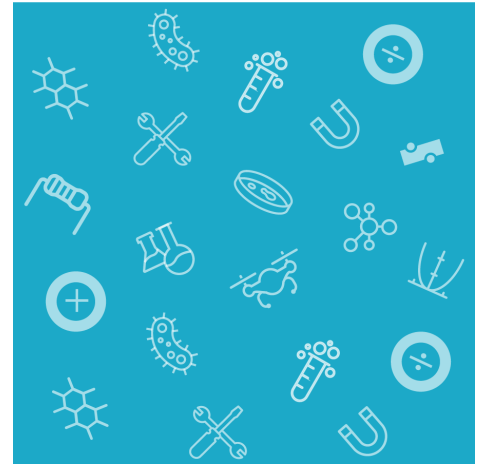


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ARMY EDUCATIONAL OUTREACH PROGRAM

eCYBERMISSION

2019 Annual Program Evaluation Report Executive Summary

July 2020



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2 | Executive Summary

eCYBERMISSION (eCM) is sponsored by the U.S Army and managed by the National Science Teaching Association (NSTA). Since the program's inception in 2002, nearly 200,000 students from across the U.S., U.S. territories, and Department of Defense Educational Activities (DoDEA)'s schools worldwide have participated in eCM. The program is a web-based science, technology, engineering, and mathematics (STEM) competition designed to engage sixth through ninth grade students in real-world problem solving *Mission Challenges* that address local community needs through scientific practices or the engineering design process. eCM teams work collaboratively to research and implement their projects, from inception to prototyping, which are documented and judged through the submission of *Mission Folders* to the eCM website.

This report documents the evaluation of the FY19 eCM 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 eCM included questionnaires for students and Team Advisors; two focus groups with eCM NJ&EE student participants and one with their Team Advisors; observations of the National Judging & Educational Event (NJ&EE), and program information provided by eCM.

A total of 17,944 students entered state competitions in FY19. The top 12 teams from each of the 5 regions advanced to regional competitions for regional judging done via video conference (facilitated by Blackboard Elluminate). The highest score in each region for each grade determined the national finalists. The STEM in Action Grant recipient teams are selected from the regional finalist teams that submit a proposal to implement their solution in their community. Up to 5 STEM in Action Grants are given each year. Twenty-one National Finalist Teams with a total of 75 students along with their Team Advisors competed at NJ&EE in FY19.

2019 eCM Fast Facts	
Description	eCYBERMISSION is a web-based science, technology, engineering, and mathematics (STEM) competition for students in grades 6 through 9 that promotes self-discovery and enables all students to recognize the real-life applications of STEM. Teams of 3 or 4 students are instructed to ask questions (for science) or define problems (for engineering), and then construct explanations (for science) or design

	solutions (for engineering) based on identified problems in their community.
Participant Population	eCYBERMISSION is open to students in grades 6–9.
Number of Registered Applicants	19,483
Number of Registered Participants	17,944
Number/Percentage of U2 Participants	10,511/58.6%
Placement Rate	100%
Registered Teams (complete)	5,097
Students Attending National Event	75
Teams Attending National Event	21
Submission Completion Rate	79.2%
Number of Adults (Team Advisors and Volunteers – incl. S&Es and Teachers)	1,733
Number of Team Advisors (Predominantly math and science teachers)	489
Number Volunteers (Ambassadors, Cyberguides, Virtual Judges)	1,200
Number of Army S&Es	449
Number of Army/DoD Research Laboratories	33
Number of K-12 Teachers (including pre-service teachers)	433
Number of K-12 Schools	444
Number of K-12 Schools – Title I	154
Number of Colleges/Universities	131
Number of HBCU/MSIs	15
Number of DoDEA Students	375
Number of DoDEA Teachers	10
Number of DoDEA Schools	13
Number of Other Collaborating Organizations	0
Total Cost	\$2,954,682
Total Travel	\$499,940
Participant Travel	\$390,597
Total Awards	\$700,297
Student Awards/Stipends	\$694,897
Adult/Teacher/Mentor Awards	\$5,400
Cost Per Student	\$165

Summary of Findings

The FY19 evaluation of eCYBERMISSION included collection of data about participants, their perceptions of program processes, resources, and activities, and indicators of achievement related to AEOP's and eCM's objectives and intended outcomes. A summary of findings is provided in the following table.

2019 eCM Evaluation Findings	
Priority #1: <i>Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industry Base</i>	
Participation in eCM decreased in FY19 as compared to previous years. The demographics of students participating in the NJ&EE are somewhat different than the demographics of students competing at regional levels.	In FY19, eCM regional sites registered 17,944 students, a decrease of 11% compared to the 20,004 students registered in FY18 and 19% compared to FY17 (21,277).
	Overall, over half of students (59%) met the AEOP definition of underserved (U2). As in previous years, both males and females were relatively equally represented at the regional level (49% female and 48% male).
	Less than half (40%) of regional students identified themselves as White, 22% identified themselves as Hispanic or Latino/a, 13% identified themselves as Black or African American, 9% as Asian, and 9% chose not to report their race/ethnicity.
	NJ&EE participants included a smaller percentage (40%) of underserved students than at the regional level (59%). As with regional participants, less than half of NJ&EE participants (40%) were White. Over a third (38%) of NJ&EE participants were Asian (compared to 9% at the regional level). While White and Asian students composed the majority of the NJ&EE population, 7% were Hispanic or Latino/a (compared to 22% at the regional level), and 3% were Black or African American (compared to 13% at the regional level).
Mentors reported that they observed gains in students' 21st Century skills over the course of their eCM participation.	Students whose schools participated in the eCM Mini-Grant experienced significant growth in assessed 21 st Century skills from the beginning (pre-) to the end (post-) of their eCM experiences for all six assessed domains. Participants experienced the greatest gains in growth in the areas of Communication skills and Productivity/Leadership skills. On average, participants' initial ratings were approaching the Progressing level while their post-eCM ratings were at the approaching Demonstrates Mastery level.

<p>eCM student participants reported engaging in STEM practices more frequently in eCM than in their typical school experiences; urban and rural students reported greater engagement with STEM practices than their peers.</p>	<p>Three-quarters or more of NJ&EE and one-third or more of eCM participants reported engaging in all STEM practices at least once during the program. Both eCM and NJ&EE students noted engaging in the following three practices most frequently (weekly or every day): working collaboratively as part of a team (eCM - 60%; NJ&EE - 85%); analyzing data or information and draw conclusions (eCM - 43%; NJ&EE - 66%); and identifying questions or problems to investigate (eCM - 42%; NJ&EE - 54%).</p>
	<p>No significant differences in engagement in STEM practices were found by overall U2 status, however urban and rural students reported significantly greater engagement with STEM practices than students in suburban schools (small effect size).</p>
<p>Most eCM student participants reported gains in their STEM knowledge as a result of participating in eCM, although NJ&EE students were more likely to report large knowledge gains; urban and rural students reported larger gains than their peers.</p>	<p>More than half of overall eCM and all NJ&EE students indicated they experienced some degree of STEM knowledge gain as a result of participating in eCM. Approximately 60% or more of NJ&EE respondents reported large gains across the STEM knowledge items, while only 16%-23% of overall eCM respondents indicated large gains.</p>
	<p>No significant differences in STEM knowledge gains were found by overall U2 status, however urban and rural students reported significantly larger gains compared to suburban students (small effect size)</p>
<p>eCM student participants reported gains in their STEM competencies, although students competing at the NJ&EE were more likely to report large STEM competency gains; urban and rural students reported larger gains than their peers.</p>	<p>Approximately half or more of survey participants reported medium or large gains on all STEM competency items, although NJ&EE students indicated greater gains in STEM competencies as compared to their regional peers across all similar items with a 15%-31% point difference. The two items with the greatest reported gains (60% or more of participants reporting medium to large gains across competition groups) were carrying out an experiment and recording data accurately (eCM - 62%; NJ&EE - 88%) and using knowledge and creativity to suggest a solution to a problem (eCM - 69%; NJ&EE - 84%).</p>
	<p>No differences in STEM competencies were found by overall U2 status, however urban and rural students reported significantly larger gains compared to suburban students (small effect size)</p>
<p>Student participants reported that eCM had positive impacts on their 21st Century skills, although students competing at the NJ&EE were more likely to report large gains.</p>	<p>While nearly half or more of all students reported that eCM impacted their 21st Century skills, in general overall eCM participants reported lower gains (40% to 72% medium/large gains) as compared to NJ&EE participants (87% to 96% medium/large gains).</p>
	<p>No significant differences in 21st Century skills gains were found by U2 status or any of the demographic subgroups associated with U2 status.</p>
<p>Students reported gains in their STEM identities as a result of participating in eCM, although students competing</p>	<p>Over a third of overall eCM participants reported medium or large gains in their STEM identities as a result of participating in eCM. The reported impact of eCM on participants' STEM Identities was more intense for NJ&EE (ranging from 75% to 94% medium/large impact) compared to overall eCM</p>

<p>at the NJ&E were more likely to report large gains.</p>	<p>participants (ranging from 39% to 56% medium/large impact). The three items with the largest difference (40% points or more) in STEM Identity by competition level were a desire to build relationships with mentors who work in STEM (eCM - 43%; NJ&EE - 88%), connecting a STEM topic or field to personal values (eCM - 42%; NJ&EE - 84%), and interest in a new STEM topic (eCM - 42%; NJ&EE - 84%).</p> <p>No significant differences in STEM identity gains were found by U2 status or any of the demographic subgroups associated with U2 status.</p>
<p>Priority #2: <i>Support and empower educators with unique Army research and technology resources</i></p>	
<p>Team Advisors used a range of mentoring strategies with students.</p>	<p>A majority of mentors reported using strategies to establish the relevance of learning activities (86%-95%), support the diverse needs of students as learners (64%-95%), support students' development of collaboration and interpersonal skills (66%-96%), and support students' engagement in authentic STEM activities (79%-98%). Most mentors also used several strategies to support students' STEM educational and career pathways (30%-72%), although less than half of mentors reported using strategies such as discussing STEM career opportunities within the DoD or other government agencies with students (41%) and recommending other AEOPs that align with student goal (34%). The use of strategies related to the DoD and AEOPs represent slight increases as compared to FY18 data.</p>
<p>Very few eCM Team Advisors discussed any AEOP other than eCM with students.</p>	<p>Very few Team Advisors (<1% - 8%) reported discussing specific AEOPs other than eCM (91%) with students during the program. About a quarter (27%) of Team Advisors indicated they discussed AEOP in general with their students.</p>
<p>eCM students reported being satisfied with program features that they had experienced, although students competing at the NJ&E were more likely to report high levels of satisfaction. Students offered various suggestions for program improvement.</p>	<p>Very few NJ&EE participants (4% or fewer) reported being dissatisfied with any feature of eCM about which they were asked, and most had experienced each of the features and were at least somewhat satisfied with each feature they had experienced. Regional students were more likely not to have experienced various program features (7%-52%), and were more likely (9%-12%) to express being "not at all" satisfied with features such as the submission process (12%) and Mission Control response times. (11%-12%). Features that both national and regional participants reported being somewhat or very much satisfied with included applying or registering for the program (eCM - 50%; NJ&EE - 81%), the submission process (eCM - 53%; NJ&EE - 82%), and the eCM website (eCM - 60%; NJ&EE - 82%).</p>

	<p>Regional eCM students' suggestions for improvement included:</p> <ul style="list-style-type: none"> • providing more or different topics or options for projects provide more or better support or resources for student research (for example, extending the times of live chats and improving the contents of the "care package") • improving the website by making it easier to navigate, allowing more than one person at a time to edit the mission folder, autosaving work, and making the submission process more user-friendly provide better or clearer instructions, questions, and/or deadlines • making eCM more interesting or fun • reducing the requirements for the mission folder or requiring less or easier work • allowing more time to complete the mission folder.
	<p>NJ&EE students' suggestions for improvement focused on elements of the NJ&EE, including:</p> <ul style="list-style-type: none"> • providing more free time and/or more time for sleep at the NJ&EE and less sitting time • providing more free time or time for students to socialize • general comments about improvements to the schedule • improvements to the DC trip providing more freedom and/or free time for students • improving the quality and/or choice of food • providing more and/or longer field trips, shorter program days and/or more time to sleep, more time to socialize with other teams • providing more hands-on/interactive activities.
<p>eCM Team Advisors reported being satisfied with program features that they had experienced. Mentors cited strengths of the program and also offered various suggestions for program improvements.</p>	<p>Very few Team Advisors (3% or less) expressed dissatisfaction with any program features. More than half of Team Advisors reported not experiencing CyberGuide live chats, CyberGuides feedback, and CyberGuide discussion forums. Most mentors were at least somewhat satisfied with all program features that they had experienced. More than 80% of eCM Team Advisors reported being somewhat or very much satisfied with the submission process (89%), eCM website (86%), application/registration process (85%), and the variety of STEM Mission Challenges available (82%).</p>
	<p>Team Advisors cited a number of strengths of eCM, including the real-world application of concepts, the opportunity for students to develop research or STEM skills, the usefulness of program resources, and the organization or structure of eCM.</p>
	<p>Team Advisors suggested improvements focused on improving program resources (updating videos, providing examples, improving timing of online chats), improving the Mission Folder (allowing video uploads, providing autosave, permitting multiple students to work within the folder at one time), and revising or clarifying rules or guidelines (clarifying IRB requirements and rubrics, and allowing flexibility in team sizes).</p>

Priority #3:

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

Most eCM students learned about eCM from their teachers.	Few students (1%-7%) learned about eCM from any source other than from their teachers (87%).
Students were primarily externally motivated to participate in eCM by teacher encouragement and academic requirements.	The two most frequently cited motivating factors were teacher encouragement to participate (58%) and academic requirements or school grades (23%).
eCM participants were likely to express interest in participating in eCM again, however the majority of students at the regional level had not heard of other AEOPs.	A large majority of students (93%) competing at the NJ&EE were at least a somewhat interested in competing in eCM again, and 50% of students at the regional level were at least somewhat interested in participating in eCM again in the future.
	Findings suggest that students are exposed to other AEOPs at NJ&EE to a greater extent than at the regional competition level. Most NJ&EE students reported that they had heard of most other AEOPs, and more (34%-69%) were at least somewhat interested in participating in programs in the future than were overall eCM students (12%-22%). As compared with FY18, NJ&EE students' awareness of JSS increased (38% had not heard of it in FY17; 22% in FY18). More than half of overall eCM students reported never having heard of AEOPs other than eCM (54%-63%).
	Adults cited participation in eCM (83%) and the AEOP website (55%) as the most useful resources for exposing students to AEOPs. Approximately half to three-quarters of Team Advisors (48%-75%) reported not experiencing the other resources.
eCM students at all competition levels learned about STEM careers generally, however students competing at the NJ&EE level were much more likely to be familiar with DoD STEM jobs or careers; adults made several suggestions for increasing students' exposure to DoD STEM jobs or careers.	Almost all NJ&EE students (98%) and three-quarters (74%) of regional participants reported hearing about at least one STEM job/career through eCM. However, NJ&EE students reported learning about more DoD jobs/careers than regional participants. Nearly all NJ&EE (98%) and less than half (43%) of regional students indicated learning about one or more DoD STEM job/career. Two-thirds (66%) of NJ&EE students reported learning about 5 or more DoD STEM Jobs/Careers as compared with only 6% of overall eCM students.
	Adults were most likely to rate participation in eCM (74%) and the eCM website (44%) as at least somewhat useful for exposing students to DoD STEM careers. More than half of adults (57%-78%) reported not having experienced the remaining AEOP resources.
	NJ&EE students in focus groups cited activities and speakers at the NJ&EE as sources of information about STEM careers in the Army or DoD.

	Adults' ideas for disseminating career information more widely within eCM included adding DoD STEM career videos to the website resources, providing Skype sessions between students in the classroom and DoD mentors, recording sessions from the national event and providing them to Team Advisors, and providing virtual lab tours via the eCM website.
eCM students expressed positive opinions about DoD research and researchers, although regional students were less likely to have an opinion when asked about these topics.	Nearly all NJ&EE students (97%-99%) and approximately half of eCM students (46%-52%) agreed with various statements about DoD research and researchers.
	Over a third of eCM students (37%-39%) expressed no opinion (selecting the response "neither agree nor disagree") for each item related to DoD research and researchers (compared to 2%-3% for NJ&EE students), suggesting that students competing at only the regional level may have had little exposure to DoD research and researchers during eCM.
Most eCM students competing at the NJ&EE level reported that they were more likely to engage in various STEM activities in the future after participating in eCM; regional students reported substantially less increase in the likelihood of future STEM engagement, and there were significant differences by U2 status and school location.	Overall eCM students' responses about their likelihood of participating in STEM activities in the future were evenly spread across categories with approximately a third falling into each of the following three categories: more/much more likely, about the same before and after, and less/much less likely. For NJ&EE students, on the other hand, approximately half or more (49%-82%) indicated they were more/much more interested after eCM participation. Activities with the greatest discrepancy between eCM and NJ&EE in future interest (more/much more likely) were working on a STEM project or experiment in a university or professional setting (eCM - 31%, NJ&EE - 82%); mentoring or teaching other students about STEM (eCM - 28%, NJ&EE - 75%); and participating in a STEM camp, club, or competition (eCM - 31%, NJ&EE - 77%).
	Students meeting the AEOP definition of U2 and students attending rural and urban schools were significantly more likely to report increases in their likelihood of future STEM engagement than non-U2 students and students attending suburban schools (small effect sizes).
Most eCM students planned to at least complete a bachelor's degree.	Regardless of competition level, large majorities of students (eCM - 84%, NJ&EE - 98%) expected to, at minimum, complete a bachelor's degree. More than half of NJ&EE students (63%) reported aspirations to continue their education after college while fewer than half of regional students (39%) indicated that they intended to pursue post-Baccalaureate education.
eCM had positive impacts for students at all levels of competition, however NJ&EE students were more likely to report impacts; students identified a number of program strengths.	Half or more of all students agreed that eCM impacted them in the following areas: more confidence in STEM knowledge, skills, and abilities (eCM - 62%, NJ&EE - 97%) and more interested in participating in STEM activities outside of school requirements (eCM - 49%, NJ&EE - 88%). Items with the greatest difference between eCM impact by competition level (50% or more) were all related to AEOP and DoD and included having a greater appreciation of Army/DoD STEM research (eCM - 47%, NJ&EE - 97%), having more interest in participating in other AEOPs (eCM - 38%, NJ&EE - 91%), being more aware of other AEOPs (eCM - 43%, NJ&EE - 99%), and being more aware of Army/DoD STEM research and careers (eCM - 43%, NJ&EE - 99%).

	No significant differences in eCM impacts were found by U2 status or any of the demographic subgroups associated with U2 status.
	Both students at the regional and national competition levels cited benefits of participating in eCM. Regional students were most likely to identify teamwork, STEM learning, the opportunity to gain research or STEM skills, and the opportunity to solve real-world problems as benefits. National students were most likely to identify teamwork, STEM learning, career information, Army or DoD information, making friends, improving communication or public speaking skills, gaining confidence, and increasing interest in or motivation for STEM as program benefits.

Recommendations for FY20 Program Improvement/Growth

Evaluation findings indicate that FY19 was another successful year for the eCM program. Over 50% of students participating in eCM were from underserved populations. eCM mini-grant participants demonstrated significant growth in assessed 21st Century skills across the program duration. On multiple outcomes measured in the evaluation, eCM had a greater impact on students from underserved populations. 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 FY20 and beyond:

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

The overall participation in eCM has continued on a downward trend in FY19, dropping to 17,944 students (compared to 21,277 in FY18. This represents a 11% decrease for FY19, and a 19% decrease from the previous year). As in FY18, the evaluation team recommends that eCM employ strategies to reach new participants as well as supports for previous participants to engage again. Through multiple years of participation, it is likely that students will grow their knowledge, skills, and experience with competition programs and this in and of itself may increase their chances of success in the future. Therefore, reaching out to underserved groups of past participants may be a strategy that may help with both of these areas for future growth.

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

eCM is a key program in the AEOP consortium portfolio which enrolls by far the most students of any single program or other programs combined. There is a great opportunity to use eCM as a vehicle for exposing students to the many other opportunities that exist in AEOP and across DoD STEM. However, this is not happening currently in the program, as only NJ&EE students have consistent opportunities to learn about the DoD and Army, as well as other programs, etc. In FY19, less than 10% of Team Advisors

reported discussing specific AEOPs with students other than eCM. Further, less than 50% of mentors discussed DoD or other government agencies with students. It is recommended that eCM make the inclusion of eCM materials regarding DoD and other AEOPs mandatory for Team Advisors to include in their work with students beginning this year.

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

As in FY17 and FY18, eCM students overall continue to report having little knowledge of other programs in the AEOP besides eCM (more than 50%). It is recommended that NSTA develop a coordinated strategy to address this across eCM overall for FY20, and it is also recommended that NSTA work with the consortium to utilize current and develop other additional resources that teachers/Team Advisors can use as tools to communicate with students about future AEOP opportunities and DoD STEM careers overall.