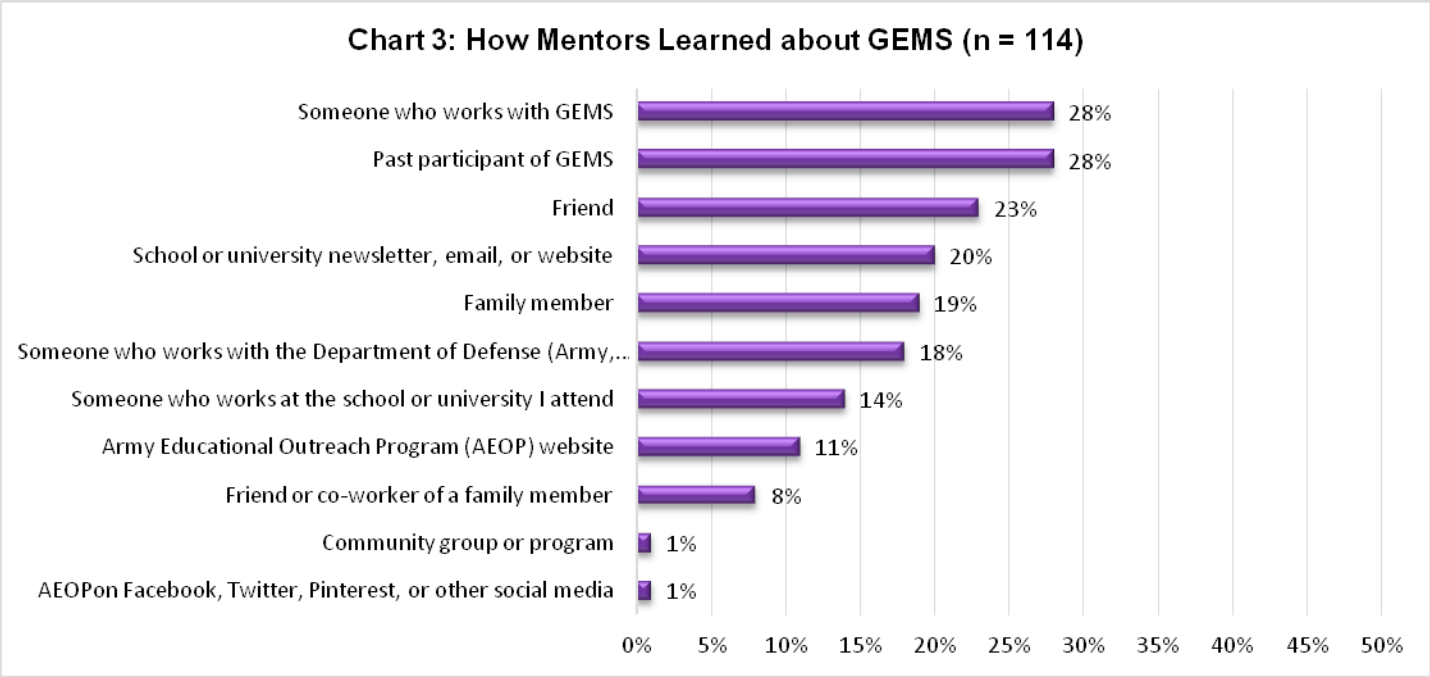
.

In order to understand which outreach and recruitment methods are most effective, the questionnaire asked students to indicate how they learned about GEMS. Chart 2 summarizes students' responses. Other than past participation (28% of respondents), the most frequently reported source of information about the local GEMS program were personal connections, including family member (27%) and friend (27%).. Other frequently reported sources included someone who works with the DoD (15%) a school or university newsletter, email, or website (13%), and the AEOP website (13%).



Mentors were also asked how they learned about GEMS when they enrolled in the program (see Chart 3). Like students, mentor responses indicated that they learned about the program primarily through personal contacts. Over a quarter of the mentors (28%) heard about GEMS from someone who works with the program and the same number reported

hearing about it from past GEMS participants. Another 23% reported learning about GEMS through a friend, 19% from a family member, and 18% from someone who works with the DoD. School or university newsletters, emails, or websites was another relatively frequently cited source of information (20%).



Motivating Factors for Participation

Motivating factors for students. Students were asked both in questionnaires and in focus groups what motivated them to participate in GEMS. Specifically, the questionnaire asked how motivating a number of factors were in their decision to participate. Table 15 indicates the factors that students rated the most motivating for their GEMS participation. Over three-quarters of responding students (76%) indicated interest in STEM motivated them "very much" to participate. The desire to learn something new or interesting was another frequently cited motivator (62% of respondents). Other frequently cited motivators included learning in ways not possible in school (30%), having fun (28%), and the opportunity to use advanced laboratory technology (18%). Interestingly, although 28% of students indicated that they learned about GEMS from a past participant of the program, only 3% of students indicated that this connection motivated them to participate.

Table 15. Factors Motivating Student Participation in GEMS (n = 2,241)	
Item	**Percent Indicating "Very much"**
Interest in science technology engineering or mathematics (STEM)	76%
Desire to learn something new or interesting	62%
Learning in ways that are not possible in school	30%
Having fun	28%
Opportunity to use advanced laboratory technology	18%
Figuring out education or career goals	16%
Desire to expand laboratory or research skills	14%
Interest in STEM careers with the Army	10%
Building college application or resume	9%
Seeing how school learning applies to real life	9%
Teacher or professor encouragement	5%
Exploring a unique work environment	5%
Opportunity to do something with friends	4%
Serving the community or country	4%
Earning stipends or awards for doing STEM	4%
Recommendations of past participants	3%
An academic requirement or school grade	1%
Networking opportunities	1%
Other	1%
The mentor(s)	<1%

Student focus group participants expanded on some of these reasons for participating in GEMS, focusing on opportunities for more in-depth learning, having fun, and also discussed external motivation from family members or teachers. For example:

> *My two favorite subjects would probably be math and science…and I want to keep excelling in them, and since school wasn't kind of giving me all that I wanted of those subjects, I did GEMS for that reason. And it has done pretty much exactly what I was hoping it would…giving me what I was missing from school.* (GEMS Student)

> *I could never learn this at actual school until older grades where they actually teach you this stuff..* (GEMS Student)

> *I decided to do GEMS because I thought it would be a fun experience for me, since I've never done this before. I wanted to learn something new, so I decided [to] do forensics.* (GEMS Student)

My teacher told me [about GEMS] and she said it was a lot of fun and since I'm in all the gifted programs and stuff she thought that it would be good for me. (GEMS Student)

My sister said it was fun, because she came last year and she liked it. And so I really wanted to do it too, because I went there and saw what she did. (GEMS Student)

The GEMS Experience

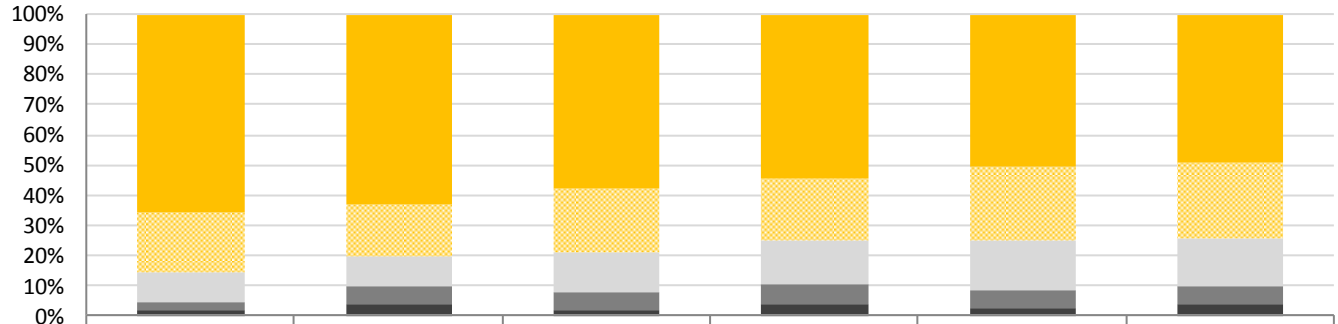
The student questionnaire included several items asking students about the nature of the activities they participated in during their GEMS experience and how those experiences compared to their STEM learning opportunities in school.

Students were asked to indicate the area that best described the focus of their GEMS activities. Science and engineering were the most frequently selected responses (41% and 40% respectively), while 15% of students reported that their GEMS experience focused on technology, and 4% responded that math was the focus of their experience. Chart 4 summarizes student responses to a questionnaire item asking them about the nature of their activities in GEMS. Learning about STEM topics new to them was most the most cited (86% of respondents) activity that students participated in "every day" or "most days." A similar majority of students indicated that they participated with this frequency in activities such as communicating with other students about STEM (80%), learning about careers that use STEM (78%), and interacting with scientists and engineers (75%). Mentors were asked a parallel item on the questionnaire and reported overall higher frequencies of student opportunities to engage in these activities than students reported (responses to these items can be found in Appendix C).[2]

"GEMS has given me the opportunity to learn and grow in all areas, such as science, engineering, and overall concepts. New ideas and procedures that I've never heard of were introduced, and I was fascinated. "-- GEMS Student

[2] Because of the relatively low response rates on the mentor questionnaire, it is impossible to determine whether any differences between the two datasets are real or an artifact of which mentors provided data. In addition, since mentors typically worked with multiple students, it is not clear which students' mentors were considering when responding to these items.

Chart 4: Nature of Student Activities in GEMS (n = 2099-2115)



	Learn about science, technology, engineering, or mathematics (STEM) topics that are new to you	Communicate with other students about STEM	Learn about different careers that use STEM	Interact with scientists or engineers	Apply STEM learning to real-life situations	Learn about new discoveries in STEM
Every day	66%	63%	57%	54%	50%	49%
Most days	20%	17%	21%	21%	25%	25%
A few times	10%	10%	13%	14%	16%	16%
At least once	3%	6%	6%	7%	6%	6%
Not at all	2%	4%	2%	4%	3%	4%

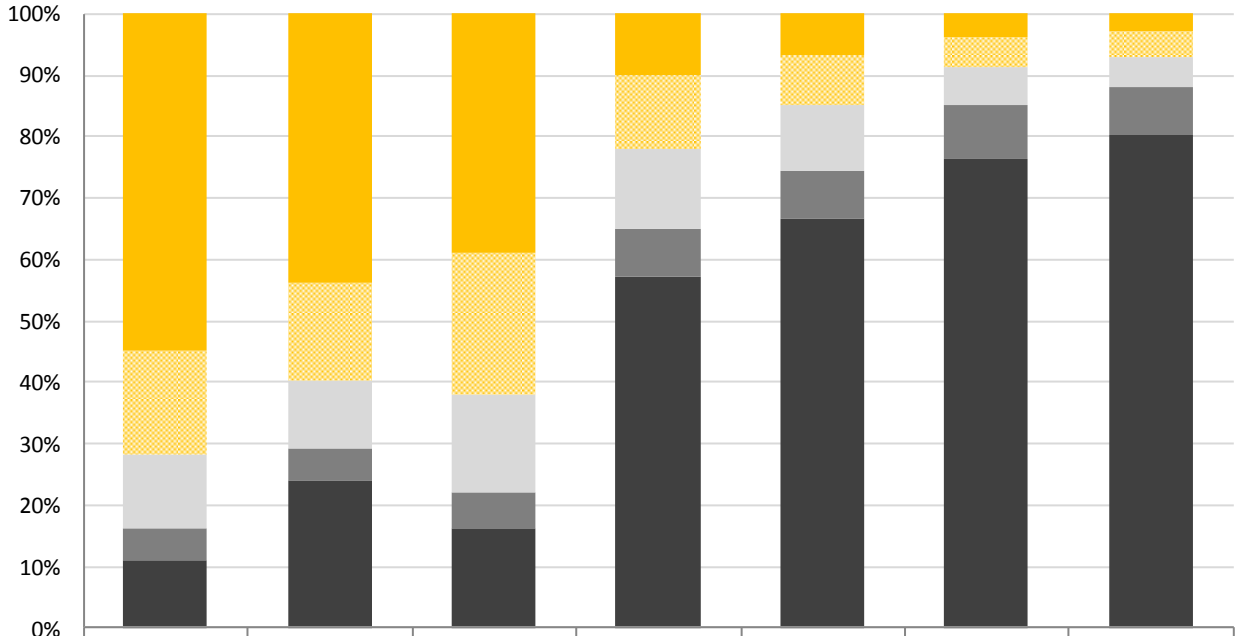
Since exposing students to STEM careers in the Army and DoD is one objective of the GEMS program, student participants in focus groups were asked about how they learned about STEM research and careers in GEMS. Student responses to this question focused on having the opportunity to hear a variety of speakers and to visit labs. The student questionnaire asked how many jobs/careers in STEM in general, and how many STEM jobs/careers in the DoD more specifically, students learned about during their experience. Table 16 provides summaries of these data from 2013 through 2015. Nearly all students (98%) reported learning about at least one STEM job/career, and most (64%) reported learning about five or more. A smaller number (87%) reported learning about at least one DoD STEM job/career and only 32% reported learning about 5 or more DoD STEM careers. These data are similar to responses for 2013 and 2014.

Table 16. Number of STEM Jobs/Careers Students Learned about During GEMS						
	STEM Jobs/Careers			DoD STEM Jobs/Careers		
	2013 (n =1476)	2014 (n =1745)	2015 (n=2081)	2013 (n =1473)	2014 (n = 1653)	2015 (n=1902)
None	3%	2%	2%	11%	16%	13%
1	3%	3%	2%	9%	9%	9%
2	7%	6%	6%	19%	13%	16%
3	13%	12%	13%	24%	20%	18%
4	13%	11%	13%	12%	9%	12%
5 or more	61%	66%	64%	25%	33%	32%

Students were also asked to indicate which resources impacted their awareness of DoD STEM careers (see Chart 5). The most impactful resource was perceived by students to be participation in GEMS, with 72% of students reporting this to being somewhat or very much important to their awareness of DoD STEM careers. Over half of respondents (62%) indicated that their mentors were somewhat or very much impactful, while 60% reported that invited speakers or career events impacted their awareness to this extent. Approximately 20% of students or less reported that resources such as the AEOP brochure, AEOP on social media, or the It Starts Here! Magazine was impactful. Data from the mentor questionnaire (shown in Appendix C) showed similar results, with program participation, invited speakers or career events, and GEMS program administrator or site coordinator chosen most frequently as impactful resources, however mentors indicated greater impact of each of these resources than did students.

The questionnaire also asked students how often they engaged in various STEM practices during GEMS (see Chart 6). Students reported high levels of engagement in most of these practices, with a majority of students indicated that they had engaged in each on most days or every day with the exception of building or making a computer model (31%). For example, 94% of responding students indicated working as part of a team on most days or every day; 92% reported participating in hands-on STEM activities, 83% reported identifying questions or problems to investigate, and; 82% reported using laboratory procedures and tools.

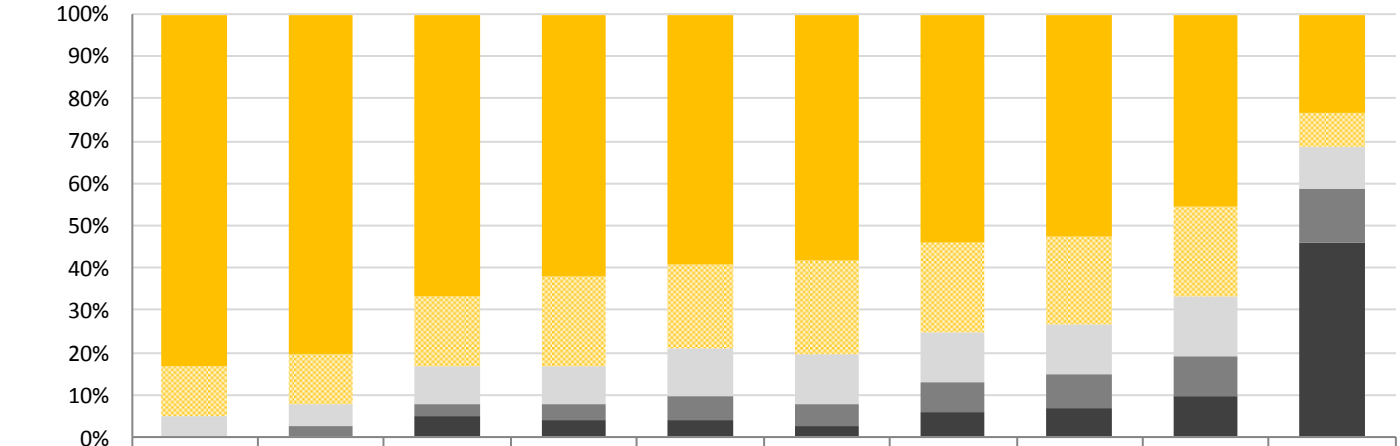
Chart 5: Impact of Resources on Student Awareness of DoD STEM Careers (n = 1898-1908)



	Participation in GEMS	Invited speakers or ñcareerî events during GEMS	My GEMS mentor(s)	Army Educational Outreach Program (AEOP) website	AEOP brochure	AEOP on Facebook, Twitter, Pinterest or other social media	It Starts Here! Magazine
Very Much	55%	44%	39%	10%	7%	4%	3%
Somewhat	17%	16%	23%	12%	8%	5%	4%
A little	12%	11%	16%	13%	11%	6%	5%
Not at all	5%	5%	6%	8%	8%	9%	8%
Did not experience	11%	24%	16%	57%	67%	77%	80%

"[GEMS] taught me about various career paths I could choose. It showed me how joining the Army is an enticing choice." -- GEMS Student

Chart 6: Student Engagement in STEM Practices in GEMS (n = 1899-1919)



	Work as part of a team	Participate in hands-on STEM activities	Use laboratory procedures and tools	Identify questions or problems to investigate	Analyze data or information	Come up with creative explanations or solutions	Draw conclusions from an investigation	Carry out an investigation	Design an investigation	Build or make a computer model
Every day	82%	80%	66%	62%	59%	58%	54%	53%	45%	23%
Most days	12%	12%	16%	21%	20%	22%	21%	21%	21%	8%
A few times	4%	5%	9%	9%	11%	12%	12%	12%	14%	10%
At least once	1%	2%	3%	4%	6%	5%	7%	8%	9%	13%
Not at all	0%	1%	5%	4%	4%	3%	6%	7%	10%	46%

A composite score[3] was calculated for each set of items, the first titled "Learning about STEM in GEMS,"[4] and the second "Engaging in STEM Practices in GEMS."[5] Response categories were converted to a scale of 1 = "Not at all" to 5 = "Every day" and calculating the average across all items in the scale. The composite scores were used to test whether there were differences in student experiences by gender and race/ethnic group (minority vs. non-minority students). Significant differences were found by gender in terms of GEMS Engagement with females reporting significantly higher views than males (small effect size; d = 0.113 standard deviations[6]).[7] Significant differences were also found by

[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.

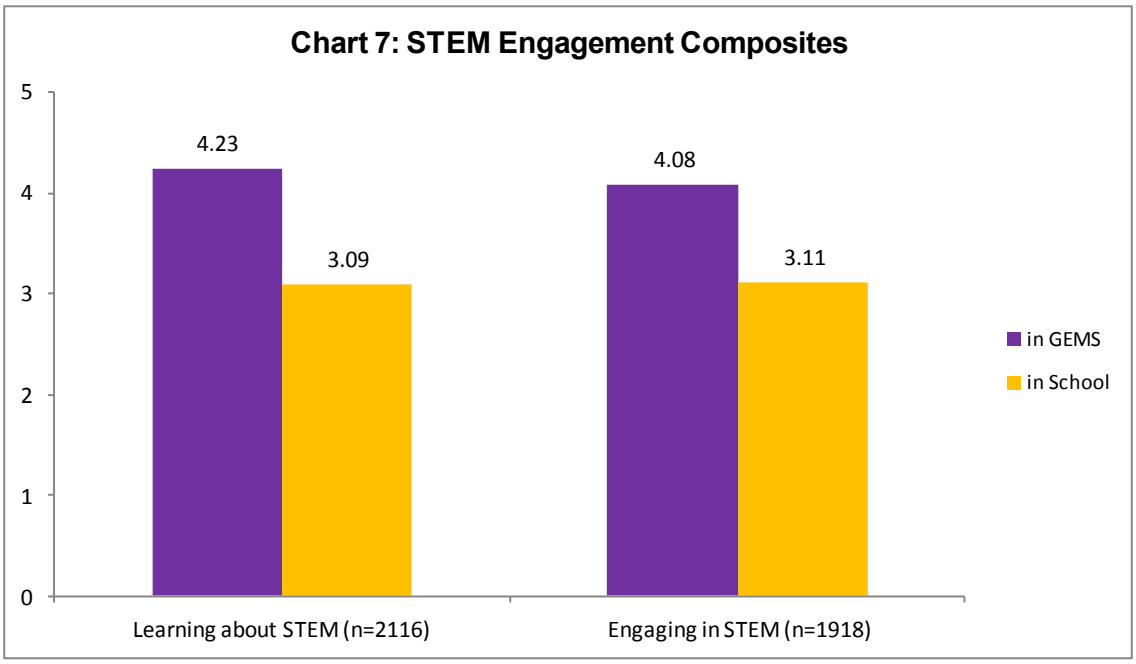
[4] The Cronbach's alpha reliability for these 6 items was 0.847.

[5] The Cronbach's alpha reliability for these 10 items was 0.880.

[6] Effect size calculated as Cohen's d: the difference in means of the two groups divided by the pooled standard deviation. 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.

race/ethnicity in terms of Learning about STEM in GEMS. Non-minority students reported significantly higher views, yet this difference had a small effects of d = 0.210 standard deviations.[8]

To examine how the GEMS experience compares to their typical school experience, students were asked how often they engaged in the same activities in school (individual item responses can be found in Appendix B). These responses were also combined into two composite variables: "Learning about STEM in School,"[9] and "Engaging in STEM Practices in School"[10] that are parallel to the ones asking about GEMS. As can be seen in Chart 7, scores were significantly higher on the "in GEMS" versions of both composites than on the "in school" versions with large effects of d = 2.094 standard deviations for Learning about STEM and d = 1.928 standard deviations for Engaging in STEM Practices.[11] These findings indicate that GEMS provides students with more intensive STEM learning experiences than they would typically receive in school.



[7] Two-tailed independent samples t-test: Engaging in STEM in GEMS by Gender t(1391) = 2.11, p = .035.
[8] Two-tailed independent samples t-test: Learning about STEM in GEMS by Race/Ethnicity t(1399) = 3.93, p = 0.001.
[9] Cronbach's alpha reliability of 0.862.
[10] Cronbach's alpha reliability of 0.916.
[11] Two-tailed paired samples t-tests: Learning about STEM $t(2115) = 48.16$, $p < 0.001$; Engaging in STEM Practices $t(1917) = 42.12$, $p < 0.001$.

The Role of Mentors

Mentors, including NPMs, RTs, and site directors, play a critical role in the GEMS program in terms of students' engagement in STEM, their sustained interest in STEM, and their inspiration to pursue STEM careers in the future. The nature and quality of the various support provided by these individuals is therefore a key component in students' GEMS experiences. Mentors were therefore asked whether they used a number of strategies when working with students. These strategies comprised five main areas of effective mentoring:[12]

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

A large majority of responding mentors reported using all but one of the strategies to help make the learning activities relevant to students (see Table 17). Nearly all mentors reported helping students become aware of the roles STEM plays in their everyday lives (97%). Similarly, 86% became familiar students backgrounds and interests at the beginning of the program, 83% gave students real-life problems to investigate and solve, and 83% asked students to relate outside events or activities to topics covered in the program. Only 37% of mentors reported selecting reading or activities that relate to students' backgrounds. The low response to this item may be due to the structure of the GEMS program in which diverse groups of students work on activities together.

Table 17. Mentors Using Strategies to Establish Relevance of Learning Activities (n = 29-30)

Item	Questionnaire Respondents
Helping students become aware of the role(s) that STEM plays in their everyday lives	97%
Become familiar with my student(s) background and interests at the beginning of the GEMS experience	86%
Giving students real-life problems to investigate or solve	83%
Asking students to relate real-life events or activities to topics covered in GEMS	83%
Helping students understand how STEM can help them improve their own community	80%
Encouraging students to suggest new readings, activities, or projects	70%
Selecting readings or activities that relate to students' backgrounds	37%

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

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

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

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

Similarly, mentors reported using a variety of strategies to support the diverse needs of students as learners. Table 18 shows mentor responses to this questionnaire item. A large majority of mentors (97%) reported interacting with students and other personnel in the same way regardless of their backgrounds and using a variety of teaching and/or mentoring strategies to meet the needs of all students. Similarly, 87% reported directing students to other individuals or programs for additional support, and over three-quarters of mentors (76%) identified the different learning styles of students at the beginning of the GEMS experience. Likewise, a majority of mentors reported integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM (66%) and highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM (53%).

Table 18. Mentors Using Strategies to Support the Diverse Needs of Students as Learners (n = 29-30)	
Item	**Questionnaire Respondents**
Interact with students and other personnel the same way regardless of their background	97%
Use a variety of teaching and/or mentoring activities to meet the needs of all students	97%
Directing students to other individuals or programs for additional support as needed	87%
Identify the different learning styles that my student (s) may have at the beginning of the GEMS experience	76%
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	66%
Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	53%
Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	40%

Mentors also reported using strategies to support students' development of collaboration and interpersonal skills (see Table 19). Having students work on collaborative activities or projects as members of a team and having students give and receive constructive feedback with others were identified as strategies used by nearly all mentors (97%). Most mentors also reported using other strategies to support these student skills. For example, 93% reported having students listen to the ideas of others with an open mind and having students exchange ideas with others whose background and viewpoints are different than their own.

Table 19. Mentors Using Strategies to Support Student Development of Collaboration and Interpersonal Skills (n = 29-30)	
Item	**Questionnaire Respondents**
Having students work on collaborative activities or projects as a member of a team	97%
Having my student(s) give and receive constructive feedback with others	97%
Having my student(s) listen to the ideas of others with an open mind	93%
Having my student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	93%
Allowing my student(s) to resolve conflicts and reach agreement within their team	90%
Having my student(s) explain difficult ideas to others	87%
Having my student(s) tell other people about their backgrounds and interests	83%

Mentors were also asked about the strategies they used to support student engagement in authentic STEM activities (see Table 20). All responding mentors reported providing students with constructive feedback to improve their STEM competencies and nearly all (97%) reported encouraging students to learn collaboratively. Other frequently used

strategies included encouraging students to seek support from other team members (93%), allowing students to work independently to improve their self-management skills (93%), and supervising students while they practice STEM research skills (90%). Similar to mentor responses in 2014, only 43% reported having students search for and review technical research to support their work, a phenomenon that may be attributable to resource and time limitations.

Table 20. Mentors Using Strategies to Support Student Engagement in "Authentic" STEM Activities (n = 29-30)	
Item	**Questionnaire Respondents**
Providing my student(s) with constructive feedback to improve their STEM competencies	100%
Encouraging students to learn collaboratively (team projects, team meetings, journal clubs, etc.)	97%
Encouraging students to seek support from other team members	93%
Allowing students to work independently to improve their self-management abilities	93%
Supervising my student(s) while they practice STEM research skills	90%
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	83%
Teaching (or assigning readings) about specific STEM subject matter	70%
Having my student(s) search for and review technical research to support their work	43%

The final set of items mentors were asked about their mentoring strategies focused on supporting students' STEM educational and career pathways (see Table 21). Most mentors reported using strategies such as providing guidance about educational pathways to prepare students for STEM careers (90%), asking students about their educational and/or career goals (86%), and recommending student and professional organizations in STEM to students (80%). Nearly three-quarters (73%) of mentors also reported recommending AEOPs that align with student goals and 63% discussed STEM career opportunities within the DoD or other government agencies. Students were asked to respond to a subset of these items (see Appendix B) and it is notable that only 46% indicated that mentors recommended AEOPs that matched student interests while 56% reported that their mentors discussed STEM career opportunities within the DoD or other government agencies.

Table 21. Mentors Using Strategies to Support Student STEM Educational and Career Pathways (n = 29-30)	
Item	**Questionnaire Respondents**
Providing guidance about educational pathways that will prepare my student(s) for a STEM career	90%
Asking my student(s) about their educational and/or career goals	86%
Recommending student and professional organizations in STEM to my student(s)	80%
Recommending Army Educational Outreach Programs that align with students' goals	73%
Recommending extracurricular programs that align with students' goals	70%
Discussing STEM career opportunities in private industry or academia	70%
Discussing the economic, political, ethical, and/or social context of a STEM career	66%
Discussing STEM career opportunities within the DoD or other government agencies	63%
Helping students build a professional network in a STEM field	63%
Helping my student(s) with their resume, application, personal statement, and/or interview preparations	30%

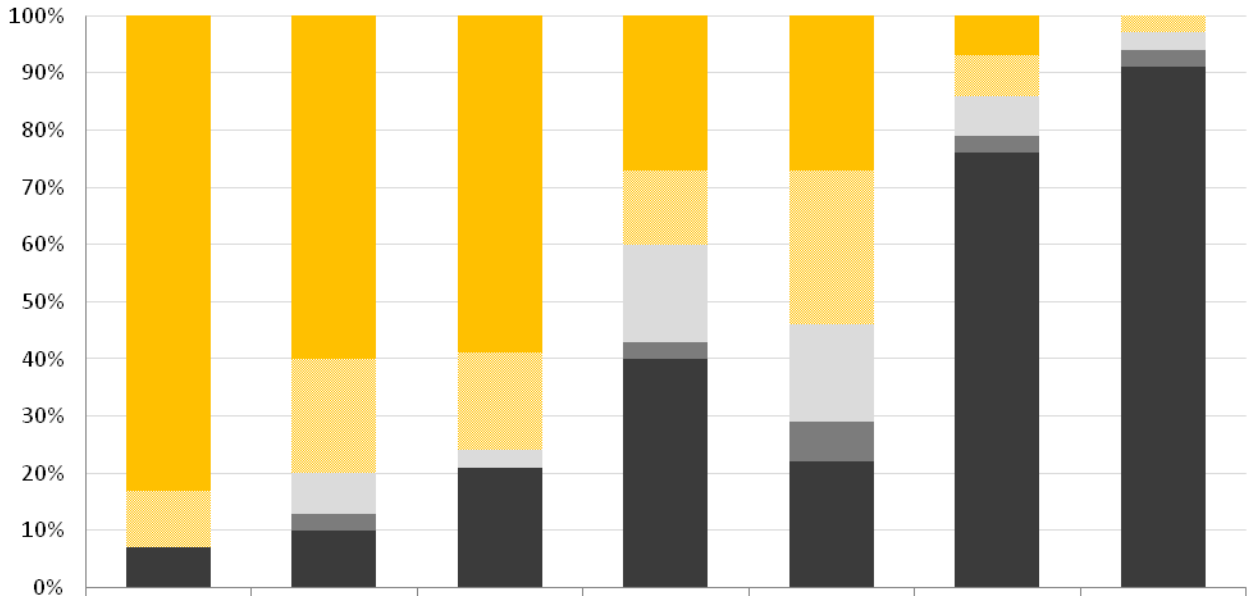
Mentors were asked which of the AEOP programs they explicitly discussed with their students during GEMS. Predictably, the most frequently discussed programs were GEMS (87%) and GEMS NPMs (73%) as can be seen in Table 22. The other most commonly discussed AEOPs were SEAP (66%) and CQL (57%). Interestingly, less than a quarter of mentors discussed programs for which students are eligible in high school including HSAP (21%), REAP (17%), UNITE (10%), and JSHS (10%). This could indicate a lack of mentor information, however, because of the low number of mentor responses, this could be an artifact of the age group mentors worked with during GEMS. It is interesting, nonetheless, that nearly half of responding mentors (48%) reported discussing AEOPs generally but that they did not discuss any specific programs.

Table 22. Mentors Explicitly Discussing AEOPs with Students (n = 29-30)	
Item	**Questionnaire Respondents**
Gains in the Education of Mathematics and Science (GEMS)	87%
GEMS Near Peer Mentor Program	73%
Science & Engineering Apprenticeship Program (SEAP)	66%
College Qualified Leaders (CQL)	57%
I discussed AEOP with my student(s) but did not discuss any specific program	48%
Science Mathematics, and Research for Transformation (SMART) College Scholarship	23%
High School Apprenticeship Program (HSAP)	21%
Research & Engineering Apprenticeship Program (REAP)	17%
Undergraduate Research Apprenticeship Program (URAP)	17%
UNITE	10%
Junior Science & Humanities Symposium (JSHS)	10%
National Defense Science & Engineering Graduate (NDSEG) Fellowship	7%

In support of the AEOP goal of having students progress from GEMS into other AEOPs, mentors were asked how useful various resources were in their efforts to expose students to AEOPs (see Chart 8). Participation in GEMS was most frequently rated as "very useful" (83%), followed by GEMS program administrators or site coordinators (60%) and invited speakers or career events (59%). Fewer mentors (27%) rated the AEOP brochure and AEOP website as very useful while 76% of mentors had not experienced AEOP on social media and 91% had no experience with the It Starts Here! Magazine. Interestingly, while 40% of mentors found the AEOP brochure to be either "very useful" or "somewhat useful" in exposing students to AEOPs, another 40% reported having no experience with the brochure.

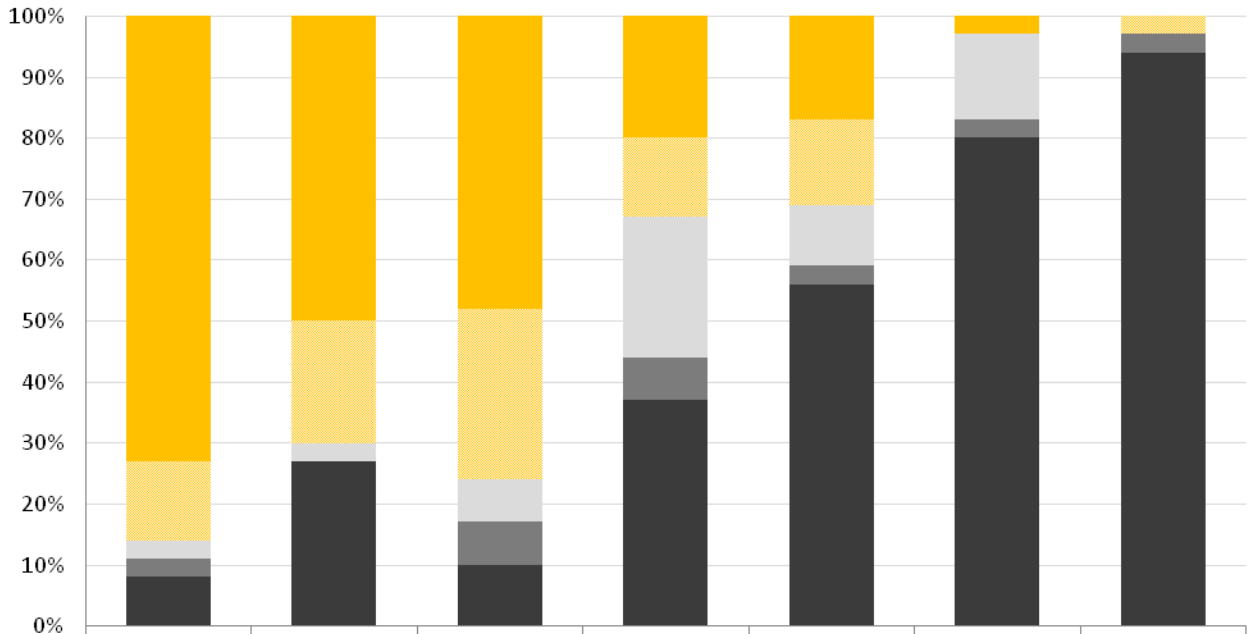
In accordance with the AEOP and GEMS goal of exposing students to DoD STEM careers, mentors were also asked how useful these resources were for exposing students to DoD STEM careers (see Chart 9). As with the previous item, mentors were most likely to rate participation in GEMS as "very much" useful (73%). About half of mentors rated invited speakers or career events (50%) and GEMS program administrators or site coordinators (48%) as very useful. Fewer mentors found AEOP materials were very useful for this purpose (a range of 0-20%), with a substantial proportion of mentors (37-94%) indicating they did not experience these resources.

Chart 8: Usefulness of Resources for Exposing Students to AEOPs (n = 29-30)



	Participation in GEMS	GEMS Program administrator or site coordinator	Invited speakers or "career" events	AEOP brochure	AEOP website	AEOP on Facebook, Twitter, Pinterest or other social media	It Starts Here! Magazine
Very Much	83%	60%	59%	27%	27%	7%	0%
Somewhat	10%	20%	17%	13%	27%	7%	3%
A little	0%	7%	3%	17%	17%	7%	3%
Not at all	0%	3%	0%	3%	7%	3%	3%
Did not experience	7%	10%	21%	40%	22%	76%	91%

Chart 9: Usefulness of Resources for Exposing Students to DoD STEM Careers (n = 29-30)



	Participation in GEMS	Invited speakers or "career" events	GEMS Program administrator or site coordinator	AEOP website	AEOP brochure	AEOP on Facebook, Twitter, Pinterest or other social media	It Starts Here! Magazine
Very Much	73%	50%	48%	20%	17%	3%	0%
Somewhat	13%	20%	28%	13%	14%	0%	3%
A little	3%	3%	7%	23%	10%	14%	0%
Not at all	3%	0%	7%	7%	3%	3%	3%
Did not experience	8%	27%	10%	37%	56%	80%	94%

Student focus group participants echoed the findings regarding the usefulness of invited speakers, indicating that connecting with STEM professionals in the DoD was particularly useful to them in learning about STEM careers. For example:

> *They give us interesting information about the jobs that they do.* (GEMS Student)

> *I already wanted to be a civil engineer but when one of them [came to] talk, I found that I wanted to do more of water management.* (GEMS Student)

Mentor focus group participants also discussed strategies used in their program to expose students to various DoD careers, also emphasizing that connecting with STEM professionals in the DoD was key to exposing students to STEM careers. Mentor comments included the following:

This program helps children [understand] that you can be a part of the army, part of the corps, and be a scientist and be an engineer and not have boots on the ground. (GEMS Mentor)

A lot [of speakers] give an overview about how their job supports the mission of the DoD, and they have videos, or sometimes they hand out informational packets. So the kids do get an understanding of exactly what [DoD workers do]. (GEMS Mentor)

[The students] do so many engineering activities, and then there's researchers who talk to the kids related to the current projects they're working on. And they're saying, 'Hey, this research that we're doing is affecting the Army in this way and assisting them with their missions.' So [the students] definitely get to see that point of view. (GEMS Mentor)

Another mentor discussed the importance of exposing students to a variety of careers and the education necessary for those careers. She said:

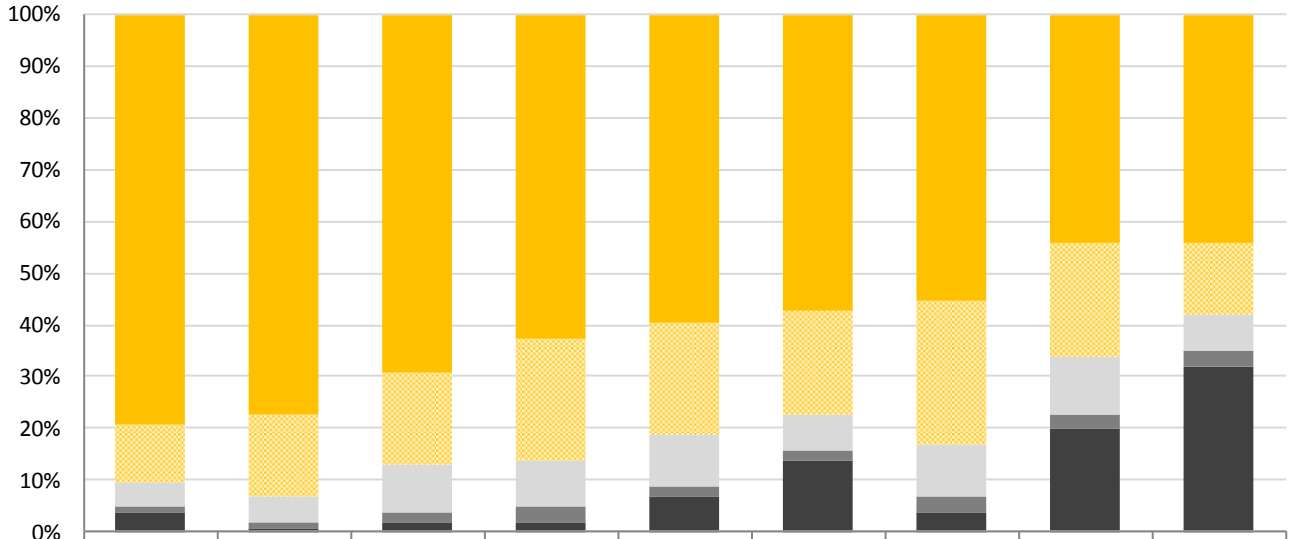
I think the exposure is really important because there are so many researchers out here that I think students did even realize that what they do is a profession…And we really emphasize [having] scientists and engineers explaining to them where they went to college and what they studied, and what students have to do to get where they are. (GEMS Mentor)

Satisfaction with GEMS

Students and mentors were asked how satisfied they were with a number of features of the GEMS program. Chart 10 displays student responses and shows that the majority of responding students were somewhat or very much satisfied with all of the listed program features. For example, 91% of students were at least somewhat satisfied with the stipend, 93% with the teaching or mentoring during program activities, and 87% with the variety of STEM topics available to them in GEMS. In light of the findings indicating that connecting with DoD STEM professionals is important in exposing students to Army and DoD STEM careers, it is noteworthy that 14% of students reported not experiencing invited speakers or career events and 32% not experiencing field trips or lab tours.

> *"I think GEMS was a great way to learn about STEM and how people work in the army and ARL laboratories. It was a great way to spend my week"*-- GEMS Student

Chart 10: Student Satisfaction with GEMS Program Features (n = 1897-1916)



	Stipends (payment)	Teaching or mentoring provided during GEMS activities	The variety of STEM topics available to you in GEMS	The physical location(s) of GEMS activities	Educational materials (e.g., workbooks, online resources, etc.) used during program activities	Invited speakers or ñcareerî events	Applying or registering for the program	Communicating with your GEMS host site organizers	Field trips or laboratory tours
Very Much	80%	77%	69%	62%	60%	57%	55%	44%	44%
Somewhat	11%	16%	18%	23%	22%	20%	28%	22%	14%
A little	5%	5%	9%	9%	10%	7%	10%	11%	7%
Not at all	1%	1%	2%	3%	2%	2%	3%	3%	3%
Did not experience	4%	1%	2%	2%	7%	14%	4%	20%	32%

Students responded to an open-ended item on the questionnaire asking them about their overall satisfaction with their GEMS experience. Of the 179 students who responded,[13] 160, or 89%, commented only on positive aspects of the program, describing satisfaction with their mentors, having fun, and their learning. For example:

> *I am extremely grateful for being chosen to participate in this program. Before GEMS, my knowledge of the military and its research laboratories was very minimal, but after this camp, I feel satisfied with my attained*

[13] Responses from a random sample of 199 students were coded, which represents 23% of the population.

> *knowledge…I now feel excited about he research going on here at WSMR. The instructors and modules carried and enthusiasm I hope to carry when I pursue STEM.* (GEMS Student)
>
> *GEMS has been very good and has helped me learn STEM topics. I also had fun and thought the mentors were very good. Overall, awesome and packed with learning.* (GEMS Student)
>
> *I had a lot of fun at GEMS! The teachers are fun and accommodating. I felt involved and respected. The projects were also fun and quite an experience, definitely something I'll never forget.* (GEMS Student)
>
> *I loved GEMS – it is really fun. I told my friends about it and now they want to do it too. I like the stuff that we do here. The workers here are so kind and want us to learn more about STEM.* (GEMS Student)

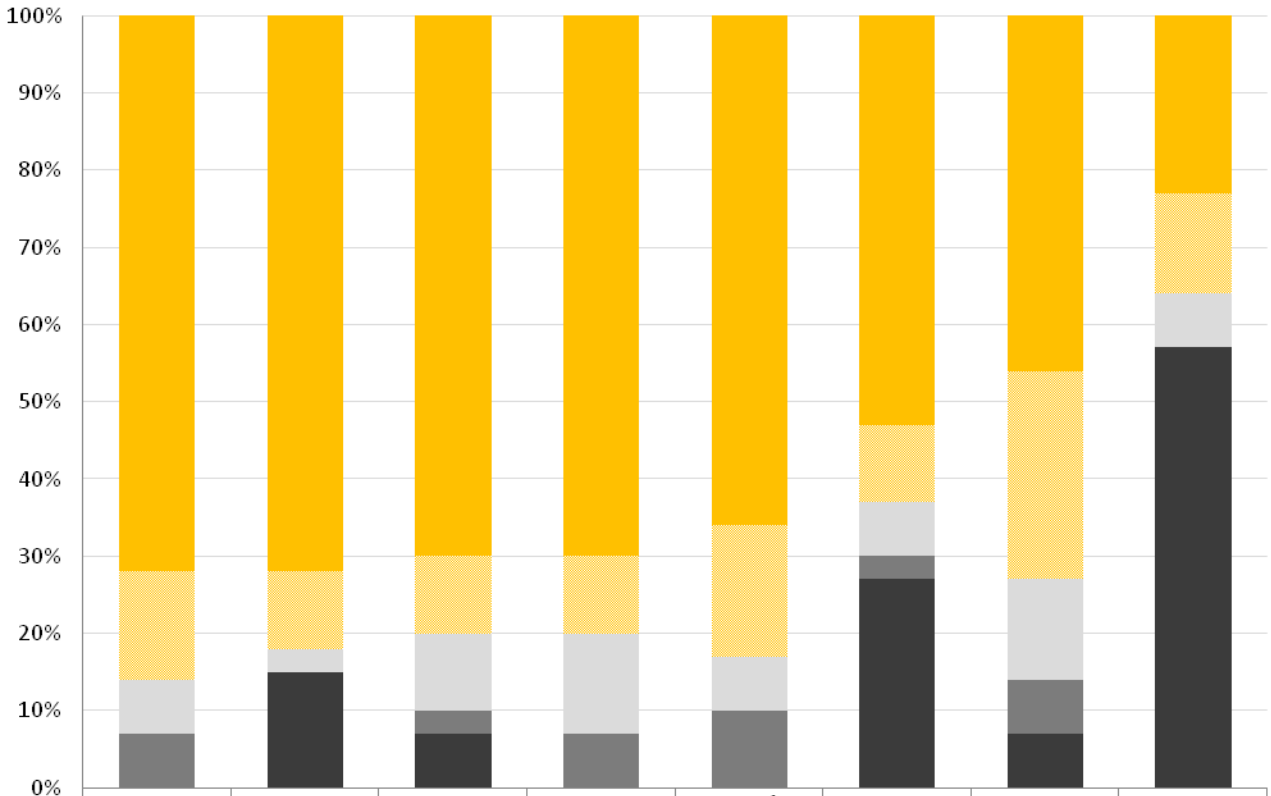
The other 19 responses (11%) included positive comments, but had some caveats. The most common caveat was that students wished there were more choice in topics. For instance:

> *I was very satisfied with GEMS because I learned a lot more about experimentation and many different STEM topics and I had fun doing it wince it was all done in a lab with hands-on experiments. I just wish we had [a] little more choice on what we wanted to do in the camp, but other than that it was a great overall camp.* (GEMS Student)

When asked how the program could be improved, 162 of the 169 student respondents to this item provided at least one response other than a response indicating that no improvement is needed. Over half of responses related to program logistics. The most common themes were suggestions to increase the duration of the program (19%), have more breaks and more time for socialization (11%), more field trips and tours (9%), and suggested improvements to lunch, including time, space, and food selection (9%). About a quarter of students suggested improvements in program activities, with a focus on increasing the number of hands-on activities (17% of respondents) and suggesting improvements in the topics or number of topics available (18%). Students also suggested that more equipment and materials and better technology would improve the GEMS program (11%). Other suggestions included increasing the number of speakers, increasing the stipend, adding more mentors, including projects students can take home, improving scheduling and time management, and eliminating or shortening the survey.

Mentors were also asked about their satisfaction with a number of program features reported being somewhat or very much satisfied with most program components they experienced (see Chart 11). For example 86% were at least somewhat satisfied with the stipend, 82% with invited speakers or career events, 80% with communications with GEMS organizers or site coordinators, and 83% with the support they received for instructing or mentoring during program activities.

Chart 11: Mentor Satisfaction with GEMS Program Features (n = 29-30)



	Stipends (payment)	Invited speakers or "career" events	Communicating with GEMS organizers / site coordinators	The physical location(s) of GEMS's activities	Support for instruction or mentorship during program activities	Field trips or laboratory tours	Application or registration process	Communicating with ASEE
Very Much	72%	72%	70%	70%	66%	53%	46%	23%
Somewhat	14%	10%	10%	10%	17%	10%	27%	13%
A little	7%	3%	10%	13%	7%	7%	13%	7%
Not at all	7%	0%	3%	7%	10%	3%	7%	0%
Did not experience	0%	15%	7%	0%	0%	27%	7%	57%

Mentors were also asked to respond to open-ended questionnaire items asking for their opinions about the program. One item asked them to identify the three most important strengths of GEMS. Of the 23 mentors who responded to this item, over half (65%) responded that the real-world applications of knowledge and hands-on experiences GEMS offers are key benefits of the program. For example:

> *[GEMS] provides students with a hands-on experience that wouldn't be found in the typical classroom…[it] allows students to work with accelerated peers who share their interests, and shows students the real life practical applications of STEM and things that they learn in school.* (GEMS Mentor)

Other themes that emerged from mentor responses was the value of teamwork and problem-solving, mentioned by 35% of respondents, gaining knowledge and skills (26%), and working with diverse students (17%).

One mentor focus group participant added that GEMS positively impacts students' confidence in their abilities:

> *[GEMS] helps them gain confidence in their abilities a lot….at the end of the week when we do the showcase, they get to show off their favorite experiment from the week, and they're acting in the role of mentors to their parents and other students' parents. This gives them presentation experience and lets them put themselves out there…they grow a lot personally throughout the week that way."* (GEMS Mentor)

Other responses to the open-ended questionnaire item about the benefits of GEMS included exposure to careers, exposure to AEOPs, having fun, and making friends. As two mentors wrote:

Mentors also discussed in the questionnaire and in focus groups benefits to themselves from participating in GEMS. Questionnaire responses in this area included the opportunity to work with students from a variety of backgrounds and interest areas, professional development opportunities, and the opportunity to expand personal perspectives. For instance:

> *As a Resource Teacher, GEMS has provided me with the opportunity to use my graduate degree by being able to assess curriculum. This program has opened my eyes to the 'Sciences" of the world. I never believed that I would enjoy science, but seeing the crime investigation, rocket launch, robotic arm, etc. has really made me a believer.* (GEMS mentor)

> *GEMS…has strengthened so many aspects of my life, whether its' networking, patience, or my fields of interest. Without this program, I wouldn't be considering getting a Masters [degree] in teaching or a science field.* (GEMS mentor)

Focus group participants cited the benefits to the NPMs of participating in GEMS. For example:

> *I think I've grown a lot personally. I've gotten a lot of really great advice from the people who work here and a lot of great feedback from the mentors as well….I actually observed their teaching and I learned from their teaching styles as well as my own.* (GEMS mentor)

> *[GEMS] has kind of helped encourage me, my love and my passion for teaching, and kind of helped me grow in that way too.* (GEMS mentor)

Another open-ended questionnaire item asked mentors to note three ways in which GEMS should be improved for future participants. A variety of improvements were suggested among the 21 responses. The application process was

noted as an area in need of improvement by 5 (24%) of respondents. One mentor suggested that difficulties with the application process could influence the diversity of the program:

> *We found that this year the application itself was so difficult; most parents were actually filling out the application and would call me constantly for help. We found a great drop in minority participation do to the inability to fill out the application; they would give up.* (GEMS mentor)

Other suggestions for improvement mirrored students responses and included having more or more advanced materials and technology (19%), providing a greater variety of topics (19%), having more hands-on activities (10%), and increasing the duration of the program (10%). Less frequently mentioned suggestions (mentioned by one mentor) included increasing stipends for both students and mentors, increasing the number of lab visits, providing more breaks, including a project that students could take home, and changing the location of the program.

Mentors were asked in another open-ended questionnaire item to share their overall satisfaction with their GEMS experience. Seventeen of the 20 respondents commented positively on the program. The most common themes in these responses were GEMS was a good experience for them personally, that the program was good for students, and that they enjoyed seeing students excited about learning. For example:

> *Every summer I participate as a GEMS teacher I am blown away by the abilities of the students that participate. They are fully engaged and have a great learning experience. It also furthers my learning as an educator.* (GEMS Mentor)

> *As a mentor I learned a lot through the GESM program and developed interests in things I never knew prior to the GEMS program. I am excited to mentor more students through the summer.* (GEMS Mentor)

Mentors who expressed dissatisfaction with aspects of the program focused on logistical issues such as location and organization, and the length of presentations. For example:

> *[The GEMS] location is poor. In a room with no windows, students sit inside all day because the security is too tight in the facility to go outside…Most presentations are long and not engaging for kids.* (GEMS mentor)

In summary, findings from the Actionable Program Evaluation indicate that the program is actively engaging students in authentic STEM experiences and providing mentorship that meets diverse student needs.

Once in the GEMS program, students are learning about DoD or STEM job/careers, with most mentors crediting student participation in the program and invited speakers as useful in this process. Although mentors report discussing other AEOPs with students, many did not discuss specific programs, and this, coupled with the low student responses indicating that mentors recommended specific AEOPs to them, suggests that there is potential for growth in this area.

The GEMS program actively engages students in learning about STEM and in STEM practices in ways that they are not engaged in typical school activities. Mentors employed strategies to help make learning activities relevant to students, support the diverse needs of students as learners, support students' development of collaboration and interpersonal skills, and support student engagement in authentic STEM activities. Overall, students and mentors were satisfied with their experience in the GEMS program.

Outcomes Evaluation

The evaluation of GEMS included measurement of several outcomes relating to AEOP and program objectives, including impacts on students' 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 toward STEM, knowledge of and interest in participating in additional AEOP opportunities, and knowledge of DoD STEM careers.[14]

STEM competencies include foundational knowledge, skills, and abilities in STEM, as well as the confidence to apply them appropriately. STEM competencies are not only important for those pursuing STEM careers, 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 GEMS evaluation therefore measured students' 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.

STEM Knowledge and Skills

Students were asked to report their gains in STEM knowledge as a result of participating in GEMS. As can be seen in Chart 12, nearly all responding students reported gains in their STEM knowledge as a result of the GEMS program. A majority of students indicated large or extreme gains in most areas, including their knowledge of how scientists and engineers work on real problems in STEM (75%), knowledge of what everyday research work is like in STEM (71%),

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

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

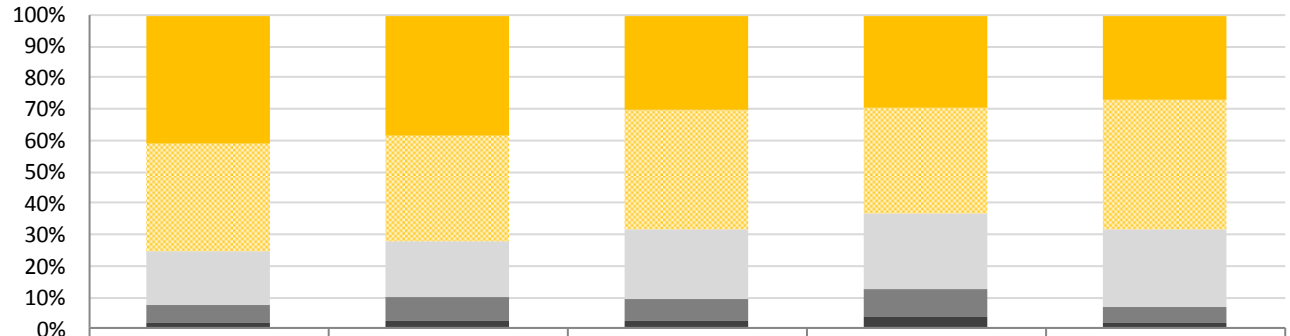
National Research Council. (2009). Learning Science in Informal Environments: People, Places, and Pursuits. Committee on Learning Science in Informal Environments. Philip Bell, Bruce Lewenstein, Andrew W. Shouse, and Michael A. Feder, Editors. Board on Science Education, Center for Education. Division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

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

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

knowledge of research conducted in a STEM topic or field (68%), an in-depth knowledge of a STEM topic (68%), and knowledge of research professes, ethics, and rules for conduct in STEM (63%). Fewer than 5% of students (range of 3-4%) reported no gain in these areas. Mentors were asked to respond to a parallel item and responded similarly, however they reported somewhat greater impacts on students' STEM knowledge (see Appendix C).

Chart 12: Student Report of Impacts on STEM Knoweldge (n = 2082-2091)



	Knowledge of how scientists and engineers work on real problems in STEM	Knowledge of what everyday research work is like in STEM	Knowledge of research conducted in a STEM topic or field	Knowledge of research processes, ethics, and rules for conduct in STEM	In depth knowledge of a STEM topic(s)
Extreme gain	41%	38%	30%	29%	27%
Large gain	34%	33%	38%	34%	41%
Some gain	17%	18%	22%	24%	25%
A little gain	6%	7%	7%	9%	5%
No gain	2%	3%	3%	4%	2%

These items were combined into a composite variable[15] to test for differential impacts across subgroups of students. Significant differences were found by gender (females higher) and race/ethnicity (minority students higher); however both differences had small effect sizes (d = 0.125 and 0.153 standard deviations respectively).[16]

Students were also asked about how GEMS impacted their STEM competencies, defined as their abilities in a number of STEM practices. Table 23 reports data for students who indicated that science was the focus of their GEMS experience while Table 24 reports data for students who indicated that engineering or technology was the focus of their experience. For science-focused students, the greatest gains were in carrying out procedures for an experiment and recording data accurately (68% reported large or extreme gains), followed by communicating about experiments and explanations in different ways (64%). A majority of students reported at least large gains in several other areas including supporting an explanation for an observation with data from experiments (59%), making a model of an object or system showing its

[15] The Cronbach's alpha reliability for these 5 items was 0.896.

[16] Two-tailed independent samples t-test: STEM Knowledge by Gender t (1387) = 2.32, p = 0.021; by race/ethnicity t (1382) = 2.85, p = .004.

parts and how they work (56%) asking a question that can be answered with one or more scientific experiments (56%), using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation (55%), and considering different interpretations of data when deciding how the data answer a question (51%). For engineering-focused students, the greatest perceived gains were in students' ability use knowledge and creativity to propose a testable solution for a problem (62%), make a model of an object or system to show its parts and how they work (61%), communicate information about their design experiments and solutions in different ways (through talking, writing, graphics, or math equations) (59%), and define a problem that can be solved by developing a new or improved object, process, or system (58%). Mentors were asked to respond to a parallel set of items on the questionnaire and reported generally greater impacts on students in these areas (see Appendix C).

Table 23. Students Reporting Large or Extreme Gains in their STEM Competencies – Science Practices (n = 1123-1135)	
Item	**Questionnaire Respondents**
Carrying out procedures for an experiment and recording data accurately	68%
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	64%
Supporting an explanation for an observation with data from experiments	59%
Asking a question that can be answered with one or more scientific experiments	56%
Making a model of an object or system showing its parts and how they work	56%
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	55%
Considering different interpretations of data when deciding how the data answer a question	51%
Defending an argument that conveys how an explanation best describes an observation	49%
Integrating information from technical or scientific texts and other media to support your explanation of an observation	47%
Organizing data in charts or graphs to find patterns and relationships	44%
Using computer models of objects or systems to test cause and effect relationships	31%

Table 24. Students Reporting Large or Extreme Gains in their STEM Competencies – Engineering Practices (n = 948-963)	
Item	**Questionnaire Respondents**
Using knowledge and creativity to propose a testable solution for a problem	62%
Making a model of an object or system to show its parts and how they work	61%
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations)	59%
Defining a problem that can be solved by developing a new or improved object, process, or system	58%
Carrying out procedures for an experiment and recording data accurately	53%
Supporting a solution for a problem with data from experiments	53%
Considering different interpretations of the data when deciding if a solution works as intended	52%
Integrating information from technical or scientific texts and other media to support your solution to a problem	47%
Defend an argument that conveys how a solution best meets design criteria	46%
Using computer models of an object or system to investigate cause and effect relationships	44%
Organizing data in charts or graphs to find patterns and relationships	40%

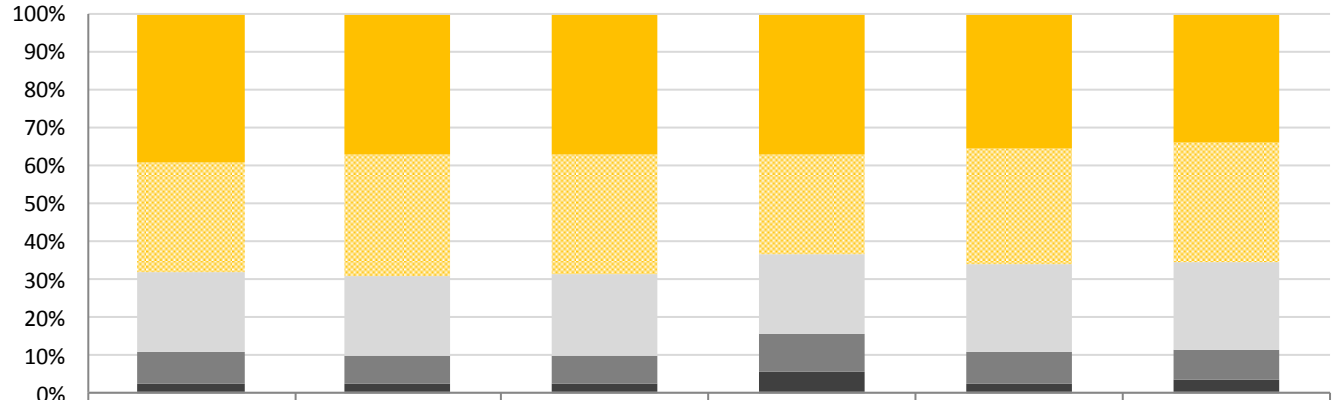
Composite scores were calculated from each set of items related to STEM competencies[17] to examine whether the GEMS program had differential impacts on subgroups of students. There were no significant differences between minority and non-minority students on either composite. Gender differences were found for the Science Competencies composite with females having slightly higher beliefs (small effect size d = 0.185 standard deviations).[18]

Students were also asked to indicate the impact of GEMS on their "21st Century Skills," defined as skills that are necessary across a wide variety of fields. As can be seen in Chart 13, approximately two-thirds of responding students reported large or extreme gains in all of these skills, including working well with students of all backgrounds (68%), making changes when things do not go as planned (69%), communicating effectively with others (69%), and sticking with a task until it is finished (66%). Mentors generally reported greater impacts on their students' in this area, although interestingly their reports of student gains in communicating effectively with others were lower than student reports and only 50% of mentors reported large or extreme student gains in this area (see Appendix C).

[17] The science practices composite has a Cronbach's alpha reliability of 0.928; The engineering practices composite has a Cronbach's alpha reliability of 0.931.

[18] Two-tailed Independent Samples t-test: Science Competencies by Gender $t(708) = 2.466$, $p = 0.014$.

Chart 13: Student Report of Impacts on 21st Century Skills (n = 1893-1905)



	Working well with students from all backgrounds	Making changes when things do not go as planned	Communicating effectively with others	Viewing failure as an opportunity to learn	Including othersí perspectives when making decisions	Sticking with a task until it is finished
Extreme gain	39%	37%	37%	37%	35%	34%
Large gain	29%	32%	32%	26%	30%	32%
Some gain	21%	21%	22%	21%	23%	23%
A little gain	8%	7%	7%	10%	8%	8%
No gain	3%	3%	3%	6%	3%	4%

These items were also combined into a composite variable[19] to test for differential impacts across subgroups of students. There were no significant differences between males and females on the 21st Century Skills composite, however there were differences in terms of race/ethnicity with minority students reporting significantly higher beliefs (small effect size d = 0.248)[20].

STEM Identity and Confidence

While deepening students' STEM knowledge and skills are important for increasing the likelihood that they will pursue STEM further in their education and/or careers, they are unlikely to do so if they do not see themselves as capable of succeeding in STEM.[21] The student questionnaire therefore included a series of items intended to measure the impact of GEMS participation on students' STEM identity, defined as their feelings of confidence and self-efficacy in terms of STEM achievement. Chart 14 displays student responses to the items associated with students' STEM identity. Since a majority of students reported large or extreme gains in all areas, these responses suggest that the program has had a

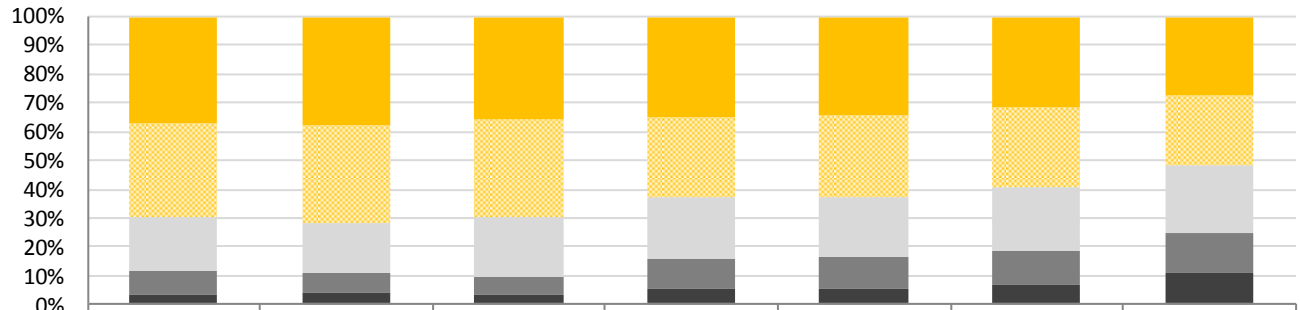
[19] The 21st Century Skills composite has a Cronbach's alpha reliability of 0.910.

[20] Two-tailed Independent Samples t-test: 21st Century differences by race/ethnicity $t(1379) = 4.60$, $p < .001$.

[21] 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.

positive impact on students' confidence in their STEM abilities. For example, 69% of responding students reported a large or extreme gain in their sense of accomplishing something in STEM, 71% in feeling more prepared for more challenging STEM activities, and 70% in their ability to think creatively about a STEM project or activity. Similar substantial proportions of students reported large or extreme gains in their desire to build relationships with mentors who work in STEM (63%), deciding on a path to pursue a STEM career (51%), interest in a new STEM topic (63%), and connecting a STEM topic or field to their personal values (59%). Comparing results on the composite created from these items,[22] there were no differences in STEM identity and confidence impact based on race/ethnicity, but females had significantly higher views than males (small effect size d = 0.219 standard deviations)[23].

Chart 14: Student Report of Impacts on STEM Identity (n = 2065-2077)



	Sense of accomplishing something in STEM	Feeling prepared for more challenging STEM activities	Thinking creatively about a STEM project or activity	Desire to build relationships with mentors who work in STEM	Interest in a new STEM topic	Connecting a STEM topic or field to my personal values	Deciding on a path to pursue a STEM career
Extreme gain	37%	37%	36%	35%	34%	31%	27%
Large gain	32%	34%	34%	28%	29%	28%	24%
Some gain	19%	17%	21%	22%	21%	22%	24%
A little gain	8%	7%	6%	10%	11%	12%	14%
No gain	4%	4%	4%	6%	6%	7%	11%

Interest and Future Engagement in STEM

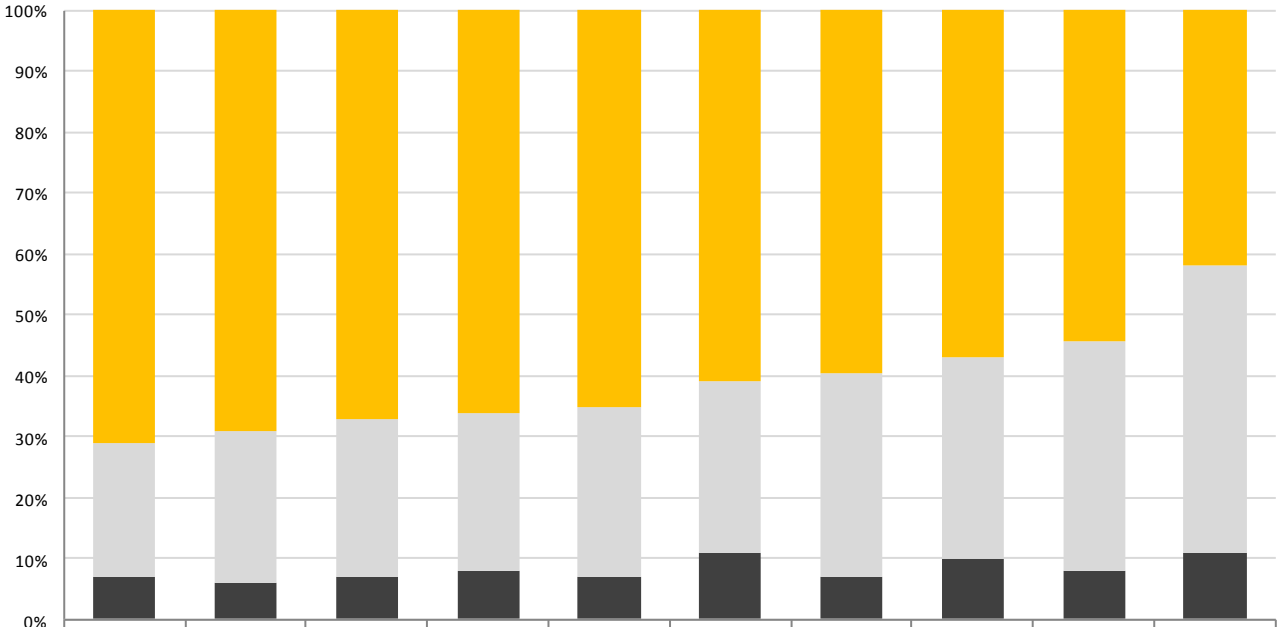
A key goal of the AEOP program is to develop a STEM literate citizenry. To achieve this goal, it is important that students be engaged in high-quality STEM activities both in and out of school. Because of this, students were asked to reflect on whether the likelihood of their engaging in STEM activities both in school and outside of school and their interest in participating in future AEOPs changed as a result of their GEMS experience. As can be seen in Chart 15, students indicated they were more likely to engage in many of these activities as a result of GEMS. For example, 71% indicated being more likely to be involved in a STEM camp, club, or competition; 69% reported being more likely to work on a

[22] The Cronbach's alpha reliability for these 7 items was 0.923.

[23] Two-tailed Independent Samples t-test: $t(1367) = 4.05$, $p < .001$.

STEM project or experiment in a university or professional setting; and 66% reported being more likely to take a STEM elective class.

Chart 15: Change in Likelihood Students Will Engage in STEM Activities Outside of School (n = 2062-2087)



	Participate in a STEM camp, club, or competition	Work on a STEM project or experiment in a university or professional setting	Tinker (play) with a mechanical or electrical device	Take an elective (not required) STEM class	Talk with friends or family about STEM	Mentor or teach other students about STEM	Help with a community service project related to STEM	Use a computer to design or program something	Work on solving mathematical or scientific puzzles	Watch or read non-fiction STEM
More likely	71%	69%	67%	66%	65%	61%	59%	57%	55%	42%
About the same	22%	25%	26%	26%	28%	28%	33%	33%	38%	47%
Less likely	7%	6%	7%	8%	7%	11%	7%	10%	8%	11%

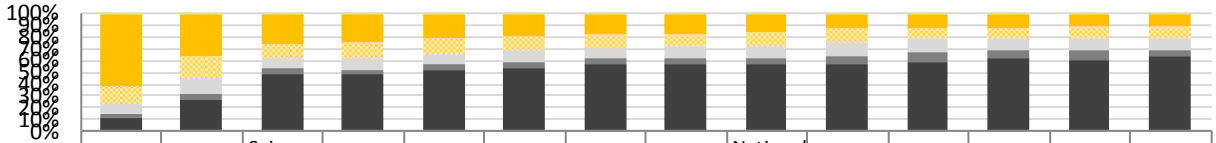
In an analysis of a composite created from these items[24] by subgroup, minority students reported more likely scores in comparison to non-minority students (a small effect of d = 0.219 standard deviations).[25] There were no significant differences between students in terms of gender.

[24] The Cronbach's alpha reliability for these 10 items was 0.912.

[25] Independent samples t-test, $t(1381) = 4.08$, $p < 0.001$.

Chart 16 displays responses to an item asking students how interested they are in participating in other AEOP programs. A large number (77%) of respondents indicated being at least somewhat interested in participating in GEMS again and more than half of respondents (54%) indicated being at least somewhat interested in participating as a NPM. There were approximately a third of students that reported interest in participating in several AEOPs available to them in high school. For instance, 37% indicated future interest in SEAP, 33% in REAP, and 31% in HSAP. Interest in eCYBERMISSION was lower, however, with 20% of students indicating they were at least somewhat interested, and students reported a similarly low level of interest in JSS (21%), 21% in JSHS, and UNITE (20%). It is noteworthy, however, that of the students who were familiar with these programs, few had no interest in participating (range of "not at all" interested was from 2-7%).

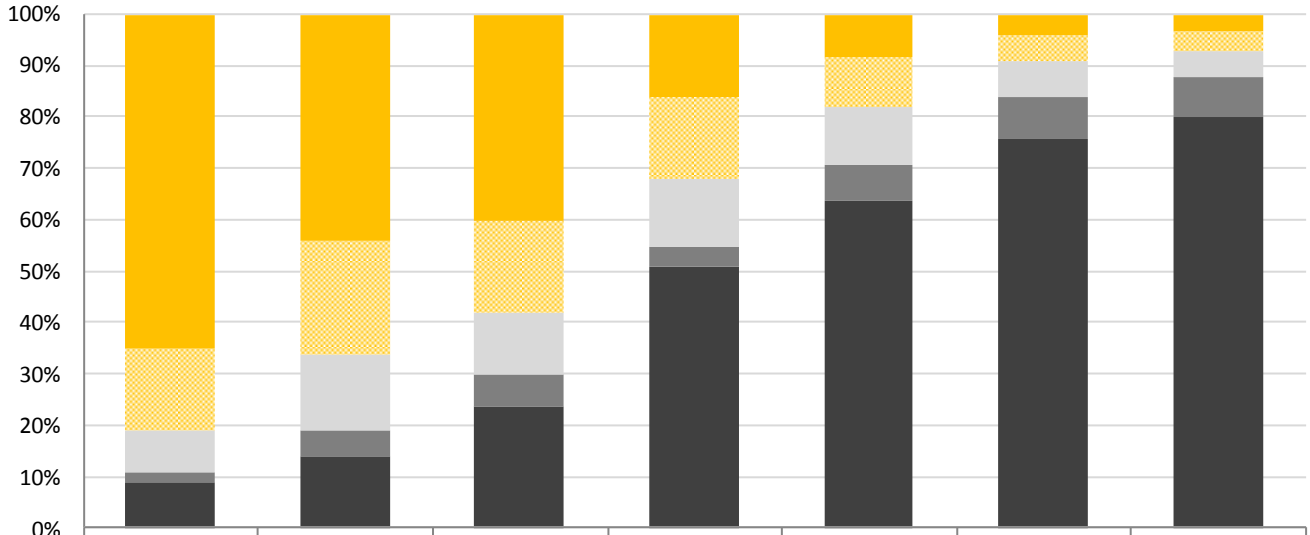
Chart 16: Student Interest in Future AEOP Programs (n = 842-862)



	Gains in the Education of Mathematics and Science (GEMS)	GEMS Near Peer Mentor Program	Science Mathematics, and Research for Transformation (SMART)...	Science & Engineering Apprenticeship Program (SEAP)	Research & Engineering Apprenticeship Program (REAP)	High School Apprenticeship Program (HSAP)	College Qualified Leaders (CQL)	Undergraduate Research Apprenticeship Program (URAP)	National Defense Science & Engineering Graduate (NDSEG) Fellow...	Camp Invention	Junior Solar Sprint (JSS)	Junior Science & Humanities Symposium (JSHS)	eCYBERMISSION	UNITE
Very much	61%	35%	25%	24%	20%	19%	17%	17%	16%	12%	11%	11%	10%	10%
Somewhat	16%	19%	12%	13%	13%	12%	11%	10%	11%	12%	10%	10%	10%	10%
A little	9%	14%	9%	10%	10%	10%	10%	10%	10%	12%	11%	10%	11%	10%
Not at all	3%	4%	4%	4%	4%	5%	5%	5%	5%	6%	9%	6%	8%	5%
Never heard of	12%	28%	50%	49%	53%	55%	57%	58%	58%	58%	59%	63%	61%	64%

Students were also asked to indicate which resources impacted their awareness of the various AEOPs (see Chart 17). Students rated participating in GEMS as most likely to impact their awareness "somewhat" or "very much" (81%). Their mentor (66%) and 58% invited speakers or career events were other frequently cited resources. Fewer than half of respondents found the other resources listed to be at least somewhat helpful. For instance, only 18% rated the impact of the AEOP brochure to be at least somewhat impactful. Large proportions of students reported never having heard of AEOP resources such as the It Starts Here! Magazine (80%), AEOP on social media (76%), and the AEOP brochure (64%).

Chart 17: Impact of Resources on Student Awareness of AEOPs (n = 1897-1909)

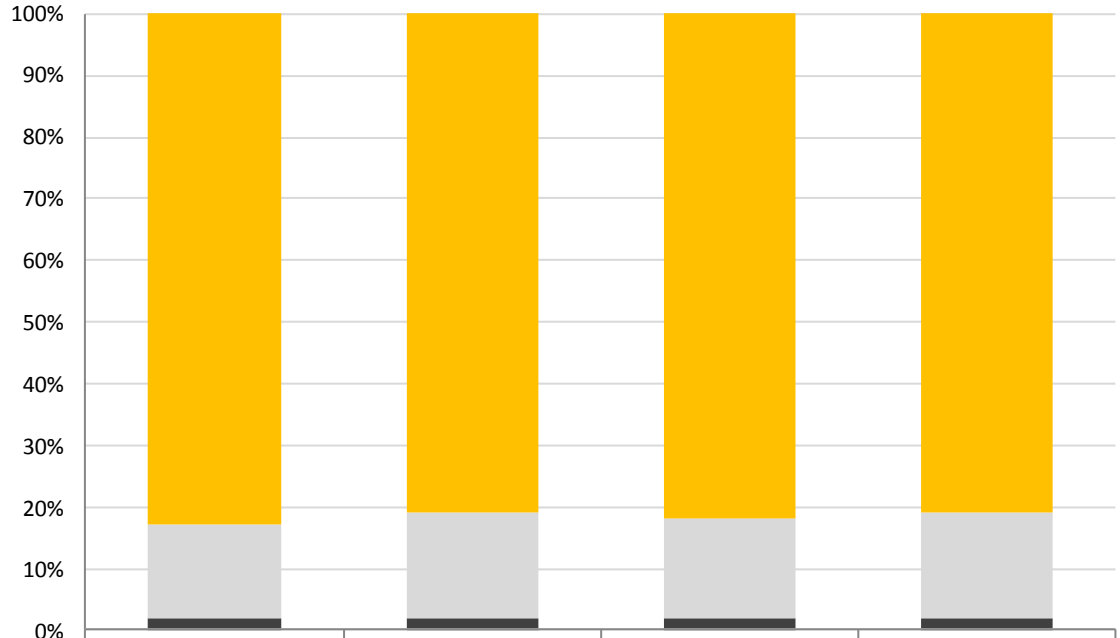


	Participation in GEMS	My GEMS mentor(s)	Invited speakers or ñcareerî events during GEMS	Army Educational Outreach Program (AEOP) website	AEOP brochure	AEOP on Facebook, Twitter, Pinterest or other social media	It Starts Here! Magazine
Very Much	65%	44%	40%	16%	8%	4%	3%
Somewhat	16%	22%	18%	16%	10%	5%	4%
A little	8%	15%	12%	13%	11%	7%	5%
Not at all	2%	5%	6%	4%	7%	8%	8%
Did not experience	9%	14%	24%	51%	64%	76%	80%

Attitudes toward Research

Because students' attitudes about the importance of DoD research is a prerequisite to their continued interest in the field and potential involvement in the future, students were asked their opinions of DoD researchers and the value of DoD research. As Chart 18 indicates, students had overwhelmingly positive perceptions of both DoD researchers and the value of DoD research. For example, 81% agreed or strongly agreed that DoD researchers advance science and engineering fields and that DoD research is valuable to society.

Chart 18: Student Opinions about DoD Researchers and Research (n = 1877-1880)



	DoD researchers solve real-world problems	DoD research is valuable to society	DoD researchers advance science and engineering fields	DoD researchers develop new, cutting edge technologies
Strongly Agree or Agree	83%	81%	81%	80%
Neutral	15%	17%	16%	17%
Strongly Disagree or Disagree	2%	2%	2%	2%

These items were also combined into a composite variable[26] to test for differential impacts across subgroups of students. There were no differences by gender. However, minority students reported significantly higher perceptions of DOD researchers in comparison to non-minority students (small effect size, d = 0.319 standard deviations).[27]

Education and Career Aspirations

Students were also asked to consider the program's impact on their education and career aspirations. In terms of education, the questionnaire asked students how far they wanted to go in school before and after participating in GEMS (see Table 24). When students were asked to think back on how far they wanted to go in school before participating in GEMS, 40% indicated that they had wanted to finish college, and 53% that they had wanted to get more education after college. After GEMS, there was an upward shift in students' education aspirations, with 29% wishing to finish college and 66% wanting to get more education after college.

[26] Cronbach's alpha reliability of 0.916 for these 4 items.

[27] Independent samples t test, $t(1372) = 5.90$, $p < 0.001$

Table 25. Student Education Aspirations (n = 1898-1900)		
	Before GEMS	**After GEMS**
Graduate from high school	4%	2%
Go to a trade or vocational school	0%	0%
Go to college for a little while	3%	2%
Finish college (get a Bachelor's degree)	40%	29%
Get more education after college	53%	66%

Students were asked to reflect on their career aspirations as well, reflecting upon what kind of work they expected to be doing at age 30 before participating in GEMS and after then after participating in GEMS (see Table 26). A substantial portion of responding students expressed interest in STEM-related careers both before and after participating in GEMS. For example, 15% indicated aspiring to a career in engineering before GEMS and 17% after, with another 10% interested in becoming a scientist or researcher before GEMS and 12% after.

Table 26. Student Career Aspirations (n = 1873-2118)		
	Before GEMS	**After GEMS**
Engineer or architect	15%	17%
Work in the medical field (doctor, nurse, lab technician)	16%	15%
Undecided	15%	14%
Scientist or researcher	10%	12%
Other†	9%	9%
Work in computers or technology	4%	5%
Athlete or other work in sports	7%	5%
Military, police, or security	4%	3%
Lawyer	3%	2%
Artist (writer, dancer, painter)	2%	1%
Business person or manager	2%	1%
Teacher	<1%	<1%

† See Appendix B for "Other" responses.

Students were also asked to respond to a questionnaire item regarding the extent to which they expect to use their STEM knowledge, skills, and/or abilities in their work when they are age 30. Table 25 displays student responses to this item. Nearly three-quarters of students (72%) expect to use STEM in their work more than 50% of the time. Only 10% of students expect to use STEM less than 25% of the time in their future work.

Table 27. Students Expecting to use STEM in Their Work at Age 30 (n = 1894)	
	Questionnaire Respondents
Not at all	2%
Less than 25% of the time	8%
26% to 50% of the time	18%
51% to 75% of the time	34%
75% to 100% of the time	38%

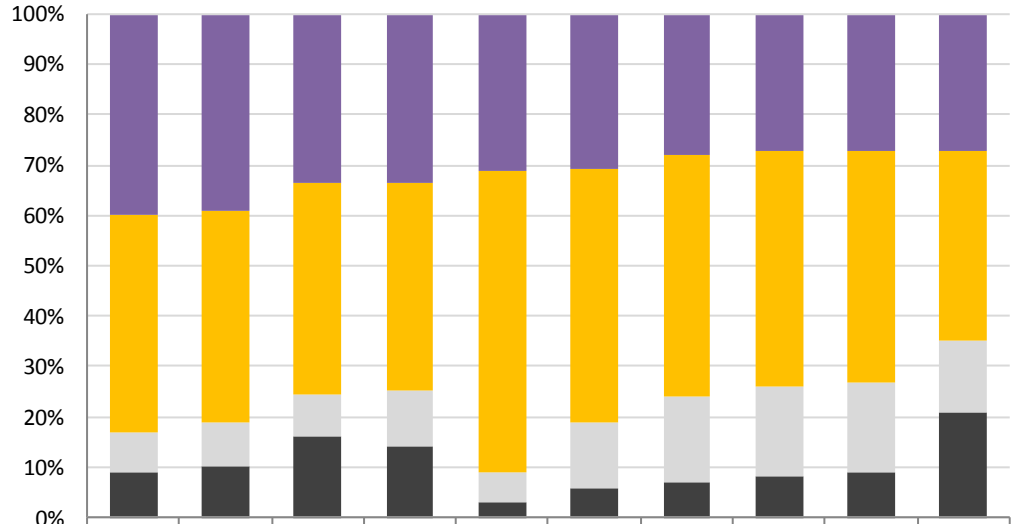
Overall Impact

Finally, students were asked to respond to an item gauging the impacts of participating in GEMS more broadly. These data are displayed in Chart 19 and indicate that GEMS contributed substantially to students' interest in, awareness of, and confidence in a number of STEM-related areas. For example, 91% of students reported that GEMS contributed to their confidence in their STEM knowledge, skills, and abilities. Likewise, a large majority of students reported that GEMS contributed to their interest in participating in STEM activities outside of school requirements (82%), to their awareness of Army or DoD STEM careers (81%), to their interest in taking STEM classes in school (76%), and to their appreciation of Army or DoD STEM research (83%). Mentors responded to a parallel item (see Appendix C) and responded similarly to students although their assessment of student gains in these areas was generally higher than were students'. These items were combined into a composite variable[28] to test for differences among subgroups of students; no significant differences were found by gender. Significant differences by race/ethnicity were found with minority students reporting higher beliefs compared to non-minority students (small effect of d = .118 standard deviations)[29].

[28] The Cronbach's alpha reliability for these 10 items was 0.904.

[29] Two-tailed Independent Samples t-test: $t(1372) = 2.19$, $p = .029$.

Chart 19: Student Opinions of GEMS Impacts (n = 1868-2048)



	I have a greater appreciation of Army or DoD STEM research	I am more aware of Army or DoD STEM research and careers	I am more aware of other AEOPs	I am more interested in participating in other AEOPs	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 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 interested in pursuing a STEM career with the Army or DoD
Agree - GEMS was primary reason	40%	39%	33%	33%	31%	31%	28%	27%	27%	27%
Agree - GEMS contributed	43%	42%	42%	41%	60%	51%	48%	47%	46%	38%
Disagree - happened, but not because of GEMS	8%	9%	8%	11%	6%	13%	17%	18%	18%	14%
Disagree - did not happen	9%	10%	16%	14%	3%	6%	7%	8%	9%	21%

Students also were given the opportunity to respond to an open-ended item on the questionnaire asking them to list the three most important ways they benefited from the program; 186 of the sampled students provided at least one answer to this question. Nearly all respondents indicated that increased knowledge and skills, either in terms of general or specific topic areas, career awareness, or specific abilities (such as lab procedures) were benefits to GEMS. Over half of respondents (62%) indicated that learning generally or about a specific topic area (for example, "gained STEM knowledge" and "helped me learn about environmental science") was a benefit. Nearly half (41%) of students indicated that learning about careers was a benefit. For example:

> *[GEMS] taught me about various career paths I could choose; it showed me how joining the army is an exciting choice.* (GEMS student)

> *[GEMS] helped me to think about what I will do after high school.* (GEMS mentor)

The opportunity to practice teamwork and problem solving skills were also fairly frequently mentioned (15% and 13% of respondents respectively). Additionally, some students cited making friends (15%) and building confidence (10%) as benefits. For instance:

> *When I didn't completely get a concept correct, I had to think of new ideas and really try harder. There was no room for giving up. Also, this program has let me work with my peers and solve problems with more than one head. Not only did things make things more efficient, I got to see things in a different perspective.* (GEMS student)

> *GEMS helped me to learn new ways of thinking when solving problems. For instance, sometimes thinking outside the box can mean to start with simple ideas. GEMS helped me meet with other girls my age who enjoy STEM activities. I learned a lot, but I was having fun while doing it.* (GEMS student)

Some students (13%) also specifically noted that learning about the DoD and about other AEOPs were benefits of the program. Other less frequently mentioned benefits included opportunities to improve communication and the stipend. For example:

> *[GEMS] showed me how you can work for the Army, [and] showed me real people who work for the Army. .* (GEMS student)

> *[GEMS] has made me aware that there are many cool Army and DoD jobs.* (GEMS student)

> *I know a lot more about AEOP STEM camps that sound interesting.* (GEMS student)

Summary of Findings

The FY15 evaluation of GEMS 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 GEMS Evaluation Findings	
Participant Profiles	
GEMS served students from populations historically underrepresented in STEM, although there is room for growth in this area.	In FY15, 45% of enrolled participants were female, indicating that GEMS successfully attracted participation from female students—a population historically underrepresented in engineering fields; this participation rate is comparable to the FY14 female participation rate of 44%. While this rate of female participation is higher than in some other AEOPs (for example JSS, with FY15 female participation of 27%), it still falls short of the approximately 50% rate that would mirror the overall female population.
	Students from historically underrepresented and underserved minority race/ethnicity and low-income groups participated in GEMS. In FY15, 22% of participating students identified themselves as Black or African American, a rate identical to this group's participation in FY14. Participation for students identifying themselves as Hispanic or Latino was 9%, a small increase from the 7% of students identifying with this group in FY14. A small proportion (11% in FY15 versus 12% in FY14) of students continued to report qualifying for free or reduced-price lunch (FRL) – a common indicator of low-income status.
	GEMS served students across a range of school contexts, although no enrolled students identified themselves as attending urban schools, and 81% of participants identified their school setting as suburban.
GEMS attracted more applicants and served more students in FY15 as compared to FY14.	GEMS met and exceeded its FY15 target of receiving 3750 applications (4,161 applications were received in FY15, an increase of 20% over the number of applications in FY14), providing some evidence that the program met its goal of disseminating information about GEMS to a diverse audience. Furthermore, 6% more students were enrolled in FY15 than in FY14.

GEMS increased the number of near-peer mentors in the program but did not attract more resource teachers.	GEMS served the increased population of students with a slight increase in the number of near-peer mentors (NPMs) in the program, although the program failed to meet its FY15 target of 95 NPMs and 55 RTs. In FY15, 94 NPMs participated in GEMS, a 3% increase over FY14 when 92 NPMs participated. The number of RTs remained at 51 for FY15.
Actionable Program Evaluation	
GEMS marketed the program in a number of ways, but there is little evidence of specific outreach efforts to schools and organizations serving groups historically under-represented in STEM.	While ASEE and GEMS sites employed multiple strategies to disseminate information about the GEMS program, there is little evidence of efforts to reach specific groups such as females and other demographic groups historically under-represented in STEM. Outreach efforts included attending the following events: National Summer Learning Conference, 2015 ASEE Annual Conference, and Thomas Jefferson Science and Tech High School. Email blasts were sent to over 4,000 teachers, guidance counselors, and principals in areas near participating GEMS labs, and promotional materials were mailed to teachers upon request.
	Students most frequently learned about the GEMS through personal connections including past participants (28%), family members (27%) and friends (27%). In spite of this, only 3% of students indicated that such personal connections (recommendations from past participants) motivated them to participate once they had learned about the program.
GEMS students reported being motivated to participate by the learning opportunities and fun provided by the program.	Students were most frequently very motivated to participate in GEMS by their interest in STEM (76%), a desire to learn something new and interesting (62%), learning in ways that are not possible in school (30%), and having fun (28%).
GEMS students reported engaging in meaningful STEM learning through team-based and hands-on activities.	Students reported engaging in a number of STEM activities on most days or every day of their GEMS experience. Between 75% and 88% of students reported learning about STEM topics, careers, cutting-edge research, and applications of STEM to real-life situations, communicating with other students about STEM, and interacting with STEM professionals on most days or every day of their GEMS experience.
	Students reported engaging in a variety of STEM practices during their GEMS experience. For example, 94% reported working as part of a team, 92% participating in hands-on activities, and 82% using laboratory procedures and tools on most days or every day.
	Students reported that they had more opportunities to learn about STEM and engage

	in STEM practices in their GEMS experience than they typically have in school.
	Mentors reported using strategies to help make learning activities relevant to students, support the needs of diverse learners, develop students' collaboration and interpersonal skills, and engage students in "authentic" STEM activities.
GEMS informs students about STEM careers in general and, to a lesser extent, about DoD STEM careers specifically.	Nearly all students (98%) reported learning about 1 or more STEM careers during GEMS with 87% reported learning about 3 or more STEM careers. In contrast, 87% of students reported learning about 1 or more DoD STEM career and 62% reported learning about 3 or more. This is a slight increase from FY14 when 84% had heard about at least 1 DoD STEM career and 61% reported hearing about 3 or more of these careers.
	Most responding mentors (86%) reported asking students about their educational and career interests and 90% reported providing guidance about educational pathways that will prepare students for a STEM career. A lesser number, 63%, specifically discussed STEM career opportunities within the DoD or other government agencies.
	Other than simply participating in GEMS, students found their GEMS mentors and invited speakers or career events during GEMS to be the resources most impactful on their awareness of DoD STEM careers. Most students (37%-94%) had not experienced AEOP resources such as the website, brochure, social media, and It Starts Here! magazine.
GEMS has an opportunity to improve student and mentor awareness of other AEOPs.	Mentors reported discussing AEOPs with students although almost half (48%) indicated that they did not discuss specific AEOP initiatives. Besides GEMS and the GEMS Near Peer Mentor program, the most commonly discussed programs were SEAP (66%) and CQL (66%). Fewer than a quarter of mentors discussed any other AEOPs with students, and only 10% discussed UNITE and JSHS, programs for which students are eligible in high school.
	Mentors reported that the most useful resources for exposing students to AEOP were participation in GEMS, program administrators or site coordinators, and invited speakers or career events. A large proportion of mentors had no experience with AEOP on social media (76%) and the It Starts Here! Magazine (91%) although 60% were familiar with the AEOP brochure and 40% found it at least somewhat useful for exposing students to other AEOPs.

Students and mentors value the GEMS experience.	Most students indicated being somewhat or very much satisfied with GEMS program features including the stipend, mentorship, and availability of program topics. Students also offered positive comments about their overall satisfaction with the program, most often describing their learning in GEMS, the personal connections they made with mentors and peers, and having fun.
	Mentors also reported being satisfied with most program features, including stipends, program location, support for instruction and mentorship, and invited speakers and career events.
Outcomes Evaluation	
GEMS students reported positive impacts on their STEM knowledge and competencies.	The vast majority of students reported at least some gains in their STEM knowledge as a result of participating in GEMS. These gains were reported in areas such as knowledge of how scientists and engineers work on real problems in STEM, knowledge of what everyday research work is like in STEM, and in depth knowledge of a STEM topic. These impacts were identified for both males and females and across all races/ethnicities.
	Students also reported impacts on their abilities in a number of STEM practices, including carrying out procedures for an investigation and recording data accurately, communicating about experiments and explanations in different ways, and using knowledge and creativity to propose a testable solution for a problem.
GEMS participants reported gains in students' 21st Century Skills.	Nearly all students reported some level of gains in their 21st Century Skills. For instance, 97% reported gains in their ability to work well with students of all backgrounds, make changes when things do not go as planned, and communicate effectively with others. Likewise, 97% of students reported gains in including others' perspectives when making decisions, and 94% gained in viewing failure as an opportunity to learn.
GEMS participants reported gains in their confidence and identity in STEM, and in their interest in engaging in STEM in the future.	The majority of students (89-96%) reported some gain in areas related to their STEM identity, defined as confidence in one's ability to succeed in STEM. Over half of students reported large or extreme gains in their sense of accomplishing something in STEM (69%), their desire to build relationships with mentors who work in STEM (63%), feeling prepared for more challenging STEM activities (71%), thinking creatively about a STEM project or activity (70%), connecting STEM topics to or fields to their personal values (59%), interest in a new STEM topic (63%), and deciding on a path to pursue a STEM career (51%).

	Students also reported gains in the likelihood that they would engage in STEM activities in the future, both in and outside of school. For example, most students indicated that, as a result of GEMS, they were more likely to participate in a STEM camp, club, or competition, work on a STEM project or experiment in a university or professional setting, tinker with a mechanical or electrical device, and take an elective STEM class.
Students reported higher education aspirations after participating in GEMS, although their career aspirations showed little change.	When students were asked to think back on how far they wanted to go in school before participating in GEMS, 40% indicated that they had wanted to finish college, and 53% that they had wanted to get more education after college. After GEMS, there was an upward shift in students' education aspirations, with 29% wishing to finish college and 66% wanting to get more education after college.
	A substantial portion of responding students expressed interest in STEM-related careers both before and after participating in GEMS. For example, 15% indicated aspiring to a career in engineering before GEMS and 17% after, with another 10% interested in becoming a scientist or researcher before GEMS and 12% after.
Although GEMS students are largely unaware of other AEOP initiatives, students showed some interest in future AEOP opportunities.	In spite of results indicating that most students were unaware of other AEOP initiatives, the majority of students indicated interest in participating in future AEOP programs. For example, approximately 1/3 of students responded that they had some level of interest in participating in JSHS, UNITE, CQL, and the GEMS Near Peer Mentor Program. Most participants (91%) credited GEMS with increasing their interest in participating in other programs.
GEMS participants reported positive opinions of DoD research and DoD researchers and reported increases in their awareness of their interest in pursuing a STEM career with the DoD.	A large majority of students had positive opinions of DoD research and researchers. For example, 81% of students agreed that DoD researchers advance science and engineering fields and that DoD research is valuable to society, and 80% agreed that DoD researchers develop new, cutting edge technologies.
	Most students reported that GEMS contributed to their awareness of DoD STEM research and careers (81%) and a greater appreciation of Army of DoD STEM research (83%). Two-thirds of students indicated that they are more interested in pursuing a STEM career with the Army or DoD after participating in GEMS.

Recommendations

Evaluation findings indicate that FY15 was a successful year overall for the GEMS program. Notable successes for the year include increases in participant applications and enrollment, continued participation by groups traditionally under-represented in STEM fields, and high levels of mentor and student satisfaction with the programs. Both students and

mentors reported gains in students' STEM knowledge and competencies and gains in students' 21st Century Skills as a result of the GEMS experience, and students emerged from the program more aware of Army and DoD STEM careers.

While these successes are commendable, there are some areas that remain with potential for growth and/or improvement. The evaluation team therefore offers the following recommendations for FY16 and beyond:

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

1. GEMS served 2,270 students in FY15, a 6% increase over FY14. This provides some indication that the program attended to evaluator recommendations that existing sites expand their capacity to accommodate more students in order to meet existing needs and interest in communities that are already served by GEMS programs. In spite of this, however, only 55% of applicants were placed in FY15 as compared to 63% in FY15. This disparity is likely due to the 20% increase in program applications from FY14 to FY15, however this indicates continued unmet need in the program. The large number of applications the program receives provides some evidence that the GEMS program could successfully be expanded to accommodate the considerable amount of unmet need and interest that persists with qualified students. Therefore, the FY14 recommendation that more GEMS sites be identified, recruited, and started in a variety of geographic locations to meet the needs and interest in more communities is repeated. Additionally, evaluators continue to recommend that existing sites expand their capacity to accommodate more students in order to meet existing needs and interest in communities that are already served by GEMS programs. The program should consider increasing the number of existing GEMS sites' administrative staff, teaching staff, physical infrastructure, and mentor participation as this is likely the most effective way to increase existing sites' capacities to meet the very large needs and interest of potential GEMS participants.

2. Both GEMS and AEOP objectives include expanding participation of populations historically underrepresented in STEM, however there was little change in these groups' participation from FY14 to FY15 and little evidence that ASEE targeted marketing of GEMS to these groups in FY15. In FY14, the program reported outreach efforts to organizations that serve these underrepresented groups (for example the Society of Women Engineers and the Hispanic Association for Colleges and Universities), however this sort of targeted outreach was not undertaken in FY15. Additionally, it is notable that no students reported attending a school located in an urban area in FY15. Because of the relationship between urban school enrollment and low-income status, forging partnerships with urban schools may result in expanding the participation of this demographic (operationalized as students receiving free-and-reduced price lunch in the evaluation). It is likely that GEMS will need to expand targeted marketing while implementing more aggressive marketing and recruitment practices. The program may wish to particularly consider targeting outreach to low-income and minority-serving schools, educational networks, community organizations, and professional associations that serve these populations. The program and individual GEMS sites may need to consider practical solutions to help more GEMS students travel to sites that are not close in proximity to their homes. For instance, GEMS may

consider offering commuting accommodations (e.g., bus transportation) that make participation more feasible for underrepresented and underserved populations that live further from GEMS sites.

3. Both the FY13 and FY14 evaluation included recommendations to ensure that "connected" applicants (e.g., those with family, family friends, or school-based connections to the site) are not disproportionately selected into the program over other qualified applicants who have no previous association with the GEMS site. Given the large proportions of students who reported learning about GEMS through personal connections, this recommendation is repeated for FY15, and the program is urged to consider strategies to ensure that students without personal connections to sites have access to the GEMS program.

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

1. The GEMS program failed to reach its FY15 target of 55 resource teacher participants in FY15 and fell short of its near-peer mentor goal by one. The program's ability to serve increasing numbers of students is limited by the number of mentors available, and therefore strategies to recruit additional RTs and NPMs and should be considered. It is also noteworthy that nine students (5% of the respondent sample) indicated in an open-ended questionnaire item that they felt having more teachers, mentors, and/or teaching time could improve the program. The number of staff that can be hired is, of course, subject to budgetary constraints, and this should be taken into consideration with any plans for program expansion.
2. Given that students were largely unaware of other AEOPs, yet identified their mentors as a key resource for information about AEOP opportunities, mentors should be provided with more comprehensive information about AEOP initiatives. Many mentors reported having no experience with AEOP resources. The program may therefore wish to incorporate information about other AEOPs into mentor orientation materials.

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

1. In order to create a robust pipeline of AEOP programs in which students progress from other AEOPs into GEMS and beyond, the program may want to consider innovative ways to work with other AEOPs to create a more seamless continuum of programs. Although many students expressed interest in participating in other AEOP programs, a substantial proportion had never heard of AEOP initiatives outside of GEMS. Since students reported that their mentors were key resources for learning about AEOPs, the program may want to work with GEMS sites to ensure that all mentors as well as students have access to structured opportunities that both describe the other AEOPs and provide information to students on how they can apply to them. In addition, since many mentors reported not having experienced most AEOP resources, it may be useful for the program to familiarize mentors with these resources and how these can be used to provide students with more information about other AEOPs.

2. Mentors also play a key role in exposing students to Army and DoD STEM careers. Evaluation data indicate 37% of mentors did not discuss Army or DoD STEM career opportunities with students. It may, therefore, be useful for the program to familiarize mentors with resources available to expose students to DoD STEM careers. While students indicated that invited speakers were a key resource for learning about DoD STEM careers, 27% of mentors indicated that they had not experienced this, and substantial percentages of mentors also indicated that they had not experienced AEOP resources such as the AEOP brochure. The program may, therefore, wish to incorporate these resources into orientation materials for mentors. It may also be useful to familiarize mentors with strategies to increase the likelihood that the program will have a long-term impact on students' decisions to pursue STEM. Examples of these strategies include interactions with role models with similar backgrounds as the students and coaching on the type of 21st Century Skills (for example, communication skills) needed to be successful in STEM careers.

3. The FY15 GEMS participation in the evaluation questionnaire is an area for concern. Response rates for both students and mentors were considerably lower than in FY14, and ongoing low response rates for mentors raise questions about the representativeness of the results. Continued efforts should be undertaken to improve participation in completion of the questionnaire, particularly for mentors. The program may want to consider emphasizing the importance of these evaluations with individual program sites and communicating expectations for evaluation activities. In addition, the evaluation instruments may need to be streamlined as perceived response burden can affect participation.

Appendices

Appendix A

FY15 GEMS Evaluation Plan

Questionnaires

Purpose:
As per the approved FY15 AEOP APP, the external evaluation of GEMS (data collected by VT and analyzed by Purdue University) includes two post-program questionnaires:

1. AEOP Youth Questionnaire to be completed by student participants; and
2. AEOP Mentor Questionnaire to be completed by Army S&Es, near-peer mentors, and/or resource teachers that facilitate, assist, or support students during GEMS educational activities.

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.

The questionnaires were revised in FY 13 and FY14 to align 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., inclusive of implementation and outcomes evaluation, and outcomes of STEM-specific competencies, transferrable competencies, attitudes about/identifying with STEM, future engagement in STEM-related activities, and educational/career pathways);
- Best practices and published assessment tools in STEM education, STEM informal/outreach, and the evaluation/ research communities; and
- AEOP's vision to improve the quality of the data collected, focusing on changes in intended student outcomes and contributions of AEOPs like CQL effecting those changes.

The use of common questionnaires and sets of items that are appropriate across programs will allow for comparisons across AEOP programs and, if administered in successive years, longitudinal studies of students as they advance through pipelines within the AEOP. Because the questionnaires incorporate batteries of items from existing tools that have been validated in published research, external comparisons may also be possible.

All AEOPs are expected to administer the Youth and Mentor questionnaires provided for their program. Both the Youth and Mentor questionnaires have two versions, an "advanced" version (JSHS and apprenticeship programs) or a "basic" version (all other programs). The same basic set of items is used in both, with slightly modified items and/or additional items used in the advanced version. Additionally, the surveys are customized to gather information specific structures, resources, and activities of programs.

Site Visits/Onsite Focus Groups

Purpose:
As per the approved FY15 AEOP APP, the external evaluation of GEMS (data collected by VT and analyzed by Purdue University) includes site visits for 2-3 laboratories with a local GEMS-SEAP-CQL pipeline.

Site visits provide the evaluation team with first-hand opportunities to speak with apprentices and their mentors. We are able to observe the AEOPs in action. The information gleaned from these visits assists in illustrating and more deeply understanding the findings of other data collected (from questionnaires). In total, the evaluation findings are used to highlight program successes and inform program changes so that the AEOPs can be even better in the future.

Evaluation Activities during GEMS Site Visits:

- One 45 minute focus group with 6-8 youth participants (apprentices);
- One 45-minute focus group with 6-8 mentors;
- 30-60 minutes to observe your program (specifically, to see students engaged in program activities, preferably with their mentors); and
- 10-15 minute transitions between each evaluation activity for moving groups in and out and providing evaluators with time to organize paperwork and take nature breaks.

Data Analyses
Quantitative and qualitative data were compiled and analyzed after all data collection concluded. Evaluators summarized quantitative data with descriptive statistics such as numbers of respondents, frequencies and proportions of responses, average response when responses categories are assigned to a 6-point scale (e.g., 1 = "Strongly Disagree" to 6 = "Strongly Agree"), and standard deviations. Emergent coding was used for the qualitative data to identify the most common themes in responses.

Evaluators conducted inferential statistics to study any differences among participant groups (e.g., by gender or race/ethnicity) that could indicate inequities in the GEMS program. Statistical significance indicates whether a result is unlikely to be due to chance alone. Statistical significance was determined with t-tests, chi-square tests, and various non-parametric tests as appropriate, with significance defined at $p < 0.05$. Because statistical significance is sensitive to the number of respondents, it is more difficult to detect significant changes with small numbers of respondents. Practical significance, also known as effect size, indicates the magnitude of an effect, and is typically reported when differences are statistically significant. The formula for effect sizes depends on the type of statistical test used, and is specified, along with generally accepted rules of thumb for interpretation, in the body of the report.

Appendix B

FY15 GEMS Participant Questionnaire Data Summary

GEMS Participant Data Summary

Which GEMS site did you participate in? (select one)

	%	Freq.
ALABAMA – U.S. Army Aeromedical Research Laboratory (USAARL) – Fort Rucker, AL	0.3%	2
ALABAMA – U.S. Army Aviation & Missile Research, Development & Engineering Center (AMRDEC) – Redstone, AL	12.7%	88
ILLINOIS – U.S. Army Engineer Research & Development Center - Construction Engineering Research Laboratory (ERDC-CERL) – Champaign, IL	3.0%	21
MARYLAND – Aberdeen Proving Ground (APG) – Aberdeen, MD	21.6%	150
MARYLAND – U.S. Army Medical Research and Material Command (USAMRMC) – Fort Detrick, MD	1.6%	11
MARYLAND – U.S. Army Medical Research and Materiel Command - Walter Reed Army Institute of Research (WRAIR) – Silver Spring, MD	46.3%	321
MARYLAND – U.S. Army Research Laboratory - Adelphi (ARL-A) – Adelphi, MD	9.8%	68
MASSACHUSETTS – U.S. Army Institute of Environmental Medicine (USARIEM) – Natick, MA	0.1%	1
MISSISSIPPI – U.S. Army Engineer Research & Development Center - Vicksburg (ERDC-MS) – Vicksburg, MS	4.5%	31
NEW MEXICO – White Sands Missile Range (WSMR) – White Sands, NM	0.0%	0
TEXAS – U.S. Army Institute of Surgical Research (USAISR) – San Antonio, TX	0.0%	0
Total	**100%**	**693**

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

	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	6%	8%	28%	32%	26%	2118	**3.66**	1.11
	118	165	597	680	558			
Apply STEM learning to real-life situations	15%	16%	24%	23%	21%	2111	**3.20**	1.14
	189	341	724	574	283			
Learn about new discoveries in STEM	12%	18%	34%	22%	14%	2094	**3.08**	1.19
	250	379	715	460	290			
Learn about different careers that use STEM	9%	16%	34%	27%	13%	2084	**3.00**	1.17
	259	404	767	397	256			
Interact with scientists or engineers	12%	19%	37%	19%	12%	2098	**2.42**	1.31
	638	601	448	168	243			
Communicate with other students about STEM	30%	29%	21%	8%	12%	2103	**3.20**	1.35
	323	331	511	487	451			

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

How often did you do each of the following in GEMS 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	2%	3%	10%	20%	66%	2115	**4.45**	0.91
	34	65	205	415	1396			
Apply STEM learning to real-life situations	3%	6%	16%	25%	50%	2107	**4.14**	1.06
	56	127	335	529	1060			
Learn about new discoveries in STEM	4%	6%	16%	25%	49%	2099	**4.09**	1.10
	75	132	341	522	1029			
Learn about different careers that use STEM	2%	6%	13%	21%	57%	2101	**4.25**	1.04
	48	127	282	446	1198			
Interact with scientists or engineers	4%	7%	14%	21%	54%	2103	**4.14**	1.16
	93	146	287	432	1145			
Communicate with other students about STEM	4%	6%	10%	17%	63%	2105	**4.30**	1.10
	79	123	212	360	1331			

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

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

	Not at all	At least once	A few times	Most days	Every day	n	Avg.	SD
Use laboratory procedures and tools	11%	13%	41%	23%	11%	1919	**3.10**	1.12
	219	251	795	434	220			
Participate in hands-on STEM activities	8%	15%	41%	22%	15%	1918	**3.20**	1.11
	157	282	781	418	280			
Work as part of a team	4%	5%	26%	41%	24%	1914	**3.74**	1.01
	81	100	501	778	454			
Identify questions or problems to investigate	7%	11%	29%	30%	24%	1908	**3.52**	1.16
	128	218	544	569	449			
Design an investigation	21%	23%	33%	14%	9%	1914	**2.68**	1.21
	394	443	630	269	178			
Carry out an investigation	17%	21%	33%	19%	11%	1916	**2.86**	1.22
	330	393	625	358	210			
Analyze data or information	5%	10%	27%	35%	22%	1917	**3.59**	1.10
	104	194	515	674	430			
Draw conclusions from an investigation	10%	14%	31%	29%	15%	1910	**3.25**	1.18
	197	267	595	555	296			
Come up with creative explanations or solutions	8%	14%	30%	30%	19%	1910	**3.39**	1.16
	144	259	575	576	356			

Build or make a computer model	54%	20%	14%	6%	5%	1919	**1.88**	1.18
	1043	380	274	124	98			

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

How often did you do each of the following in GEMS this year?

	Not at all	At least once	A few times	Most days	Every day	n	Avg.	SD
Use laboratory procedures and tools	5%	3%	9%	16%	66%	1919	**4.34**	1.12
	102	67	172	315	1263			
Participate in hands-on STEM activities	1%	2%	5%	12%	80%	1915	**4.67**	0.77
	21	42	98	221	1533			
Work as part of a team	0%	1%	4%	12%	82%	1910	**4.74**	0.63
	8	22	79	232	1569			
Identify questions or problems to investigate	4%	4%	9%	21%	62%	1909	**4.34**	1.04
	69	79	171	407	1183			
Design an investigation	10%	9%	14%	21%	45%	1909	**3.81**	1.37
	199	181	272	398	859			
Carry out an investigation	7%	8%	12%	21%	53%	1906	**4.04**	1.26
	136	144	222	403	1001			
Analyze data or information	4%	6%	11%	20%	59%	1907	**4.25**	1.10
	72	114	202	387	1132			
Draw conclusions from an investigation	6%	7%	12%	21%	54%	1899	**4.10**	1.22
	122	125	221	403	1028			
Come up with creative explanations or solutions	3%	5%	12%	22%	58%	1906	**4.27**	1.05
	59	94	229	411	1113			

Build or make a computer model	46%	13%	10%	8%	23%	1912	**2.50**	1.65
	874	250	191	154	443			

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

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 GEMS:

	Yes - my mentor used this strategy with me	No - my mentor did not use this strategy with me	n
Helped me become aware of STEM in my everyday life	86%	14%	2106
	1815	290	
Helped me understand how I can use STEM to improve my community	72%	28%	2102
	1504	595	
Used a variety of strategies to help me learn	91%	9%	2102
	1916	185	
Gave me extra support when I needed it	93%	7%	2102
	1954	147	
Encouraged me to share ideas with others who have different backgrounds or viewpoints than I do	79%	21%	2103
	1661	441	
Allowed me to work on a team project or activity	98%	2%	2107
	2072	34	
Helped me learn or practice a variety of STEM skills	94%	6%	2104
	1975	128	
Gave me feedback to help me improve in STEM	84%	16%	2101
	1764	336	
Talked to me about the education I need for a STEM career	74%	26%	2097
	1543	553	
Recommended Army Educational Outreach Programs that match my interests	45%	55%	2099
	939	1159	
Discussed STEM careers with the DoD or government	65%	35%	2104
	1367	736	

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 Educational Outreach Program (AEOP) website	51%	4%	13%	16%	16%	1909	**2.43**	1.60
	965	85	240	310	309			
AEOP on Facebook, Twitter, Pinterest or other social media	76%	8%	7%	5%	4%	1906	**1.54**	1.09
	1443	152	136	99	76			
AEOP brochure	64%	7%	11%	10%	8%	1897	**1.90**	1.36
	1219	137	202	185	154			
It Starts Here! Magazine	80%	8%	5%	4%	3%	1897	**1.43**	0.99
	1512	157	91	73	64			
My GEMS mentor(s)	14%	5%	15%	22%	44%	1902	**3.76**	1.42
	274	94	279	417	838			
Invited speakers or "career" events during GEMS	24%	6%	12%	18%	40%	1905	**3.45**	1.61
	452	115	222	351	765			
Participation in GEMS	9%	2%	8%	16%	65%	1908	**4.25**	1.25
	169	47	155	305	1232			

Note. Response scale: 0 = "Did not experience," 1 = "Not at all," 2 = "A little," 3 = "Somewhat," 4 = "Very much."

How much did each of the following resources help you learn about STEM careers in the Army or DoD?

	Did not experience	Not at all	A little	Somewhat	Very much	n	Avg.	SD
Army Educational Outreach Program (AEOP) website	57%	8%	13%	12%	10%	1908	**2.09**	1.44
	1092	159	243	222	192			
AEOP on Facebook, Twitter, Pinterest or other social media	77%	9%	6%	5%	4%	1907	**1.50**	1.05
	1461	168	119	88	71			
AEOP brochure	67%	8%	11%	8%	7%	1898	**1.79**	1.28
	1265	159	202	146	126			
It Starts Here! Magazine	80%	8%	5%	4%	3%	1904	**1.43**	0.98
	1516	161	90	75	62			
My GEMS mentor(s)	16%	6%	16%	23%	39%	1903	**3.63**	1.45
	304	121	300	432	746			
Invited speakers or "career" events during GEMS	24%	5%	11%	16%	44%	1905	**3.51**	1.63
	450	104	214	301	836			
Participation in GEMS	11%	5%	12%	17%	55%	1906	**4.01**	1.35
	204	89	237	333	1043			

Note. Response scale: 0 = "Did not experience," 1 = "Not at all," 2 = "A little," 3 = "Somewhat," 4 = "Very much."

How SATISFIED were you with the following GEMS features?

	Did not experience	Not at all	A little	Somewhat	Very much	n	Avg.	SD
Applying or registering for the program	4%	3%	10%	28%	55%	1916	**4.27**	1.04
	84	50	192	534	1056			
Communicating with your GEMS host site organizers	20%	3%	11%	22%	44%	1900	**3.66**	1.54
	386	57	206	423	828			
The physical location(s) of GEMS activities	2%	3%	9%	23%	62%	1906	**4.39**	0.95
	43	66	176	437	1184			
The variety of STEM topics available to you in GEMS	2%	2%	9%	18%	69%	1907	**4.51**	0.87
	34	38	171	345	1319			
Teaching or mentoring provided during GEMS activities	1%	1%	5%	16%	77%	1906	**4.66**	0.72
	19	23	98	305	1461			
Stipends (payment)	4%	1%	5%	11%	80%	1897	**4.61**	0.92
	71	22	88	206	1510			
Educational materials (e.g., workbooks, online resources, etc.) used during program activities	7%	2%	10%	22%	60%	1913	**4.27**	1.14
	127	33	186	426	1141			
Invited speakers or "career" events	14%	2%	7%	20%	57%	1915	**4.03**	1.42
	274	39	133	379	1090			
Field trips or laboratory tours	32%	3%	7%	14%	44%	1916	**3.35**	1.76
	613	60	129	273	841			

Note. Response scale: 0 = "Did not experience," 1 = "Not at all," 2 = "A little," 3 = "Somewhat," 4 = "Very much."

As a result of your GEMS 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)	2%	5%	25%	41%	27%	2090	**3.86**	0.95
	46	106	521	848	569			
Knowledge of research conducted in a STEM topic or field	3%	7%	22%	38%	30%	2084	**3.86**	1.01
	55	146	465	785	633			
Knowledge of research processes, ethics, and rules for conduct in STEM	4%	9%	24%	34%	29%	2082	**3.74**	1.09
	86	182	510	703	601			
Knowledge of how scientists and engineers work on real problems in STEM	2%	6%	17%	34%	41%	2091	**4.06**	1.00
	45	121	360	702	863			
Knowledge of what everyday research work is like in STEM	3%	7%	18%	33%	38%	2086	**3.95**	1.07
	64	155	383	693	791			

Note. Response scale: 1 = "No gain," 2 = "A little gain," 3 = "Some gain," 4 = "Large gain," 5 = "Extreme gain."

Which category best describes the focus of your student(s) GEMS activities?

	%	Freq.
Science	54%	1145
Technology	28%	588
Engineering	16%	345
Mathematics	2%	33
Total	**100%**	**862**

As a result of your GEMS 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%	10%	30%	0.33	0.23	1135	**3.62**	1.06
	41	116	335	379	264			
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	4%	12%	29%	0.32	0.23	1131	**3.59**	1.08
	44	133	329	366	259			
Making a model of an object or system showing its parts and how they work	9%	12%	22%	0.29	0.27	1131	**3.53**	1.26
	106	135	254	329	307			
Carrying out procedures for an experiment and recording data accurately	2%	8%	22%	0.34	0.34	1130	**3.91**	1.02
	21	93	243	386	387			
Using computer models of objects or systems to test cause and effect relationships	34%	16%	19%	0.16	0.15	1127	**2.63**	1.46
	379	184	212	184	168			
Organizing data in charts or graphs to find patterns and relationships	12%	20%	25%	0.23	0.21	1128	**3.22**	1.30
	130	224	279	257	238			
Considering different interpretations of data when deciding how the data answer a question	6%	14%	28%	0.28	0.23	1123	**3.46**	1.17
	71	162	320	315	255			
Supporting an explanation for an observation with data from experiments	4%	12%	25%	0.32	0.27	1129	**3.65**	1.13
	50	132	283	360	304			
Defending an argument that conveys how an explanation best describes an observation	9%	14%	27%	0.26	0.23	1126	**3.40**	1.24
	105	158	308	293	262			

Integrating information from technical or scientific texts and other media to support your explanation of an observation	12%	14%	27%	0.27	0.2	1131	**3.30**	1.26
	131	160	311	302	227			
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	4%	12%	21%	0.3	0.34	1131	**3.77**	1.15
	45	132	236	339	379			

As a result of your GEMS 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	3%	10%	30%	0.32	0.26	962	**3.67**	1.06
	31	92	286	304	249			
Using knowledge and creativity to propose a testable solution for a problem	4%	9%	25%	0.33	0.29	963	**3.75**	1.08
	37	83	242	319	282			
Making a model of an object or system to show its parts and how they work	6%	9%	23%	0.29	0.32	962	**3.72**	1.18
	60	87	223	281	311			
Carrying out procedures for an experiment and recording data accurately	9%	11%	27%	0.28	0.25	960	**3.49**	1.23
	86	107	259	265	243			
Using computer models of an object or system to investigate cause and effect relationships	23%	12%	21%	0.21	0.23	953	**3.08**	1.47
	218	119	198	203	215			
Considering different interpretations of the data when deciding if a solution works as intended	11%	13%	25%	0.28	0.24	952	**3.42**	1.27
	102	119	238	265	228			

Organizing data in charts or graphs to find patterns and relationships	21%	15%	23%	0.22	0.18	953	**3.01**	1.40
	204	144	220	209	176			
Supporting a solution for a problem with data from experiments	11%	13%	23%	0.3	0.23	951	**3.39**	1.28
	107	126	220	283	215			
Defend an argument that conveys how a solution best meets design criteria	15%	15%	24%	0.24	0.22	948	**3.22**	1.34
	142	143	230	229	204			
Integrating information from technical or scientific texts and other media to support your solution to a problem	16%	16%	21%	0.25	0.22	946	**3.21**	1.38
	151	156	196	233	210			
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations)	6%	11%	23%	0.26	0.33	955	**3.67**	1.22
	61	108	224	251	311			

Note. Response scale: 1 = "No gain," 2 = "A little gain," 3 = "Some gain," 4 = "Large gain," 5 = "Extreme gain."

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

	No gain	A little gain	Some gain	Large gain	Extreme gain	n	Avg.	SD
Sticking with a task until it is finished	4%	8%	23%	32%	34%	1905	**3.82**	1.11
	76	159	430	601	639			
Making changes when things do not go as planned	3%	7%	21%	32%	37%	1903	**3.92**	1.07
	57	141	398	604	703			
Working well with students from all backgrounds	3%	8%	21%	29%	39%	1901	**3.93**	1.09
	57	153	393	554	744			
Including others' perspectives when making decisions	3%	8%	23%	30%	35%	1903	**3.87**	1.07
	52	158	446	580	667			

Communicating effectively with others	3%	7%	22%	32%	37%	1893	**3.91**	1.07
	59	134	407	602	691			
Viewing failure as an opportunity to learn	6%	10%	21%	26%	37%	1900	**3.79**	1.21
	108	195	390	499	708			

Note. Response scale: 1 = “No gain,” 2 = “A little gain,” 3 = “Some gain,” 4 = “Large gain,” 5 = “Extreme gain.”

As a result of your GEMS 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	6%	11%	21%	29%	34%	2077	**3.74**	1.19
	118	221	443	597	698			
Deciding on a path to pursue a STEM career	11%	14%	24%	24%	27%	2070	**3.41**	1.32
	233	296	491	497	553			
Sense of accomplishing something in STEM	4%	8%	19%	32%	37%	2071	**3.90**	1.11
	82	169	396	658	766			
Feeling prepared for more challenging STEM activities	4%	7%	17%	34%	37%	2065	**3.92**	1.11
	90	154	360	696	765			
Thinking creatively about a STEM project or activity	4%	6%	21%	34%	36%	2065	**3.92**	1.07
	75	129	426	692	743			
Desire to build relationships with mentors who work in STEM	6%	10%	22%	28%	35%	2067	**3.75**	1.20
	122	210	450	571	714			
Connecting a STEM topic or field to my personal values	7%	12%	22%	28%	31%	2067	**3.65**	1.23
	147	244	449	578	649			

Note. Response scale: 1 = "No gain," 2 = "A little gain," 3 = "Some gain," 4 = "Large gain," 5 = "Extreme gain."

As a result of your GEMS 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?

	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	6%	5%	47%	27%	15%	2087	**3.41**	0.99
	117	109	976	573	312			
Tinker (play) with a mechanical or electrical device	3%	4%	26%	39%	28%	2074	**3.85**	0.98
	64	84	533	814	579			
Work on solving mathematical or scientific puzzles	3%	5%	38%	33%	22%	2073	**3.66**	0.97
	67	94	778	680	454			
Use a computer to design or program something	5%	5%	33%	31%	26%	2080	**3.68**	1.06
	98	110	691	642	539			
Talk with friends or family about STEM	3%	4%	28%	36%	29%	2080	**3.82**	1.00
	71	79	591	743	596			
Mentor or teach other students about STEM	5%	6%	28%	35%	26%	2080	**3.73**	1.06
	95	117	590	727	551			
Help with a community service project related to STEM	3%	4%	33%	34%	25%	2074	**3.74**	0.99
	71	77	694	708	524			
Participate in a STEM camp, club, or competition	3%	4%	22%	35%	36%	2078	**3.98**	0.99
	58	78	454	737	751			
Take an elective (not required) STEM class	4%	4%	26%	34%	32%	2062	**3.87**	1.03
	73	88	541	691	669			

Work on a STEM project or experiment in a university or professional setting	3%	3%	25%	35%	34%	2080	**3.94**	1.00
	67	64	510	727	712			

Note. Response scale: 1 = “Much less likely,” 2 = “Less likely,” 3 = “About the same before and after,” 4 = “More likely,” 5 = “Much more likely.”

Before you participated in GEMS, how far did you want to go in school?

	%	Freq.
Graduate from high school	4%	71
Go to a trade or vocational school	0%	9
Go to college for a little while	3%	63
Finish college (get a Bachelor's degree)	40%	755
Get more education after college	53%	1000
Total	100%	1898

After you have participated in GEMS, how far do you want to go in school?

	%	Freq.
Graduate from high school	2%	35
Go to a trade or vocational school	0%	6
Go to college for a little while	2%	46
Finish college (get a Bachelor's degree)	29%	556
Get more education after college	66%	1256
Total	100%	1900

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

	%	Freq.
not at all	2%	30
up to 25% of the time	8%	148
up to 50% of the time	18%	341
up to 75% of the time	34%	651
up to 100% of the time	38%	724
Total	**100%**	1894

Before you participated in GEMS, what kind of work did want to do when you are 30 years old? (select one)

	%	Freq.
Undecided	16%	291
Scientist or researcher	10%	180
Work in computers or technology	9%	163
Engineer or architect	15%	283
Work in the medical field (doctor, nurse, lab technician)	15%	273
Teacher	2%	34
Business person or manager	2%	37
Lawyer	4%	66
Military, police, or security	4%	80
Artist (writer, dancer, painter)	3%	48
Skilled craftsperson (carpenter, electrician, machinist)	0%	5
Athlete or other work in sports	7%	132
Other. (specify): †	15%	291
Total	**100%**	1873

† Other = "surgeon," "veterinarian" (n=3) "Astronomer" (n=2), "A singing artist and a music producer," "a professional fisher and hunter," "mechanical engineer," "army engineer," "Forensic Anthropologist," "astrophysicist," "Piano player," "The President," "video game designer," "race car driver," "actress/singer," "chemical engineer or computer scientist," "engineer or doctor or scientist," "Actor," "Vet tech," "pediatrician, lawyer, or CFO," "Biomedical engineer" (n=2), "entrepreneur," "therapist," "Marine Biotechnical," "Polymath," "Mathematician," "preacher," "Oncologist," "Pilot" (n=2) "Mechanical Engineering (Designing Roller Coasters)," "Forensics," "Biomedical engineering or pediatric oncology," "Botanist," "Cybersecurity or Game designer," "Trumpet performance," "musician," "Engineer or Law," "Model or veterinarian," "Graphics designer, "Forex Currency Broker," "beautician," "swag," "FBI agent (investigator)," "artist and engineer," "soccer and basketball player," "veterinary science," "animation (CGI) or business fashion design," "chemist," "Wildlife Biologist, Animal Behaviorist, "Game Development," "Psychiatrist," "animal doctor," "scientist, technology, sports," "coding/video game design" "forensic psychologist," "Pro Soccer Player or Entertainer (actor, dancer, singer, etc.)," "business," "something to do with children," "CEO of private military contracting/aerospace/space exploration/robotics company," "astronaut/astrophysicist," "professor of dramaturgue, forensic anthropology, music anatomy and theory," "Engineer in the Navy," Business person or manager, Lawyer, Artist, Athlete," "Pediatric Oncologist," "Engineer, Work in computers or technology," "chemical engineer," "chef or a business owner, "study of the universe," "anaeseologist," "Vet, Singer, Writer," "clarinetist," "Train Driver," "DEA Agent/Private Investigator," "Accountant," "military doctor," "Entertainment," "Paleontologist," "archeologist," "actress/performing arts," "photographer," "doctor," "performer," "Aerospace Engineer and NASA Astronaut," "Flavor chemistry," "musician," "hydrologist," "mortician," "movie director," "athletic science and game design with athletics," "dentist," "Game programmer," "something related to STEM but undecided about specifics," Teacher or biomedical engineer," "Nascar driver"

After you have participated in GEMS, what kind of work do you want to do when you are 30 years old? (select one)

	%	Freq.
Undecided	15%	282
Scientist or researcher	12%	229
Work in computers or technology	9%	175
Engineer or architect	17%	310
Work in the medical field (doctor, nurse, lab technician)	15%	278
Teacher	1%	24
Business person or manager	1%	25
Lawyer	3%	50
Military, police, or security	5%	90
Artist (writer, dancer, painter)	2%	32
Skilled craftsperson (carpenter, electrician, machinist)	0%	5
Athlete or other work in sports	5%	97
Other, specify: †	14%	264
Total	**100%**	**821**

† Other = "surgeon," "veterinarian," "Astronomer" "A singing artist and a music producer," "chemist," "army engineer," "mechanical engineer," "Food Science," "Forensic Anthropologist," "graphic designer/animator," "astrophysicist," "The President," "video game designer," "race car driver," "actress/singer," "engineer or doctor or scientist," "Actor," "pediatrician, lawyer, or CFO," "Biomedical engineer," "Vet surgeon, psychiatrist," "entrepreneur," "Polymath," "Mathematician," "preacher," "Oncologist," "Pilot" (n=2) "Mechanical Engineering (Designing Roller Coasters)," "engineering or medicine," "Cybersecurity or Game designer," "musician," "Engineer or Law," "Graphics designer, "Forex Currency Broker," "beautician," "FBI agent (investigator)," "artist and engineer," "veterinary science," "animation (CGI) or business fashion design," "chemist," "military doctor," "Wildlife Biologist, Animal Behaviorist, "Game Development," "Psychiatrist," "animal doctor," "scientist, technology, sports," "coding/video game design" "forensic psychologist," "Pro Soccer Player or Entertainer (actor, dancer, singer, etc.)," "something to do with children," "CEO of private military contracting/aerospace/space exploration/robotics company," "astronaut/astrophysicist," "professor of dramaturgue, forensic anthropology, music anatomy and theory," "Engineer in the Navy," Business person or manager, Lawyer, Artist, Athlete," "Pediatric Oncologist," "Engineer, Work in computers or technology," "be a computerist," "exterior fashion designer," "chemical engineer," "chef or a business owner, "study of the universe," "anaeseologist," "Vet, Singer, Writer," "Train Driver," "biomedical engineer," "military doctor," "Entertainment," "Paleontologist," "actress/performing arts," "surgeon," "doctor" (n=2), "performer," "Flavor chemistry," "doctor and play sports," "movie director," "athletic science and game design with athletics," "dentist," "Game programmer," "something related to STEM but undecided about specifics," Teacher or biomedical engineer"

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
Camp Invention	58%	6%	12%	12%	12%	1880	**2.14**	1.51
	1095	106	227	219	233			
eCYBERMISSION	61%	8%	11%	10%	10%	1881	**2.01**	1.43
	1140	157	206	184	194			
Junior Solar Sprint (JSS)	59%	9%	11%	10%	11%	1868	**2.03**	1.43
	1110	168	210	182	198			
Gains in the Education of Mathematics and Science (GEMS)	12%	3%	9%	16%	61%	2026	**4.12**	1.36
	236	58	173	317	1242			
UNITE	64%	5%	10%	10%	10%	1875	**1.95**	1.42
	1205	103	195	191	181			
Junior Science & Humanities Symposium (JSHS)	63%	6%	10%	10%	11%	1878	**2.02**	1.47
	1175	106	194	192	211			
Science & Engineering Apprenticeship Program (SEAP)	49%	4%	10%	13%	24%	1878	**2.59**	1.71
	923	78	182	239	456			
Research & Engineering Apprenticeship Program (REAP)	53%	4%	10%	13%	20%	1874	**2.43**	1.66
	992	79	189	238	376			
High School Apprenticeship Program (HSAP)	55%	5%	10%	12%	19%	1880	**2.35**	1.64
	1033	89	183	223	352			
College Qualified Leaders (CQL)	57%	5%	10%	11%	17%	1879	**2.27**	1.61
	1070	88	184	216	321			
GEMS Near Peer Mentor Program	28%	4%	14%	19%	35%	2019	**3.31**	1.63
	557	86	274	388	714			
Undergraduate Research Apprenticeship Program (URAP)	58%	5%	10%	10%	17%	1863	**2.23**	1.60
	1086	89	184	190	314			
Science Mathematics, and Research for Transformation (SMART) College Scholarship	50%	4%	9%	12%	25%	1881	**2.57**	1.73
	949	68	174	224	466			
National Defense Science & Engineering Graduate (NDSEG) Fellowship	58%	5%	10%	11%	16%	1883	**2.20**	1.58
	1095	102	188	201	297			

Note. Response scale: 0 = “I’ve never heard of this program,” 1 = “Not at all,” 2 = “A little,” 3 = “Somewhat,” 4 = “Very much.

How many jobs/careers in STEM did you learn about during GEMS?

	%	Freq.
None	2%	50
1	2%	48
2	6%	117
3	13%	278
4	13%	261
5 or more	64%	50
Total	**100%**	2081

How many Army or DoD STEM jobs/careers did you learn about during GEMS?

	%	Freq.
None	13%	243
1	9%	163
2	16%	313
3	18%	343
4	12%	235
5 or more	32%	243
Total	**100%**	1902

How much do you agree or disagree with the following statements about DoD researchers and research:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	n	Avg.	SD
DoD researchers advance science and engineering fields	1%	1%	16%	43%	38%	1880	**4.16**	0.83
	25	18	310	806	721			
DoD researchers develop new, cutting edge technologies	1%	1%	17%	39%	41%	1877	**4.18**	0.85
	24	23	327	725	778			
DoD researchers solve real-world problems	1%	1%	15%	36%	47%	1877	**4.27**	0.82
	21	12	284	679	881			
DoD research is valuable to society	1%	1%	17%	33%	48%	1878	**4.25**	0.86
	24	18	315	621	900			

Note. Response scale: 1 = “Strongly Disagree,” 2 = “Disagree,” 3 = “Neither Agree nor Disagree,” 4 = “Agree,” 5 = “Strongly Agree.”

Which of the following statements describe you AFTER participating in the GEMS program?

	Disagree - This did not happen	Disagree - This happened but not because of GEMS	Agree - GEMS contributed	Agree - GEMS was primary reason	n	Avg.	SD
I am more confident in my STEM knowledge, skills, and abilities	3%	6%	60%	31%	2048	**3.20**	0.66
	53	126	1227	642			
I am more interested in participating in STEM activities outside of school requirements	6%	13%	51%	31%	2041	**3.06**	0.82
	123	259	1035	624			
I am more aware of other AEOPs	16%	8%	42%	33%	1868	**2.92**	1.03
	306	158	782	622			
I am more interested in participating in other AEOPs	14%	11%	41%	33%	1868	**2.94**	1.01
	270	203	772	623			
I am more interested in taking STEM classes in school	7%	17%	48%	28%	2035	**2.98**	0.85
	142	336	978	579			
I am more interested in earning a STEM degree	8%	18%	47%	27%	2033	**2.93**	0.88
	169	356	951	557			
I am more interested in pursuing a career in STEM	9%	18%	46%	27%	2033	**2.92**	0.89
	174	368	945	546			
I am more aware of Army or DoD STEM research and careers	10%	9%	42%	39%	1868	**3.10**	0.93
	188	164	789	727			
I have a greater appreciation of Army or DoD STEM research	9%	8%	43%	40%	1871	**3.15**	0.90
	163	151	804	753			

I am more interested in pursuing a STEM career with the Army or DoD	21%	14%	38%	27%	1871	**2.71**	1.08
	394	262	708	507			

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

Appendix C

FY15 GEMS Mentor Questionnaire Data Summary

GEMS Mentor Data Summary

Which of the following BEST describes the organization you work for? (select ONE)

	%	Freq.
No organization	3.3%	1
School or district (K-12)	36.7%	11
State educational agency	0.0%	0
Institution of higher education (vocational school, junior college, college, or university)	10.0%	3
Private Industry	3.3%	1
Department of Defense or other government agency	43.3%	13
Non-profit	0.0%	0
Other, (specify) †	3.3%	1
Total	**100%**	**30**

† Other = "retired scientist"

Which of the following BEST describes your current occupation (select ONE)

	%	Freq.
Teacher	33.3%	10
Other school staff	10.0%	3
University educator	0.0%	0
Scientist, Engineer, or Mathematician in training (undergraduate or graduate student, etc.)	30.0%	9
Scientist, Engineer, or Mathematics professional	13.3%	4
Other, (specify): †	13.3%	4
Total	**100%**	**30**

† Other = "retired scientist," "camp counselor," "Near Peer Mentor," "Administrator"

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

	%	Freq.
Upper elementary	8.3%	1
Middle school	66.7%	8
High school	50.0%	6
Total	**100%**	**15**

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

	%	Freq.
Upper elementary	8.3%	1
Physical science (physics, chemistry, astronomy, materials science, etc.)	25.0%	3
Biological science	33.3%	4
Earth, atmospheric, or oceanic science	33.3%	4
Environmental science	41.7%	5
Computer science	8.3%	1
Technology	8.3%	1
Engineering	25.0%	3
Mathematics or statistics	16.7%	2
Medical, health, or behavioral science	8.3%	1
Social Science (psychology, sociology, anthropology)	0.0%	0
Other, (specify): †	25.0%	3
Total	**100%**	**28**

† Other = "college student," "Project Lead the Way," "English"

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

	%	Freq.
Physical science (physics, chemistry, astronomy, materials science, etc.)	16.7%	5
Biological science	10.0%	3
Earth, atmospheric, or oceanic science	3.3%	1
Environmental science	3.3%	1
Computer science	6.7%	2
Technology	0.0%	0
Engineering	23.3%	7
Mathematics or statistics	6.7%	2
Medical, health, or behavioral science	3.3%	1
Social Science (psychology, sociology, anthropology)	0.0%	0
Other, (specify): †	26.7%	8
Total	**100%**	**30**

†Other = "STEM," "none," "STEM education"

Which GEMS site did you participate in? (select one)

	%	Freq.
ALABAMA – U.S. Army Aeromedical Research Laboratory (USAARL) – Fort Rucker, AL	0.0%	0
ALABAMA – U.S. Army Aviation & Missile Research, Development & Engineering Center (AMRDEC) – Redstone, AL	0.0%	0
ILLINOIS – U.S. Army Engineer Research & Development Center - Construction Engineering Research Laboratory (ERDC-CERL) – Champaign, IL	14.3%	4
MARYLAND – Aberdeen Proving Ground (APG) – Aberdeen, MD	35.7%	10
MARYLAND – U.S. Army Medical Research and Materiel Command (USAMRMC) – Fort Detrick, MD	10.7%	3
MARYLAND – U.S. Army Medical Research and Materiel Command - Walter Reed Army Institute of Research (WRAIR) – Silver Spring, MD	10.7%	3
MARYLAND – U.S. Army Research Laboratory - Adelphi (ARL-A) – Adelphi, MD	14.3%	4
MASSACHUSETTS – U.S. Army Institute of Environmental Medicine (USARIEM) – Natick, MA	0.0%	0
MISSISSIPPI – U.S. Army Engineer Research & Development Center - Vicksburg (ERDC-MS) – Vicksburg, MS	7.1%	2
NEW MEXICO – White Sands Missile Range (WSMR) – White Sands, NM	7.1%	2
TEXAS – U.S. Army Institute of Surgical Research (USAISR) – San Antonio, TX	0.0%	0
Total	**100%**	**28**

Which of the following BEST describes your role during GEMS?

	%	Freq.
Instructor (typically a University or Army Scientist or Engineer)	10.0%	3
Classroom Assistant	6.7%	2
Resource Teacher	36.7%	11
Near Peer mentor	33.3%	10
Assistant Near Peer mentor	3.3%	1
Other, (specify): ‡	10.0%	3
Total	**100%**	**30**

‡ Other = "GEMS teacher for group of students," "Program Director," "GEMS Coordinator"

How SATISFIED were you with the following GEMS features?

	Did not experience	Not at all	A little	Somewhat	Very much	n	Avg.	SD
Application or registration process	6.7%	6.7%	13.3%	26.7%	46.7%	30	**4.00**	1.23
	2	2	4	8	14			
Communicating with American Society For Engineering Education (ASEE)	56.7%	0.0%	6.7%	13.3%	23.3%	30	**2.47**	1.78
	17	0	2	4	7			
Communicating with GEMS organizers / site coordinators	6.7%	3.3%	10.0%	10.0%	70.0%	30	**4.33**	1.21
	2	1	3	3	21			
The physical location(s) of GEMS's activities	0.0%	6.7%	13.3%	10.0%	70.0%	30	**4.43**	0.97
	0	2	4	3	21			
Support for instruction or mentorship during program activities	0.0%	10.0%	6.7%	16.7%	66.7%	30	**4.40**	1.00
	0	3	2	5	20			
Stipends (payment)	0.0%	6.9%	6.9%	13.8%	72.4%	29	**4.52**	0.91
	0	2	2	4	21			
Invited speakers or "career" events	13.8%	0.0%	3.4%	10.3%	72.4%	29	**4.28**	1.41
	4	0	1	3	21			
Field trips or laboratory tours	26.7%	3.3%	6.7%	10.0%	53.3%	30	**3.60**	1.75
	8	1	2	3	16			

Note. Response scale: 0 = "Did not experience," 1 = "Not at all," 2 = "A little," 3 = "Somewhat," 4 = "Very much."

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 GEMS.

	Yes - I used this strategy	No - I did not use this strategy	n
Become familiar with my student(s) background and interests at the beginning of the GEMS experience	86.2%	13.8%	29
	25	4	
Giving students real-life problems to investigate or solve	83.3%	16.7%	30
	25	5	
Selecting readings or activities that relate to students' backgrounds	36.7%	63.3%	30
	11	19	
Encouraging students to suggest new readings, activities, or projects	70.0%	30.0%	30
	21	9	
Helping students become aware of the role(s) that STEM plays in their everyday lives	96.7%	3.3%	30
	29	1	
Helping students understand how STEM can help them improve their own community	80.0%	20.0%	30
	24	6	
Asking students to relate real-life events or activities to topics covered in GEMS	83.3%	16.7%	30
	25	5	

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 GEMS.

	Yes - I used this strategy	No - I did not use this strategy	n
Identify the different learning styles that my student (s) may have at the beginning of the GEMS experience	75.9%	24.1%	29
	22	7	
Interact with students and other personnel the same way regardless of their background	96.7%	3.3%	30
	29	1	
Use a variety of teaching and/or mentoring activities to meet the needs of all students	96.7%	3.3%	30
	29	1	
Integrating ideas from education literature to teach/mentor students from groups underrepresented in STEM	65.5%	34.5%	29
	19	10	
Providing extra readings, activities, or learning support for students who lack essential background knowledge or skills	40.0%	60.0%	30
	12	18	
Directing students to other individuals or programs for additional support as needed	86.7%	13.3%	30
	26	4	
Highlighting under-representation of women and racial and ethnic minority populations in STEM and/or their contributions in STEM	53.3%	46.7%	30
	16	14	

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 GEMS.

	Yes - I used this strategy	No - I did not use this strategy	n
Teaching (or assigning readings) about specific STEM subject matter	70.0% 21	30.0% 9	30
Having my student(s) search for and review technical research to support their work	43.3% 13	56.7% 17	30
Demonstrating laboratory/field techniques, procedures, and tools for my student(s)	83.3% 25	16.7% 5	30
Supervising my student(s) while they practice STEM research skills	90.0% 27	10.0% 3	30
Providing my student(s) with constructive feedback to improve their STEM competencies	100.0% 30	0.0% 0	30
Allowing students to work independently to improve their self-management abilities	93.1% 27	6.9% 2	29
Encouraging students to learn collaboratively (team projects, team meetings, journal clubs, etc.)	96.7% 29	3.3% 1	30
Encouraging students to seek support from other team members	93.3% 28	6.7% 2	30

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 GEMS.

	Yes - I used this strategy	No - I did not use this strategy	n
Having my student(s) tell other people about their backgrounds and interests	83.3%	16.7%	30
	25	5	
Having my student(s) explain difficult ideas to others	86.7%	13.3%	30
	26	4	
Having my student(s) listen to the ideas of others with an open mind	93.3%	6.7%	30
	28	2	
Having my student(s) exchange ideas with others whose backgrounds or viewpoints are different from their own	93.3%	6.7%	30
	28	2	
Having my student(s) give and receive constructive feedback with others	96.6%	3.4%	29
	28	1	
Having students work on collaborative activities or projects as a member of a team	96.7%	3.3%	30
	29	1	
Allowing my student(s) to resolve conflicts and reach agreement within their team	90.0%	10.0%	30
	27	3	

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 GEMS.

	Yes - I used this strategy	No - I did not use this strategy	n
Asking my student(s) about their educational and/or career goals	86.2% 25	13.8% 4	29
Recommending extracurricular programs that align with students' goals	70.0% 21	30.0% 9	30
Recommending Army Educational Outreach Programs that align with students' goals	73.3% 22	26.7% 8	30
Providing guidance about educational pathways that will prepare my student(s) for a STEM career	90.0% 27	10.0% 3	30
Discussing STEM career opportunities within the DoD or other government agencies	63.3% 19	36.7% 11	30
Discussing STEM career opportunities in private industry or academia	70.0% 21	30.0% 9	30
Discussing the economic, political, ethical, and/or social context of a STEM career	65.5% 19	34.5% 10	29
Recommending student and professional organizations in STEM to my student(s)	80.0% 24	20.0% 6	30
Helping students build a professional network in a STEM field	63.3% 19	36.7% 11	30
Helping my student(s) with their resume, application, personal statement, and/or interview preparations	30.0% 9	70.0% 21	30

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

	Did not experience	Not at all	A little	Somewhat	Very much	n	Avg.	SD
Army Educational Outreach Program (AEOP) website	23.3%	6.7%	16.7%	26.7%	26.7%	30	**3.27**	1.53
	7	2	5	8	8			
AEOP on Facebook, Twitter, Pinterest or other social media	76.7%	3.3%	6.7%	6.7%	6.7%	30	**1.63**	1.27
	23	1	2	2	2			
AEOP brochure	40.0%	3.3%	16.7%	13.3%	26.7%	30	**2.83**	1.70
	12	1	5	4	8			
It Starts Here! Magazine	89.7%	3.4%	3.4%	3.4%	0.0%	29	**1.21**	0.68
	26	1	1	1	0			
GEMS Program administrator or site coordinator	10.0%	3.3%	6.7%	20.0%	60.0%	30	**4.17**	1.32
	3	1	2	6	18			
Invited speakers or "career" events	20.7%	0.0%	3.4%	17.2%	58.6%	29	**3.93**	1.60
	6	0	1	5	17			
Participation in GEMS	6.7%	0.0%	0.0%	10.0%	83.3%	30	**4.63**	1.03
	2	0	0	3	25			

Note. Response scale: 0 = "Did not experience," 1 = "Not at all," 2 = "A little," 3 = "Somewhat," 4 = "Very much."

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

	Did not experience	Not at all	A little	Somewhat	Very much	n	Avg.	SD
Army Educational Outreach Program (AEOP) website	36.7%	6.7%	23.3%	13.3%	20.0%	30	**2.73**	1.57
	11	2	7	4	6			
AEOP on Facebook, Twitter, Pinterest or other social media	79.3%	3.4%	13.8%	0.0%	3.4%	29	**1.45**	0.99
	23	1	4	0	1			
AEOP brochure	55.2%	3.4%	10.3%	13.8%	17.2%	29	**2.34**	1.65
	16	1	3	4	5			
It Starts Here! Magazine	93.1%	3.4%	0.0%	3.4%	0.0%	29	**1.14**	0.58
	27	1	0	1	0			
GEMS Program administrator or site coordinator	10.3%	6.9%	6.9%	27.6%	48.3%	29	**3.97**	1.35
	3	2	2	8	14			
Invited speakers or "career" events	26.7%	0.0%	3.3%	20.0%	50.0%	30	**3.67**	1.71
	8	0	1	6	15			
Participation in GEMS	6.7%	3.3%	3.3%	13.3%	73.3%	30	**4.43**	1.17
	2	1	1	4	22			

Note. Response scale: 0 = "Did not experience," 1 = "Not at all," 2 = "A little," 3 = "Somewhat," 4 = "Very much."

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

	Disagree - This did not happen	Disagree - This happened but not because of JSS	Agree - JSS contributed	Agree - JSS was primary reason	n	Avg.	SD
More confident in STEM knowledge, skills, and abilities	0.0%	3.6%	75.0%	21.4%	28	**3.18**	0.48
	0	1	21	6			
More interested in participating in STEM activities outside of school requirements	0.0%	7.4%	63.0%	29.6%	27	**3.22**	0.58
	0	2	17	8			
More aware of other AEOPs	11.1%	7.4%	66.7%	14.8%	27	**2.85**	0.82
	3	2	18	4			
More interested in participating in other AEOPs	14.8%	7.4%	59.3%	18.5%	27	**2.81**	0.92
	4	2	16	5			
More interested in taking STEM classes in school	0.0%	14.8%	66.7%	18.5%	27	**3.04**	0.59
	0	4	18	5			
More interested in earning a STEM degree	3.7%	11.1%	63.0%	22.2%	27	**3.04**	0.71
	1	3	17	6			
More interested in pursuing a career in STEM	0.0%	7.4%	70.4%	22.2%	27	**3.15**	0.53
	0	2	19	6			
More aware of DoD STEM research and careers	7.4%	3.7%	66.7%	22.2%	27	**3.04**	0.76
	2	1	18	6			
Greater appreciation of DoD STEM research	7.4%	11.1%	55.6%	25.9%	27	**3.00**	0.83
	2	3	15	7			
More interested in pursuing a STEM career with the DoD	7.4%	11.1%	55.6%	25.9%	27	**3.00**	0.83
	2	3	15	7			

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

How much do you agree or disagree with the following statements about DoD researchers and research:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	n	Avg.	SD
DoD researchers advance science and engineering fields	3.3%	0.0%	3.3%	26.7%	66.7%	30	**4.53**	0.86
	1	0	1	8	20			
DoD researchers develop new, cutting edge technologies	3.3%	0.0%	3.3%	20.0%	73.3%	30	**4.60**	0.86
	1	0	1	6	22			
DoD researchers solve real-world problems	3.3%	3.3%	3.3%	16.7%	73.3%	30	**4.53**	0.97
	1	1	1	5	22			
DoD research is valuable to society	3.4%	0.0%	6.9%	20.7%	69.0%	29	**4.52**	0.91
	1	0	2	6	20			

Note. Response scale: 1 = “Strongly Disagree,” 2 = “Disagree,” 3 = “Neither Agree nor Disagree,” 4 = “Agree,” 5 = “Strongly Agree.”

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

	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%	0.0%	16.7%	83.3%	30	**4.83**	0.38
	0	0	0	5	25			
Apply STEM knowledge to real-life situations	0.0%	0.0%	0.0%	31.0%	69.0%	29	**4.69**	0.47
	0	0	0	9	20			
Learn about new discoveries in STEM	6.7%	3.3%	16.7%	30.0%	43.3%	30	**4.00**	1.17
	2	1	5	9	13			
Learn about different careers that use STEM	0.0%	6.7%	10.0%	13.3%	70.0%	30	**4.47**	0.94
	0	2	3	4	21			
Interact with scientists or engineers	0.0%	3.3%	10.0%	10.0%	76.7%	30	**4.60**	0.81
	0	1	3	3	23			
Communicate with other students about STEM	0.0%	0.0%	3.4%	3.4%	93.1%	29	**4.90**	0.41
	0	0	1	1	27			
Use laboratory or field techniques, procedures, and tools	3.3%	3.3%	3.3%	16.7%	73.3%	30	**4.53**	0.97
	1	1	1	5	22			
Participate in hands-on STEM activities	0.0%	0.0%	0.0%	10.0%	90.0%	30	**4.90**	0.31
	0	0	0	3	27			
Work as part of a team	0.0%	0.0%	3.3%	6.7%	90.0%	30	**4.87**	0.43
	0	0	1	2	27			
Identify questions or problems to investigate	0.0%	0.0%	13.3%	13.3%	73.3%	30	**4.60**	0.72
	0	0	4	4	22			
Design an investigation	13.3%	16.7%	10.0%	26.7%	33.3%	30	**3.50**	1.46
	4	5	3	8	10			
Carry out an investigation	6.7%	16.7%	6.7%	20.0%	50.0%	30	**3.90**	1.37
	2	5	2	6	15			
Analyze data or information	3.3%	3.3%	16.7%	16.7%	60.0%	30	**4.27**	1.08
	1	1	5	5	18			
Draw conclusions from an investigation	10.0%	6.7%	6.7%	20.0%	56.7%	30	**4.07**	1.36
	3	2	2	6	17			
Come up with creative explanations or solutions	6.7%	0.0%	13.3%	16.7%	63.3%	30	**4.30**	1.15
	2	0	4	5	19			
Build or make a computer model	40.0%	10.0%	16.7%	13.3%	20.0%	30	**2.63**	1.61
	12	3	5	4	6			

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

AS A RESULT OF THEIR GEMS 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%	3.3%	10.0%	56.7%	30.0%	30	**4.13**	0.73
	0	1	3	17	9			
Knowledge of research conducted in a STEM topic or field	3.3%	3.3%	13.3%	50.0%	30.0%	30	**4.00**	0.95
	1	1	4	15	9			
Knowledge of research processes, ethics, and rules for conduct in STEM	3.4%	10.3%	37.9%	20.7%	27.6%	29	**3.59**	1.12
	1	3	11	6	8			
Knowledge of how professionals work on real problems in STEM	0.0%	6.7%	13.3%	30.0%	50.0%	30	**4.23**	0.94
	0	2	4	9	15			
Knowledge of what everyday research work is like in STEM	3.3%	6.7%	13.3%	36.7%	40.0%	30	**4.03**	1.07
	1	2	4	11	12			

Note. Response scale: 1 = "No gain," 2 = "A little gain," 3 = "Some gain," 4 = "Large gain," 5 = "Extreme gain."

Which category best describes the focus of your student(s) GEMS activities?

	%	Freq.
Science	43.3%	13
Technology	20.0%	6
Engineering	36.7%	11
Mathematics	0.0%	0
Total	**100%**	**30**

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

	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	7.7%	0.0%	15.4%	69.2%	7.7%	13	**3.69**	0.95
	1	0	2	9	1			
Using knowledge and creativity to suggest a testable explanation (hypothesis) for an observation	0.0%	7.7%	15.4%	69.2%	7.7%	13	**3.77**	0.73
	0	1	2	9	1			
Making a model of an object or system showing its parts and how they work	0.0%	23.1%	15.4%	30.8%	30.8%	13	**3.69**	1.18
	0	3	2	4	4			
Carrying out procedures for an experiment and recording data accurately	0.0%	0.0%	7.7%	46.2%	46.2%	13	**4.38**	0.65
	0	0	1	6	6			
Using computer models of objects or systems to test cause and effect relationships	38.5%	7.7%	7.7%	23.1%	23.1%	13	**2.85**	1.72
	5	1	1	3	3			
Organizing data in charts or graphs to find patterns and relationships	30.8%	0.0%	23.1%	38.5%	7.7%	13	**2.92**	1.44
	4	0	3	5	1			
Considering different interpretations of data when deciding how the data answer a question	15.4%	0.0%	15.4%	69.2%	0.0%	13	**3.38**	1.12
	2	0	2	9	0			
Supporting an explanation for an observation with data from experiments	15.4%	0.0%	15.4%	46.2%	23.1%	13	**3.62**	1.33
	2	0	2	6	3			
Defending an argument that conveys how an explanation best describes an observation	7.7%	15.4%	15.4%	38.5%	23.1%	13	**3.54**	1.27
	1	2	2	5	3			
Integrating information from technical or scientific texts and other media to support your explanation of an observation	30.8%	0.0%	23.1%	38.5%	7.7%	13	**2.92**	1.44
	4	0	3	5	1			
Communicating about your experiments and explanations in different ways (through talking, writing, graphics, or mathematics)	0.0%	15.4%	15.4%	30.8%	38.5%	13	**3.92**	1.12
	0	2	2	4	5			

Note. Response scale: 1 = "No gain," 2 = "A little gain," 3 = "Some gain," 4 = "Large gain," 5 = "Extreme gain."

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

	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	5.9%	5.9%	23.5%	52.9%	11.8%	17	**3.59**	1.00
	1	1	4	9	2			
Using knowledge and creativity to propose a testable solution for a problem	5.9%	5.9%	23.5%	41.2%	23.5%	17	**3.71**	1.10
	1	1	4	7	4			
Making a model of an object or system to show its parts and how they work	5.9%	17.6%	11.8%	35.3%	29.4%	17	**3.65**	1.27
	1	3	2	6	5			
Carrying out procedures for an experiment and recording data accurately	11.8%	5.9%	11.8%	41.2%	29.4%	17	**3.71**	1.31
	2	1	2	7	5			
Using computer models of an object or system to investigate cause and effect relationships	17.6%	11.8%	23.5%	23.5%	23.5%	17	**3.24**	1.44
	3	2	4	4	4			
Considering different interpretations of the data when deciding if a solution works as intended	11.8%	5.9%	29.4%	29.4%	23.5%	17	**3.47**	1.28
	2	1	5	5	4			
Organizing data in charts or graphs to find patterns and relationships	11.8%	23.5%	23.5%	17.6%	23.5%	17	**3.18**	1.38
	2	4	4	3	4			
Supporting a solution for a problem with data from experiments	11.8%	5.9%	35.3%	29.4%	17.6%	17	**3.35**	1.22
	2	1	6	5	3			
Defend an argument that conveys how a solution best meets design criteria	5.9%	17.6%	17.6%	41.2%	17.6%	17	**3.47**	1.18
	1	3	3	7	3			
Integrating information from technical or scientific texts and other media to support your solution to a problem	23.5%	11.8%	23.5%	29.4%	11.8%	17	**2.94**	1.39
	4	2	4	5	2			
Communicating information about your design experiments and solutions in different ways (through talking, writing, graphics, or math equations)	5.9%	11.8%	29.4%	23.5%	29.4%	17	**3.59**	1.23
	1	2	5	4	5			

Note. Response scale: 1 = "No gain," 2 = "A little gain," 3 = "Some gain," 4 = "Large gain," 5 = "Extreme gain."

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

	No gain	A little gain	Some gain	Large gain	Extreme gain	n	Avg.	SD
Sticking with a task until it is finished	0.0%	3.3%	16.7%	43.3%	36.7%	30	**4.13**	0.82
	0	1	5	13	11			
Making changes when things do not go as planned	0.0%	3.3%	13.3%	26.7%	56.7%	30	**4.37**	0.85
	0	1	4	8	17			
Including others' perspectives when making decisions	0.0%	10.0%	16.7%	36.7%	36.7%	30	**4.00**	0.98
	0	3	5	11	11			
Communicating effectively with others	0.0%	3.4%	20.7%	41.4%	34.5%	29	**4.07**	0.84
	0	1	6	12	10			
Desire to build relationships with professionals in a field	3.3%	20.0%	26.7%	20.0%	30.0%	30	**3.53**	1.22
	1	6	8	6	9			
Connecting a topic or field with their personal values	6.7%	6.7%	23.3%	26.7%	36.7%	30	**3.80**	1.21
	2	2	7	8	11			

Note. Response scale: 1 = "No gain," 2 = "A little gain," 3 = "Some gain," 4 = "Large gain," 5 = "Extreme gain."

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

	Disagree - This did not happen	Disagree - This happened but not because of GEMS	Agree – GEMS contributed	Agree - GEMS was primary reason	n	Avg.	SD
More confident in STEM knowledge, skills, and abilities	0.0%	3.6%	75.0%	21.4%	28	**3.18**	0.48
	0	1	21	6			
More interested in participating in STEM activities outside of school requirements	0.0%	7.4%	63.0%	29.6%	27	**3.22**	0.58
	0	2	17	8			
More aware of other AEOPs	11.1%	7.4%	66.7%	14.8%	27	**2.85**	0.82
	3	2	18	4			
More interested in participating in other AEOPs	14.8%	7.4%	59.3%	18.5%	27	**2.81**	0.92
	4	2	16	5			
More interested in taking STEM classes in school	0.0%	14.8%	66.7%	18.5%	27	**3.04**	0.59
	0	4	18	5			
More interested in earning a STEM degree	3.7%	11.1%	63.0%	22.2%	27	**3.04**	0.71
	1	3	17	6			
More interested in pursuing a career in STEM	0.0%	7.4%	70.4%	22.2%	27	**3.15**	0.53
	0	2	19	6			
More aware of DoD STEM research and careers	7.4%	3.7%	66.7%	22.2%	27	**3.04**	0.76
	2	1	18	6			
Greater appreciation of DoD STEM research	7.4%	11.1%	55.6%	25.9%	27	**3.00**	0.83
	2	3	15	7			
More interested in pursuing a STEM career with the DoD	7.4%	11.1%	55.6%	25.9%	27	**3.00**	0.83
	2	3	15	7			

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

Appendix D

FY15 GEMS Student Focus Group Protocol

2015 Gains in the Education of Mathematics and Science (GEMS) Evaluation Study Student 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 GEMS. In case you have not been in a focus group before, I'd like to give the group 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:

- What is shared in the room stays in the room.
- Only one person speaks at a time.
- If you disagree please do so respectfully.
- It is important for us to hear the positive and negative sides of an issue.
- This is voluntary - you may choose not to answer any question, or stop participating at any time.
- We will be audio recording the session for note-taking purposes only. Audio will be destroyed.
- Do you have any questions before we begin?

Key Questions

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

   The Army Educational Outreach Program (AEOP) is a primary sponsor of GEMS. We do these focus groups 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 GEMS is teaching students about STEM career opportunities in the Army and Department of Defense.**
   - During GEMS, 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 GEMS. You are definitely eligible to participate in some of these programs and we need to know if you learned about them during GEMS.**
   - During GEMS, did you learn about any of the outreach programs that the AEOP sponsors? (REAP, SEAP, CQL, SMART, etc.)
   - How did you learn about them?
   - Do you think that you will try to participate in any of those programs?

4. **Were you happy that you chose to participate in GEMS this year?**
   - What, specifically do you think you got out of participating in GEMS?
   - Were there any other benefits of participating in GEMS?

5. **Do you have any suggestions for improving GEMS 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.**

Appendix E

FY15 GEMS Mentor Focus Group Protocol

2015 Gains in the Education of Mathematics and Science (GEMS) Evaluation Study Adult 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 GEMS. 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:

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

Key Questions:

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

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

2. **We need to understand more about how GEMS is helping students know more about STEM career opportunities in the Department of Defense, especially civilian positions.**
   - Have you seen any efforts by GEMS to educate participants about the Army, DoD, or careers in the DoD?
   - What strategies seem to be the most effective for GEMS students?
   - Do you have any suggestions for helping GEMS 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 GEMS 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., JSHS, JSS, REAP, SEAP, HSAP, etc.)
   - Have you seen any efforts at GEMS 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 GEMS to help engage underserved or underrepresented groups of adults and youth?
   - What strategies seem to work the best? The worst?
   - Any suggestions for helping GEMS reach new populations of adult and youth participants?

5. **What suggestions do you have for improving GEMS?**

6. **Last Chance - Have we missed anything? Tell us anything you want us to know that we didn't ask about.**

Appendix F

FY15 Student Questionnaire

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	Go to end of chapter

6. Which GEMS site did you participate in? (select one)

Select one.

○	ALABAMA – U.S. Army Aeromedical Research Laboratory (USAARL) – Fort Rucker, AL
○	ALABAMA – U.S. Army Aviation & Missile Research, Development & Engineering Center (AMRDEC) – Redstone, AL
○	ILLINOIS – U.S. Army Engineer Research & Development Center - Construction Engineering Research Laboratory (ERDC-CERL) – Champaign, IL
○	MARYLAND – Aberdeen Proving Ground (APG) – Aberdeen, MD
○	MARYLAND – U.S. Army Medical Research and Materiel Command (USAMRMC) – Fort Detrick, MD
○	MARYLAND – U.S. Army Medical Research and Materiel Command - Walter Reed Army Institute of Research (WRAIR) – Silver Spring, MD
○	MARYLAND – U.S. Army Research Laboratory - Adelphi (ARL-A) – Adelphi, MD
○	MASSACHUSETTS – U.S. Army Institute of Environmental Medicine (USARIEM) – Natick, MA
○	MISSISSIPPI – U.S. Army Engineer Research & Development Center - Vicksburg (ERDC-MS) – Vicksburg, MS
○	NEW MEXICO – White Sands Missile Range (WSMR) – White Sands, NM
○	TEXAS – U.S. Army Institute of Surgical Research (USAISR) – San Antonio, TX

7. 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	○	○	○	○	○

8. How often did you do each of the following in GEMS 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	○	○	○	○	○

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*
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	○	○	○	○	○

10. How often did you do each of the following in GEMS 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	○	○	○	○	○

11. 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 GEMS:

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	○	○

12. 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 Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
My GEMS mentor(s)	○	○	○	○	○
Invited speakers or “career” events during GEMS	○	○	○	○	○
Participation in GEMS	○	○	○	○	○

13. 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 Educational Outreach Program (AEOP) website	○	○	○	○	○
AEOP on Facebook, Twitter, Pinterest or other social media	○	○	○	○	○
AEOP brochure	○	○	○	○	○
It Starts Here! Magazine	○	○	○	○	○
My GEMS mentor(s)	○	○	○	○	○
Invited speakers or “career” events during GEMS	○	○	○	○	○
Participation in GEMS	○	○	○	○	○

14. How SATISFIED were you with the following GEMS features?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Applying or registering for the program	○	○	○	○	○
Communicating with your GEMS host site organizers	○	○	○	○	○
The physical location(s) of GEMS activities	○	○	○	○	○
The variety of STEM topics available to you in GEMS	○	○	○	○	○
Teaching or mentoring provided during GEMS activities	○	○	○	○	○
Stipends (payment)	○	○	○	○	○
Educational materials (e.g., workbooks, online resources, etc.) used during program activities	○	○	○	○	○
Invited speakers or “career” events	○	○	○	○	○
Field trips or laboratory tours	○	○	○	○	○

15. As a result of your GEMS 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	○	○	○	○	○

16. Which category best describes the focus of your student(s) GEMS activities?

Select one.

○	Science	(Go to question number 17.)
○	Technology	(Go to question number 18.)
○	Engineering	(Go to question number 18.)
○	Mathematics	(Go to question number 18.)

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

Select one per row.

If answered, go to question number 19.

	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	○	○	○	○	○
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	○	○	○	○	○
Defending an argument that conveys how an explanation best describes an observation	○	○	○	○	○
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)	○	○	○	○	○

18. As a result of your GEMS 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*
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	○	○	○	○	○
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	○	○	○	○	○
Defend an argument that conveys how a solution best meets design criteria	○	○	○	○	○
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)	○	○	○	○	○

19. As a result of your GEMS 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*
Sticking with a task until it is finished	○	○	○	○	○
Making changes when things do not go as planned	○	○	○	○	○
Working well with students from all backgrounds	○	○	○	○	○
Including others' perspectives when making decisions	○	○	○	○	○
Communicating effectively with others	○	○	○	○	○
Viewing failure as an opportunity to learn	○	○	○	○	○

20. As a result of your GEMS 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	○	○	○	○	○
Thinking creatively about a STEM project or activity	○	○	○	○	○
Desire to build relationships with mentors who work in STEM	○	○	○	○	○
Connecting a STEM topic or field to my personal values	○	○	○	○	○

21. As a result of your GEMS 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	○	○	○	○	○

22. Before you participated in GEMS, 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

23. After you have participated in GEMS, 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

24. 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

25. Before you participated in GEMS, what kind of work did want to do when you are 30 years old? (select one)

Select one.

○	Undecided
○	Scientist or researcher
○	Work in computers or technology
○	Engineer or architect
○	Work in the medical field (doctor, nurse, lab technician)
○	Teacher
○	Business person or manager
○	Lawyer
○	Military, police, or security
○	Artist (writer, dancer, painter)
○	Skilled craftsperson (carpenter, electrician, machinist)
○	Athlete or other work in sports
○	Other, (specify)::

26. After you have participated in GEMS, what kind of work do you want to do when you are 30 years old? (select one)

Select one.

○	Undecided
○	Scientist or researcher
○	Work in computers or technology
○	Engineer or architect
○	Work in the medical field (doctor, nurse, lab technician)
○	Teacher
○	Business person or manager
○	Lawyer
○	Military, police, or security
○	Artist (writer, dancer, painter)
○	Skilled craftsperson (carpenter, electrician, machinist)
○	Athlete or other work in sports
○	Other, specify::

27. 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*
Camp Invention	○	○	○	○	○
eCYBERMISSION	○	○	○	○	○
Junior Solar Sprint (JSS)	○	○	○	○	○
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	○	○	○	○	○

28. How many jobs/careers in STEM did you learn about during GEMS?

Select one.

○	None
○	1
○	2
○	3
○	4
○	5 or more

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

Select one.

○	None
○	1
○	2
○	3
○	4
○	5 or more

30. 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	○	○	○	○	○

31. Which of the following statements describe you AFTER participating in the GEMS program?

Select one per row.

	Disagree - This did not happen	*Disagree - This happened but not because of GEMS*	*Agree - GEMS contributed*	*Agree - GEMS 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	○	○	○	○

32. What are the three most important ways that GEMS has helped you?

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

33. What are the three ways that we could make GEMS better?

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

34. Please tell us about your overall satisfaction with your GEMS experience.

Appendix G

FY15 Mentor Questionnaire

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

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.

☐	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)::

14. Which GEMS site did you participate in? (select one)

Select one.

○	ALABAMA – U.S. Army Aeromedical Research Laboratory (USAARL) – Fort Rucker, AL
○	ALABAMA – U.S. Army Aviation & Missile Research, Development & Engineering Center (AMRDEC) – Redstone, AL
○	ILLINOIS – U.S. Army Engineer Research & Development Center - Construction Engineering Research Laboratory (ERDC-CERL) – Champaign, IL
○	MARYLAND – Aberdeen Proving Ground (APG) – Aberdeen, MD
○	MARYLAND – U.S. Army Medical Research and Materiel Command (USAMRMC) – Fort Detrick, MD
○	MARYLAND – U.S. Army Medical Research and Materiel Command - Walter Reed Army Institute of Research (WRAIR) – Silver Spring, MD
○	MARYLAND – U.S. Army Research Laboratory - Adelphi (ARL-A) – Adelphi, MD
○	MASSACHUSETTS – U.S. Army Institute of Environmental Medicine (USARIEM) – Natick, MA
○	MISSISSIPPI – U.S. Army Engineer Research & Development Center - Vicksburg (ERDC-MS) – Vicksburg, MS
○	NEW MEXICO – White Sands Missile Range (WSMR) – White Sands, NM
○	TEXAS – U.S. Army Institute of Surgical Research (USAISR) – San Antonio, TX

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

Select one.

○	Instructor (typically a University or Army Scientist or Engineer)
○	Classroom Assistant
○	Resource Teacher
○	Near Peer mentor
○	Assistant Near Peer mentor
○	Other, (specify)::

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

_____ students.

19. How SATISFIED were you with the following GEMS features?

Select one per row.

	Did not experience	*Not at all*	*A little*	*Somewhat*	*Very much*
Application or registration process	○	○	○	○	○
Communicating with American Society For Engineering Education (ASEE)	○	○	○	○	○
Communicating with GEMS organizers / site coordinators	○	○	○	○	○
The physical location(s) of GEMS's activities	○	○	○	○	○
Support for instruction or mentorship during program activities	○	○	○	○	○
Stipends (payment)	○	○	○	○	○
Invited speakers or "career" events	○	○	○	○	○
Field trips or laboratory tours	○	○	○	○	○

20. 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 GEMS.

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 GEMS 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 GEMS	○	○

21. 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 GEMS.

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 GEMS 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	○	○

22. 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 GEMS.

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	○	○

23. 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 GEMS.

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	○	○

24. 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 GEMS.

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	○	○

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

Select one per row.

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

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

Select one per row.

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

27. Which of the following AEOPs did YOU EXPLICITLY DISCUSS with your student(s) during GEMS? (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	○	○

28. 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	○	○	○	○	○

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

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	○	○	○	○	○

30. AS A RESULT OF THEIR GEMS 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	○	○	○	○	○

31. Which category best describes the focus of your student(s) GEMS activities?

Select one.

○	Science	(Go to question number 32.)
○	Technology	(Go to question number 33.)
○	Engineering	(Go to question number 33.)
○	Mathematics	(Go to question number 33.)

32. AS A RESULT OF THEIR GEMS 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 34.

	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	○	○	○	○	○
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	○	○	○	○	○
Defending an argument that conveys how an explanation best describes an observation	○	○	○	○	○
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)	○	○	○	○	○

33. AS A RESULT OF THEIR GEMS 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	○	○	○	○	○
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	○	○	○	○	○
Defend an argument that conveys how a solution best meets design criteria	○	○	○	○	○
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)	○	○	○	○	○

34. AS A RESULT OF THE GEMS 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*
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	○	○	○	○	○
Desire to build relationships with professionals in a field	○	○	○	○	○
Connecting a topic or field with their personal values	○	○	○	○	○

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

Select one per row.

	Disagree - This did not happen	*Disagree - This happened but not because of JSS*	*Agree - JSS contributed*	*Agree - JSS 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	○	○	○	○

36. What are the three most important strengths of GEMS?	
Strength #1:	
Strength #2:	
Strength #3:	

37. What are the three ways GEMS should be improved for future participants?	
Improvement #1:	
Improvement #2:	
Improvement #3:	

38. Please tell us about your overall satisfaction with your GEMS experience.

Appendix H

ASEE FY15 Evaluation Report Response

No response was received from ASEE regarding the GEMS FY15 Evaluation Report.