Army Educational Outreach Program

eCYBERMISSION (eCM)

2013 Annual Program Evaluation Report

ARMY EDUCATIONAL OUTREACH PROGRAM

August 2013

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eCYBERMISSION
FORMAL EVALUATION REPORT

Presented to the:

National Science Teachers Association
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DAVID HEIL & ASSOCIATES, INC.

Innovations in Science Learning

Table of Contents

Executive Summary

In 2012-2013, David Heil and Associates, Inc. (DHA), at the request of the National Science Teachers Association, conducted a comprehensive three-part evaluation and efficacy study of the eCYBERMISSION competition for students in grades six through nine.

The eCYBERMISSION online competition invites students to accept "mission challenges" in one of seven areas. Three to four students work together as a team under the guidance of a Team Advisor to identify and propose a solution to a community problem related to their mission challenge, using scientific methods and/or an engineering design process. Since the program's inception in 2002, more than 100,000 students from across the U.S. and U.S. territories, and DoDEA schools worldwide, have participated in the program.

DHA's evaluation assessed the impact of the program on past and current program participants. Specifically, the evaluation addressed questions related to program strengths and challenges, benefits to the participants, and overall effectiveness in meeting short and long-term program goals.

Findings

Part I. Alumni/Past Winner Outcomes

The data show that eCYBERMISSION contributed to, or in some cases was the primary reason for increased learning and engagement in STEM pursuits. The program primarily serves to enhance existing interest in STEM, and to expand awareness of possible areas of study. In addition, approximately half of the respondents credit their eCYBERMISSION experience as a factor in improved grades and performance in school. Nearly half enrolled in more STEM classes in high school than they had originally planned, and nearly 40% enrolled in AP or IB STEM classes (at least in part) due to their eCYBERMISSION experience.

Participation in eCYBERMISSION also impacted interest in pursuing a STEM career for many of the Past Winners. Following eCYBERMISSION participation, nearly 80% of the survey respondents indicated that their interest in pursuing a STEM career increased, and more than half indicated that eCYBERMISSION contributed to or was the primary reason for the increase. Participants noted that the program strengthened their interest in STEM innovations and provided them with professional insights, reinforcing their desire to follow a STEM career path.

Among those respondents who have completed high school, 89% had been accepted to the college or university of their choice, and 44% credited eCYBERMISSION with contributing to, or being the primary reason for, getting into the college or university of their choice. Participation in eCYBERMISSION also contributed to, or was the primary reason for, earning scholarships for college and, for many alumni, actually having the resources for attending college.

Finally, the eCYBERMISSION experience had a relatively low effect on generating interest and participation in other AEOP opportunities, as well as a moderate effect on increased interest in learning more about the Armed Forces and serving in the military.

Part II. Actionable Program Evaluation

Past and current program participants believe that eCYBERMISSION is achieving desired outcomes for students, particularly in terms of building teamwork and fostering innovation. A variety of factors motivate students to participate, and these factors differ for students who reach the national level of the competition and those who participated through a stipend-supported school. The differences in motivation suggest that perhaps eCYBERMISSION should be marketed differently to schools with underserved students who do not have a strong pre-existing interest in STEM.

This evaluation determined that advisors and team members alike underutilize many eCYBERMISSION resources. This is a concern that suggests a need for improving awareness of the resources and defining how they can be utilized. Resources selected by Team Advisors and Past Winners as "most helpful" were those that provide clear communication and timely responses to questions. The eCYBERMISSION website was the resource identified as more helpful than any other, and the reasons included ease of navigation as well as the information and examples that could be found on the site.

While criticism was not as common as praise, the most frequent criticism of eCYBERMISSION resources was that they were difficult to navigate or were not user-friendly. Interface with the website was most frequently mentioned, but several respondents specifically mentioned difficulties in completing the Mission Folder within the constraints of the template. A common theme running through the suggestions for improvement was the need for better communication, particularly in terms of making participants aware of the resources that are available and providing clear criteria and specific guidelines and timelines. There were also some concerns about the clarity and the fairness of judging criteria.

The National Judging & Educational Event (NJ&EE) is viewed positively by Team Advisors and students. Participants agreed that NJ&EE is fun, engaging, motivating, rewarding, exciting and educational. Students used words like "awesome," "amazing," and "uplifting" to describe their experience. Specifically, students were most appreciative of the "Get Up and Speak" workshop, the judging day experience, and the STEM Tech Expo. Team advisors identified several benefits for students, including opportunity for students to recognize what they had accomplished, meeting others from around the country, expanding student horizons, and the exposure to the Tech Expo. Students identified meeting people and making new friends and learning about Army Values and Research conducted by the Military as the main benefits of the NJ&EE. Focus group discussions identified additional benefits, including being inspired to do more, bonding between the teams, and the opportunity to see research in action.

While past participant response to the NJ&EE is overall positive, their ratings of the event show a progressive decline since 2006. The strongest criticisms from past Team Advisors and students

are that the event is too regimented, too restrictive, and the schedule is too full and rushed. The students also want more variety, flexibility, and choice in the educational and recreational activities, presentations, and tour events that are offered. The students and their advisors (particularly those who had attended past events) also believe that the NJ&EE should be held in Washington D.C., rather than in Virginia. Finally, several of the advisors questioned the ethics of inviting a Team Advisor to serve as a judge, suggesting that it provided that team with an unfair advantage.

Part III. Qualitative and Quantitative Data (2012-2013 Competition Year)

The 2012-13 eCYBERMISSION competitors attributed positive changes in attitudes and behaviors to their participation in eCYBERMISSION, for all of the measured outcomes. The outcomes included attitudes toward STEM disciplines, motivation to study STEM disciplines, career aspirations, STEM self-efficacy, 21st Century Skills, and STEM extracurricular activities.

Students who participated in NJ&EE and those who were from stipend-supported schools reported positive changes in STEM attitudes, motivation, self-efficacy and confidence, and interest in STEM careers as a result of participating in eCYBERMISSION. In addition, both groups increased their confidence regarding 21st Century Skills and participation in STEM extra-curricular activities. Overall, the NJ&EE students had higher levels of pre-existing interest, motivation, and behaviors prior to and after participating in eCYBERMISSION in comparison to stipend-supported school students. However, the changes in interest, motivation, and behavior for Stipend School students were equal to or greater than those found for the NJ&EE students.

RECOMMENDATIONS

1. We recommend that the program continue to explore and assess the impact of eCYBERMISSION and NJ&EE each year of the program, modeled on Parts II and III of the current evaluation, so that the effectiveness of ongoing improvements to the program may be assessed. In addition, a comprehensive longitudinal study designed to track cohorts of current and future eCYBERMISSION state and regional winners is needed to provide a rigorous and thorough assessment of the long-term impacts of the program.
2. Based on the positive outcomes for students, including those who did not advance beyond the state level of the competition, we recommend that eCYBERMISSION continue to expand its outreach to underserved schools that typically have not participated.
3. When recruiting teachers at stipend-supported schools, encourage teachers to work with just one or a few teams, rather than an entire class. Teachers who worked with entire classes found that it was not possible to provide quality feedback and guidance to every team.
4. Creative and strategic marketing is needed to increase awareness of the program. The eCYBERMISSION staff should determine avenues to reach still more schools and teachers. NSTA is in a unique position to reach science teachers throughout the U.S.

This is particularly important if the program hopes to reach students who are not already strongly interested in STEM. The same recommendation holds true for interesting eCYBERMISSION participants in other Army Education Outreach Programs.

5. To encourage parents to get involved, publicize the advantages that the program provides to their children—the prize incentives (Savings Bonds for college), an expense-paid trip to Washington, D.C. for national finalists, and the now documented increases in student interest, motivation, self-confidence, and expanded opportunities that result, at least in part, from participation in the program.
6. The website is the "face" of eCYBERMISSION, and as such both markets and represents the program, in addition to providing the means for large numbers of students to compete. An evaluation specific to the eCYBERMISSION website and its component resources should be conducted to assess user-friendliness, ease-of-navigation, ease of submitting materials, and the use of innovative and fresh content.
7. Provide teams with timely and specific feedback, including comments, from the Cyber judges. This may require communicating clear and specific expectations to all the volunteer judges. The teams want and need feedback that will help them better understand the strengths and limitations of their projects and their presentation of materials. Students and advisors also called for a clearer communication of judging criteria.

The National Judging and Education Event (NJ&EE)

8. As the "crown" of the eCYBERMISSION competition, the NJ&EE should be exciting and fun for both the student teams and their team advisors. In addition to the high standards and rigor that NJ&EE provides, participants expect it to be fun and exciting; in essence, a reward for their accomplishments as regional winners. The NJ&EE needs to inject more fun into the experience in order for it to remain one of the key motivating factors of the program.
9. It is recommended that the NJ&EE should be located in Washington D.C., where students, advisors, and parents can take advantage of what for some is a "once in a lifetime" trip, to explore our nation's capitol and its plentiful educational opportunities.
10. The atmosphere at the NJ&EE would benefit from a somewhat less regimented schedule and greater flexibility in how students and advisors are required to spend their time. The program would benefit from lightening up a bit and finding those situations where it is safe to trust the students to adhere to Army Values.
11. Find additional ways to show appreciation to the teachers, parents, and other adults who serve as Team Advisors. They receive intrinsic satisfaction from seeing their students' excitement, growth, and accomplishments, and for some that is enough. However, in many, if not all instances the advisors are making sacrifices to attend the

NJ&EE and would appreciate some free time as well as more time to interact with other advisors.

12. While the Tech Expo content, scheduled activities, guest speakers, and tours are all viewed as excellent, the event could be improved by injecting some new content and choice into the Tech Expo.
13. The overall NJ&EE schedule needs to be expanded or evolve to provide more time for students to interact with students from other teams, to provide more breaks, and more time to explore the stops on the tour of D.C. It is also recommended that travel arrangements be made so that all teams, especially teams who are traveling a great distance, arrive on the same day and that everyone has time to rest, relax, and start to get to know one another before jumping into the NJ&EE program.
14. Notifying the teams that they will be competing in the NJ&EE needs to happen sooner, if possible, in order for teams to complete the necessary paperwork to get approval from their school districts for travel.
15. Perhaps most important, the judging process must not only be fair, but must be *perceived* as fair by all who participate. Allowing a Team Advisor to serve as a judge is inappropriate and raises questions regarding how this may have impacted her own team's performance and ratings. It's a good idea to have one or more teachers serve as judges, but an advisor to one of the teams actively competing at NJ&EE should never participate as a judge.

Introduction

In 2012-2013, David Heil and Associates, Inc. (DHA) conducted a comprehensive three-part evaluation and efficacy study of the eCYBERMISSION competition for students in grades six through nine. Now in its eleventh year, eCYBERMISSION is sponsored by the U.S. Army, and managed by the National Science Teachers Association (NSTA). This online collaborative learning competition is designed to inspire student interest in STEM learning and STEM careers. The eCYBERMISSION logic model provided below presents DHA's summary of the expected outcomes for the program in relation to the program's current activities and deliverables.

eCYBERMISSION Logic Model

Priorities

- Engage students in hands-on "mission challenges" that utilize scientific research and methodologies and/or the engineering design process
- Provide students experience with how STEM principles and practices can contribute to solving community-based problems
- Increase students' interest and engagement in STEM learning as well as their pursuit of future STEM coursework and possible STEM related careers

Inputs	→	Outputs	→	Outcomes	
				Short-term:	**Long-term:**
• Army sponsorship • Program operations managed by NSTA • 10 years of successful program implementation • Competitive teams of 3 to 4 students • Adult Team Advisors • Resources on the eCYBERMISSION website • Volunteer scientists and engineers serve as CyberGuides to students • Volunteer reviewers score online submissions and select state and regional winners • National judges select national winners • Students win savings bonds as prizes at each level of the competition		• More than 100,000 students have participated in the program to date • Students in grades 6-9 compete with mission challenges in 7 areas including alternative sources of energy; the environment, food, health and fitness; force and motion; national security and safety; robotics; and technology • Each student team proposes a solution to a local community problem • Student teams submit mission folders online • Regional winners attend and compete at a National Judging & Education Event (NJ&EE) in Washington, DC		• Increased student interest in STEM learning • Increased student enrollment in STEM courses in secondary school • Improved student STEM grades and test scores in secondary school • Increased student participation in STEM competitions and other extra-curricular STEM activities • Increased student eligibility for STEM related scholarships • Increased student appreciation and understanding of how the Army utilizes STEM • Increased student participation in other Army Educational Outreach Programs (AEOP)	• Increased student interest in taking additional STEM coursework in secondary and post-secondary schooling • Increased student interest in and pursuit of STEM related degrees • Increased student pursuit of STEM related careers • A more STEM literate society

The eCYBERMISSION online competition invites students to accept "mission challenges" in one of seven areas. Three to four students work together as a team under the guidance of a Team Advisor to identify and propose a solution to a community problem related to their mission challenge, using scientific methods and/or an engineering design process. Each team submits a *Mission Folder*, the official write-up of their project, via the eCYBERMISSION website. Volunteers review and score the *Mission Folders* to identify State and Regional level winners for each grade level. Regional winners compete at a National Judging and Educational Event (NJ&EE), held annually in the Washington, DC area. Winners at each level are awarded Savings Bonds.

Since the program's inception in 2002, more than 100,000 students from across the U.S. and U.S. territories, and DoDEA schools worldwide, have participated in the program. During the most recent year of the competition, 3,451 teams of three to four students each submitted *Mission Folders* to eCYBERMISSION. DHA's evaluation assessed the impact of the program on past and current program participants. Specifically, the evaluation addressed questions related to program strengths and challenges, benefits to the participants, and overall effectiveness in meeting short and long-term program goals. DHA collected feedback from past and current student participants, team advisors, and parents to document the program's impact on students' attitudes, behaviors, STEM coursework, interest in military research options, and career interests and choices. In addition, improvement and sustainability of the eCYBERMISSION competition were addressed.

Part I: Alumni/Past Winner Outcome Evaluation

Past Project Years

The eCYBERMISSION online competition has been providing students with opportunities to engage in exciting and meaningful hands-on scientific research and/or engineering design challenges since 2002. Anecdotal evidence and individual-year data from eCYBERMISSION's National Judging and Educational Event (NJ&EE) suggests that the program has been successful in promoting student interest and engagement in STEM. However, prior to this evaluation, there had not been a systematic study to assess the overall impacts of the program. Part I of the study: the *Alumni/Past Winner Outcome Evaluation* addressed the program's success in meeting short and long-term goals of the program by documenting outcomes for past winners from the past 10 years of the competition.

Key Evaluation Questions

The following questions provided the framework for Part I of the study.

Did program participation:

- Increase student interest and engagement in STEM learning at the secondary education level?
- Increase student interest in pursuing a STEM career?

- Increase student pursuit of college level STEM studies?
- Increase student achievement in STEM disciplines?
- Increase student engagement in a STEM related career?
- Specifically, to what extent did each of the following increase as a result of participating in the eCYBERMISSION Competition?
    - Enrollment in STEM classes throughout high school
    - Enrollment in AP STEM classes
    - Increases in overall grade point average, and specifically STEM courses, in the competition year and subsequent years
    - Scoring well on the PSAT, SAT, MCAT, LSAT, and/or GRE exams
    - Participation in additional Army Educational Outreach Programs
    - Participation in other STEM related competitions, enrichment activities
    - Application and acceptance to the college or university of choice
    - Scholarships received, especially in STEM related courses of study
    - Pursuit and achievement of post secondary STEM studies, degrees earned
    - Pursuit and achievement of STEM related careers

Methodologies & Instruments

A list of nearly 4,000 previous state, regional, and national winners and a list of over 1,400 past team advisors were compiled based upon information archived by the U.S. Army, and their previous program contractors Booz Allen Hamilton and DHA, Inc. Due to the age of the program, some of the contact information was no longer current and/or was redundant, particularly for some multiple-year winners and team advisors. To update the contact information, DHA mailed postcards to 3,980 past winners (or their parents, if under the age of 18) and 1,434 team advisors, inviting them to link to a URL to provide up-to-date contact information using the registration/consent form. In response, 376 past winners or their parents completed an online registration/consent form. Ninety-eight percent of those who responded agreed to participate or to allow their child to participate in the survey, and provided a current email address. Twenty-three advisors also completed an online registration/consent form. Contact information was brought up-to date, resulting in a list of 2,772 past winners and 1,835 advisors. It should be noted that even with the updated information, it is probable that many of these addresses are no longer current or that multiple addresses existed for some potential respondents. It is also notable that in addition to providing updated contact information, a few parents took the added step of contacting DHA to offer anecdotal information regarding how important eCYBERMISSION had been in their child's life.

DHA emailed the links to the online surveys to 2,772 students and/or parents and 1,835 team advisors, inviting them to complete the survey. The survey links were first sent on 05/06/13, and again on 05/13/13 and 05/23/13. Because participation was voluntary, an incentive was

provided. Respondents who agreed to complete the survey were entered into a drawing to win an iPad. Consent forms providing information on the study were built into the surveys, and respondents gave their informed consent prior to completing the survey. Respondents were assigned an identification number for data tracking purposes and their names were removed from the database to maintain confidentiality and protect their anonymity. Data were self-reported and not sourced from district, school, or university records.

Survey questions addressed program impacts and outcomes as described in the evaluation questions listed above. The questions were designed to correlate with other data gathering instruments described in Part II and Part III of the study to ensure that a unified and articulated story emerged from the multiple studies undertaken.

Study Sample

Past Winner Sample. Of the 2,772 emailed survey links, 572 individuals opened the link to the survey. Of these, 466 or 17% actually completed the survey.

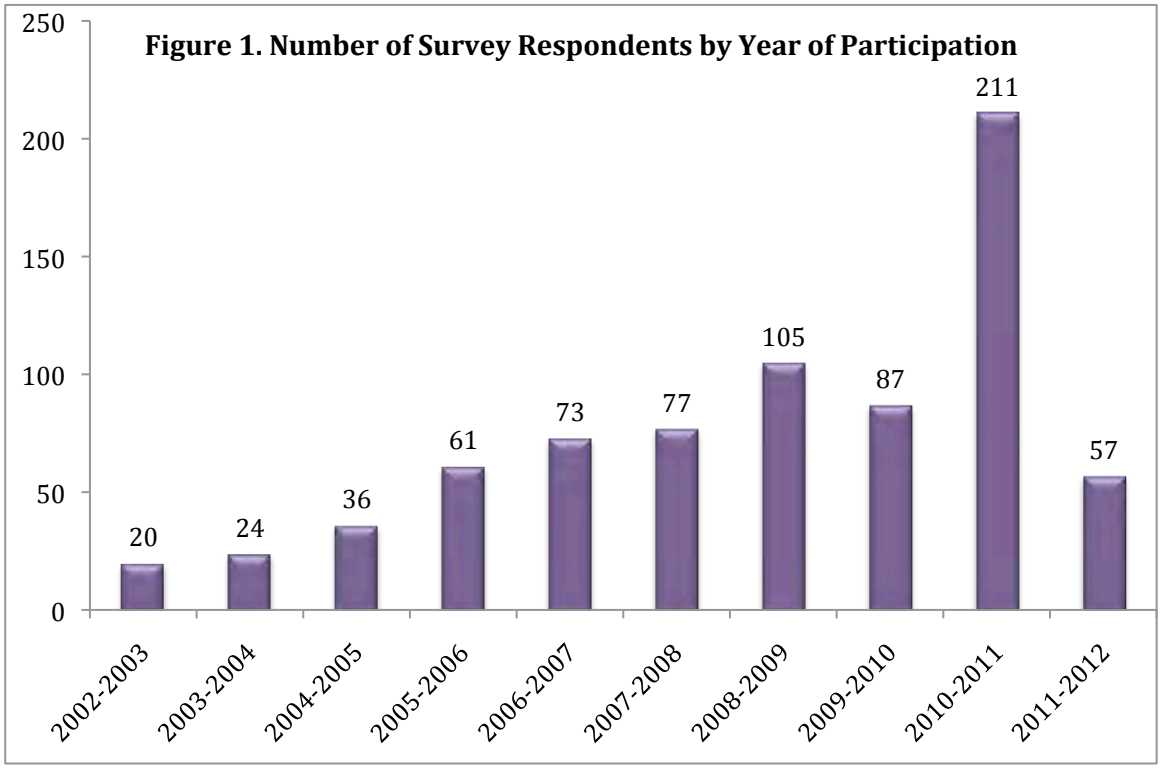
Many of the respondents had participated multiple times in eCYBERMISSION. More females (62%) than males (38%) responded to the survey. Of the 453 former winners who responded to the question, 75.7% attended or had attended U.S. based public schools and 19.6% attended or had attended U.S. based private schools. The remaining 6.8% attended DoDEA schools, charter schools, or were home schooled. In terms of race or ethnicity, the respondents were predominantly Caucasian. (See Table 1.)

Table 1. Race or Ethnicity of Survey Respondents.

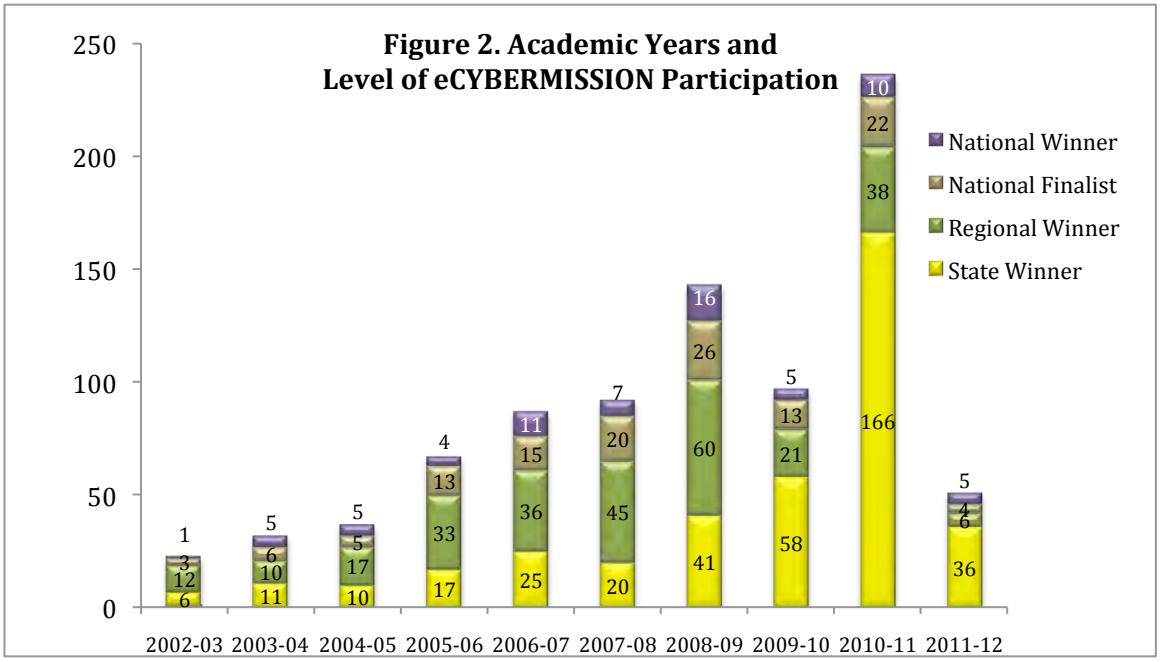
Race and/or Ethnicity		
Answer Options	**Response Percent**	**Response Count**
African American	2.7%	12
Caucasian	67.4%	304
Asian American	18.6%	84
Hispanic/Latino	4.4%	20
Multi-Racial	3.8%	17
Other	3.1%	14
	answered question	**451**

Overall, the survey sample appears to be representative of eCYBERMISSION winners in general, with the exception of gender. There are more male winners than female winners, but more females than males responded to the survey. While survey respondents over the past five years of the competition outnumber those from the first five years, t-test analyses revealed that the two groups did not differ significantly on any of the variables of interest.

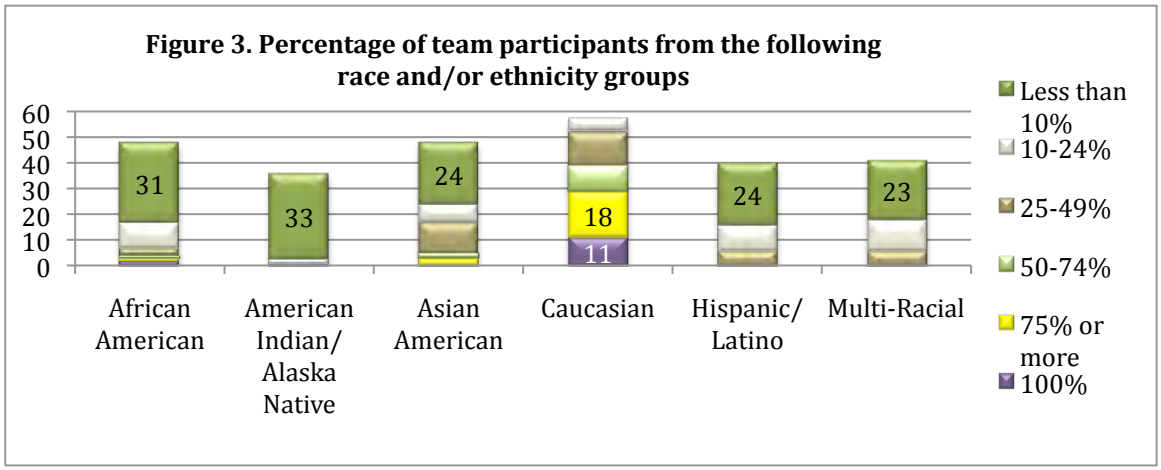
The number of respondents who participated at each level in each year of the competition are presented in Figure 1. The general trend was that the number of respondents increased with successive past years of the competition (with the exception of 2009-10 and 2011-12), so that 274 of 466 or 59% of past winners who completed the survey were under the age of 18. The increasing number of respondents for successive years of the survey reflects increasing availability and accuracy of participant contact information, and perhaps greater interest in responding to the survey when the eCYBERMISSION experience was still "fresh."



The past winners were asked to indicate all of the levels at which they had competed and won in the competition. Figure 2 illustrates the number of winners at each level for each year of the competition. In 2009-10, 2010-11, and 2011-12, state winners were predominant, but for the other years of the competition, regional winners were the principal group responding to the survey.

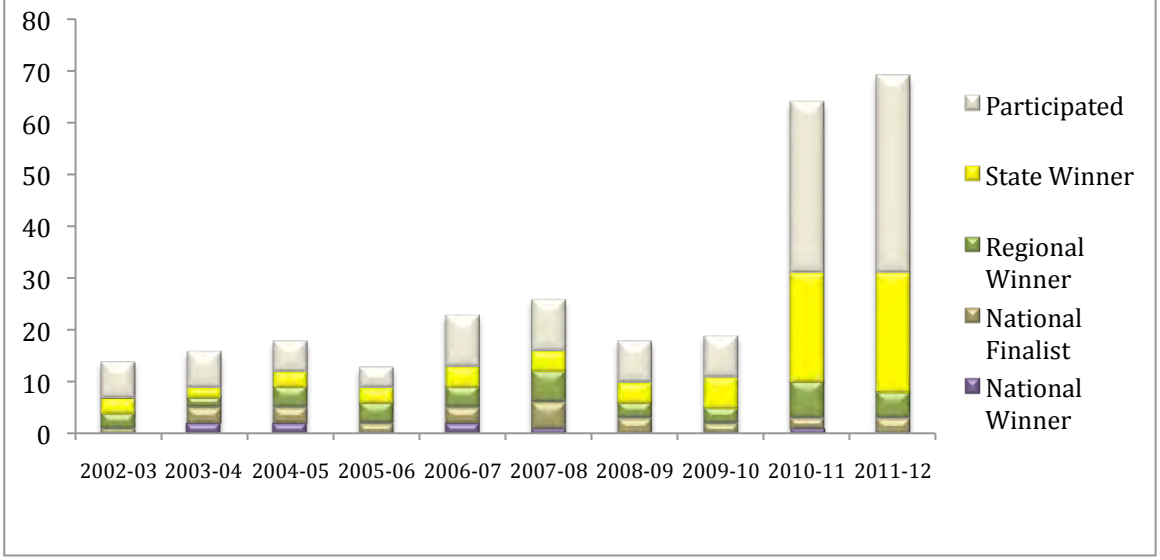


Team Advisors Sample. Seventy-six Team Advisors consented to complete the online survey. The majority of the respondents were female (67.6%), and taught at the middle school level (82.1%) in U.S. based public schools (68.1%). Another 10.1% taught in private schools, 7.2% were home schoolers, and 8.7% taught in a Department of Defense Educational Activity (DoDEA) school. Another 10.1% did not teach, but were parent team advisors or worked with students in another capacity. Nearly half (48%) of the respondents reported that 50–75% of their team participants have been female, and 12% reported that 100% of their teams had been female. Nine percent reported that less than 10% of their teams have been female. Respondents were also asked about the ethnicity of their team participants. The results are presented in Figure 3. Caucasian students are the predominant group, while next to Native American, African-Americans are the least represented group.



As was true for the past winner respondent sample, the number of Team Advisors responding to the survey tended to increase the more recent their participation. Many of them have participated in multiple years. Figure 4 presents the number of respondents who served as Team Advisors during each of the past ten years of the competition.

Figure 4. Team Advisors' Years of Participation in eCYBERMISSION and Level of Competition



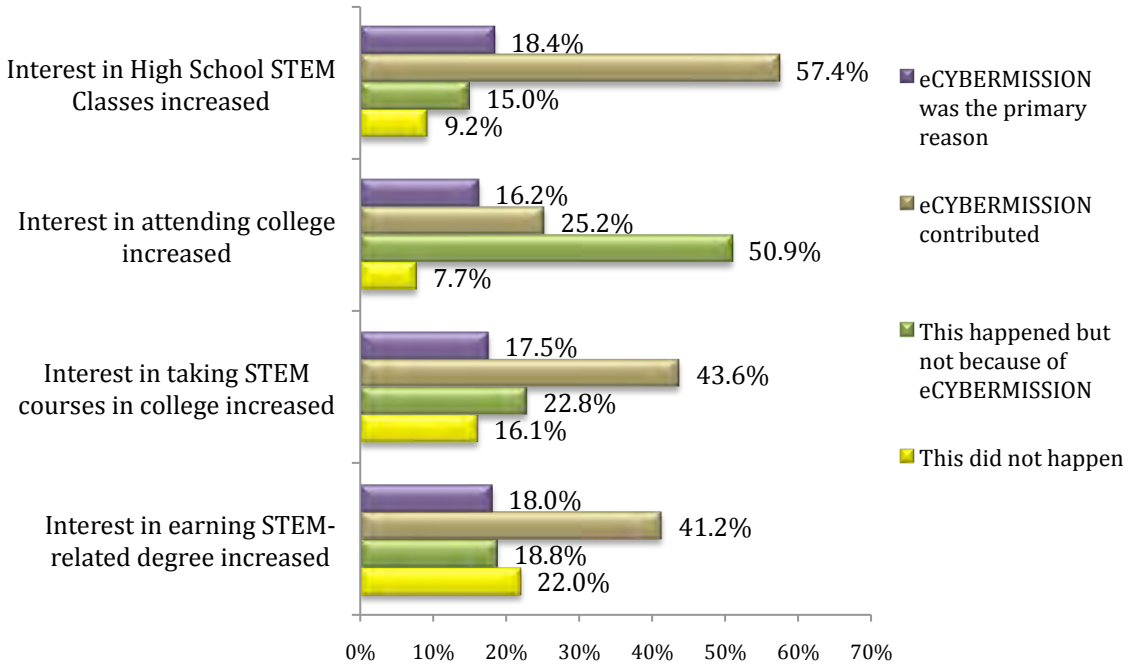
Findings

The main goals of the eCYBERMISSION program are to: 1) increase student interest in taking additional STEM coursework in secondary and post-secondary schooling; 2) increase student interest in and pursuit of STEM related degrees; and 3) increase student pursuit of STEM related careers. Data collected from past winners and their Team Advisors suggest that the program has been successful in achieving this goal, in spite of the fact that the majority of eCYBERMISSION winners have pre-existing interest in STEM studies and careers.

Student Interest and Engagement in STEM Learning

To assess whether or not eCYBERMISSION has been successful in increasing student interest in STEM learning, past winners were asked if their interest in pursuing STEM studies had increased following the competition, and if they attributed increased interest to their participation in eCYBERMISSION. Figure 5 shows that eCYBERMISSION contributed to or was the primary reason for increased interest in STEM learning for a majority of the respondents. Only increased interest in attending college was not attributed to eCYBERMISSION by a majority of the respondents. In this case, just over half of the respondents indicated that interest in college increased, but not because of eCYBERMISSION.

Figure 5. Impact on Interest in STEM Studies (n = 413)



Survey responses indicate that while eCYBERMISSION was the primary reason for increased interest in STEM coursework and degrees for only approximately 18% of the respondents, it contributed to increased engagement for approximately half of the respondents. It should be noted that most students that participated in eCYBERMISSION had a pre-existing interest in STEM disciplines and careers, and in attending college. Qualitative data from the survey and focus groups support the quantitative findings that participation in eCYBERMISSION served to enhance the existing interest, and expand awareness of possible areas of study. Representative comments from survey respondents and focus group participants illustrate this finding:

"My interest in STEM led me to eCYBERMISSION, not the other way around."

"I already REALLY wanted to take STEM classes and go to college and all that jazz. eCYBERMISSION was a fun science activity to interact with my peers more than I already was. I already plan on going into some sort of science major and, and then hopefully go on to medical school."

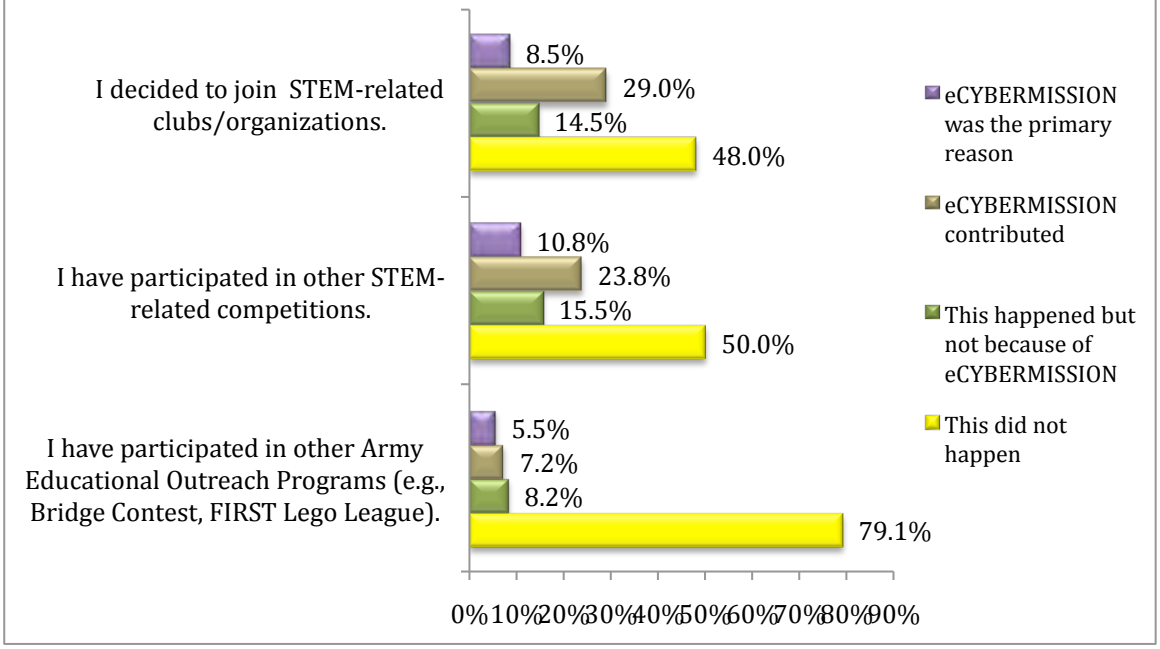
"I have always been interested in science, I just thought it was a good way to apply what I had been learning."

"I have always loved math and science, this is just a phenomenal way to build on it."

"I have always loved science and experiments. This helped me bolster my interest in science!"

Participating in eCYBERMISSION did not lead to increased participation in STEM clubs or other organizations, competitions, and other Army Educational Outreach Programs (AEOP) for most of the Past Winners. Results are presented in Figure 6. Approximately half of the survey respondents indicated that they engaged in additional STEM competitions or organizations, but eCYBERMISSION contributed to or was the primary reason for only approximately one third of the respondents. Fewer than 25% of the respondents reported that they participated in other AEOP, and only 13% of the respondents credited eCYBERMISSION for their participation.

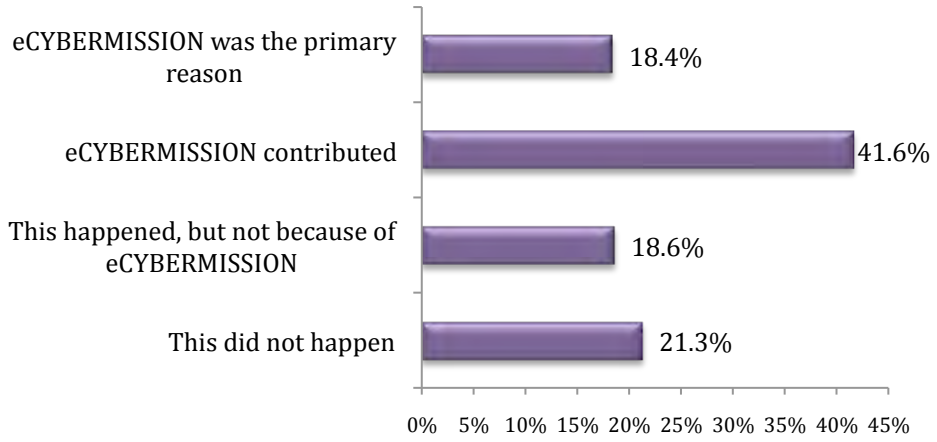
Figure 6. eCYBERMISSION and Engagement in STEM Activities (n = 405)



Student Interest in Pursuing a STEM Career

Participation in eCYBERMISSION did have an impact on interest in pursuing a STEM career, at least for many of the past winners. Following eCYBERMISSION participation, nearly 80% of the survey respondents indicated that their interest in pursuing a STEM career increased, and 60% indicated that eCYBERMISSION contributed to or was the primary reason for the increase. Figure 7 presents the percentages of respondents who became more interested in pursuing a STEM career following their eCYBERMISSION experiences.

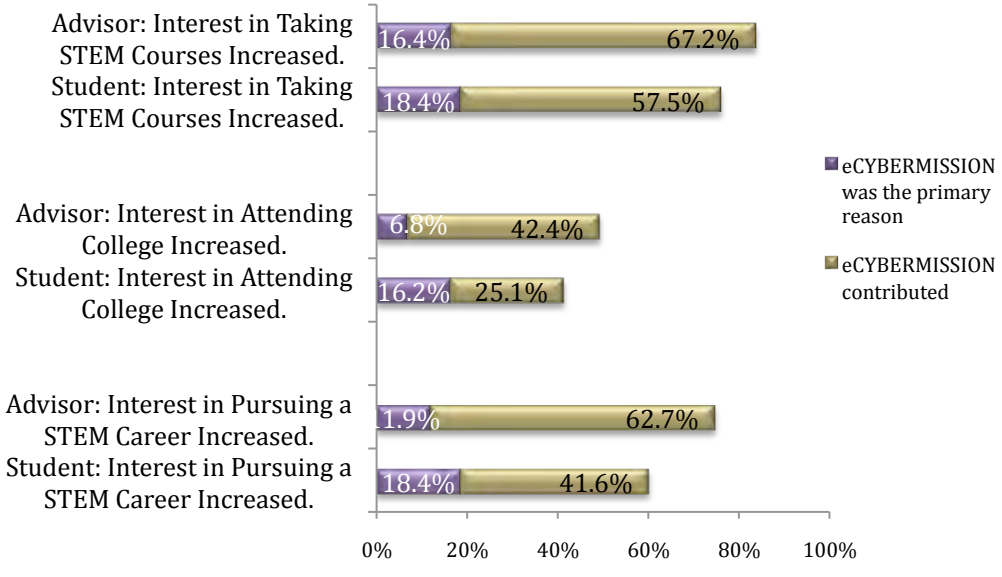
Figure 7. My interest in pursuing a STEM career increased (n = 413)



Team Advisors Perceptions of Student Impacts

Additional indicators of interest were provided by the Team Advisors' responses regarding their perceptions of the impact of eCYBERMISSION on student interest in taking STEM courses in high school, attending college, and pursuing a STEM career. Team Advisors' ratings were similar to those of the past winners themselves, but the Team Advisors tended to underestimate eCYBERMISSION as the primary reason and overestimate eCYBERMISSION as a contributing reason for increases in each of these three areas. As can be seen in Figure 8, Team Advisors slightly overestimated the influence of eCYBERMISSION in each of these areas.

Figure 8. Advisor Perceptions Compared to Student Responses



Qualitative Data

Open-ended comments made by students provided additional evidence for the ways in which eCYBERMISSION impacted student interest in STEM studies and careers. When asked, "In what other ways if any, has eCYBERMISSION impacted your interest in STEM academic studies or STEM professions?" 40 out of 195 participants responded that the program strengthened their interest in STEM innovations, 23 found that the experience provided them with professional insights, and 21 expressed that their desire to follow a career path into STEM was reinforced. In essence, eCYBERMISSION reinforced their desire to have STEM careers but for most, it was not the primary reason interest increased. Comments suggested that eCYBERMISSION was influential in helping students gain an increased awareness of the kinds of opportunities that are available in STEM fields and how STEM professionals contribute to the field. Sample comments taken from the Past Winners Survey are presented in the text box below.

"My career path was planned for bio-medical careers at the time I participated in eCYBERMISSION. Research for my team's project opened up opportunities to network with labs which allowed access to experimentation procedures and technology which I would have not had a chance to experience and test otherwise. This helped me view first-hand jobs and research in the bio-medical field."

"Because of eCYBERMISSION, I decided I definitely want to make a career in a scientific R&D. And it opened doors for me. For instance, I was accepted into a three week, invitation only physics camp at Stanford. Having eCYBERMISSION on my application helped me get in. Then I was invited to a weeklong STEM camp in Annapolis. I used my winning from eCYBERMISSION to attend both events. If not for that, my family could not have afforded to send me to those camps, where my desire to make a career of science became even stronger."

"These are things that I was already interested in, mainly because it was middle school and they were the subjects I was good at and had cool teachers in. But this showed me the practicality of what we were really doing and now I am looking more realistically at careers in engineering, having an understanding of what it does as far as solving problems in the real world."

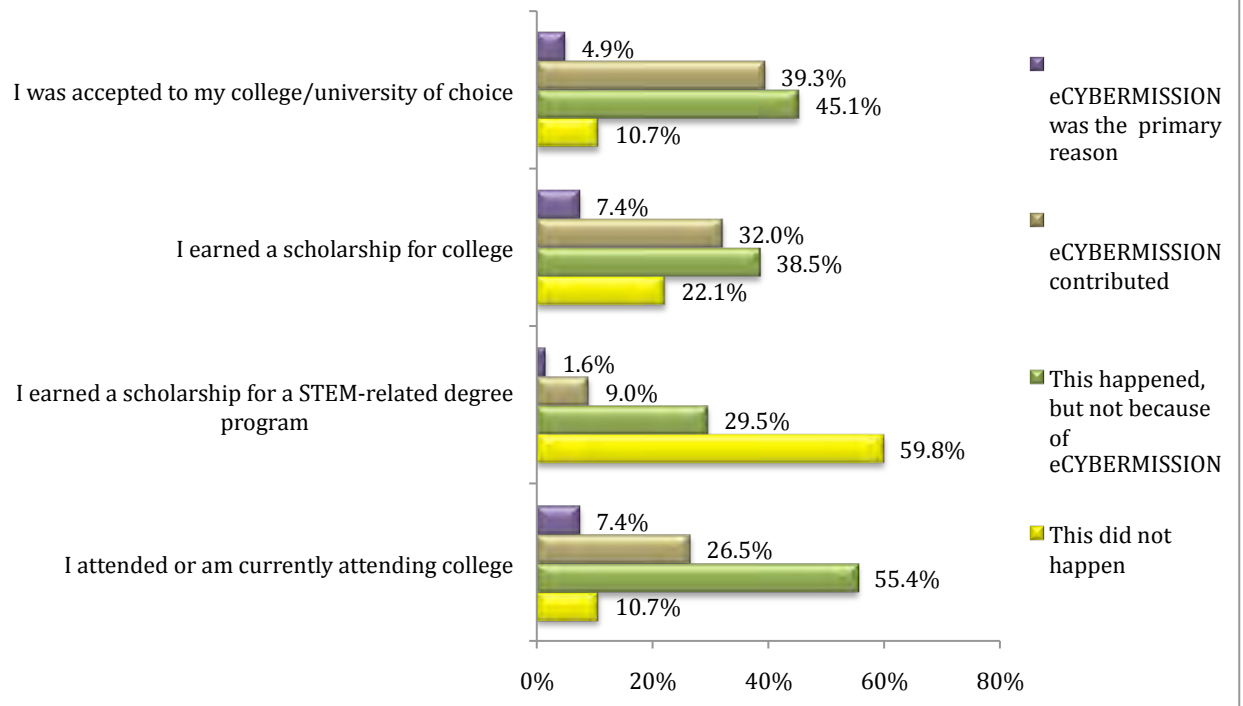
"It has increased my interest in STEM and allowed me to explore a field of science and technology that I had previously not known about."

"ECYBERMISSION showed me how important the STEM field is in our modern world, and how it is rapidly becoming the future of many major careers. eCYBERMISSION has opened many opportunities for me and introduced me to new areas in STEM as well as job opportunities and ways to apply the STEM professions."

Student Pursuit of College Level STEM Studies

Participation in eCYBERMISSION had an impact on acceptance into post-secondary programs. Among those respondents who had already completed high school, 89.3% had been accepted to the college or university of their choice, and 44.2% credited eCYBERMISSION with contributing or even being the primary reason for getting into the college or university of their choice. Participation in eCYBERMISSION also contributed to or was the primary reason for earning scholarships for college (39.4%) and actually attending college (33.9%), although the impact was not as strong as the impact on acceptance to a college or university. Participation in eCYBERMISSION had the least impact on earning a scholarship for pursuing a STEM related career. Figure 9 illustrates the impact of participation in eCYBERMISSION on college acceptance, attendance, and support.

Figure 9. Impact of eCYBERMISSION on College Acceptance, Attendance, and Support (n = 122)

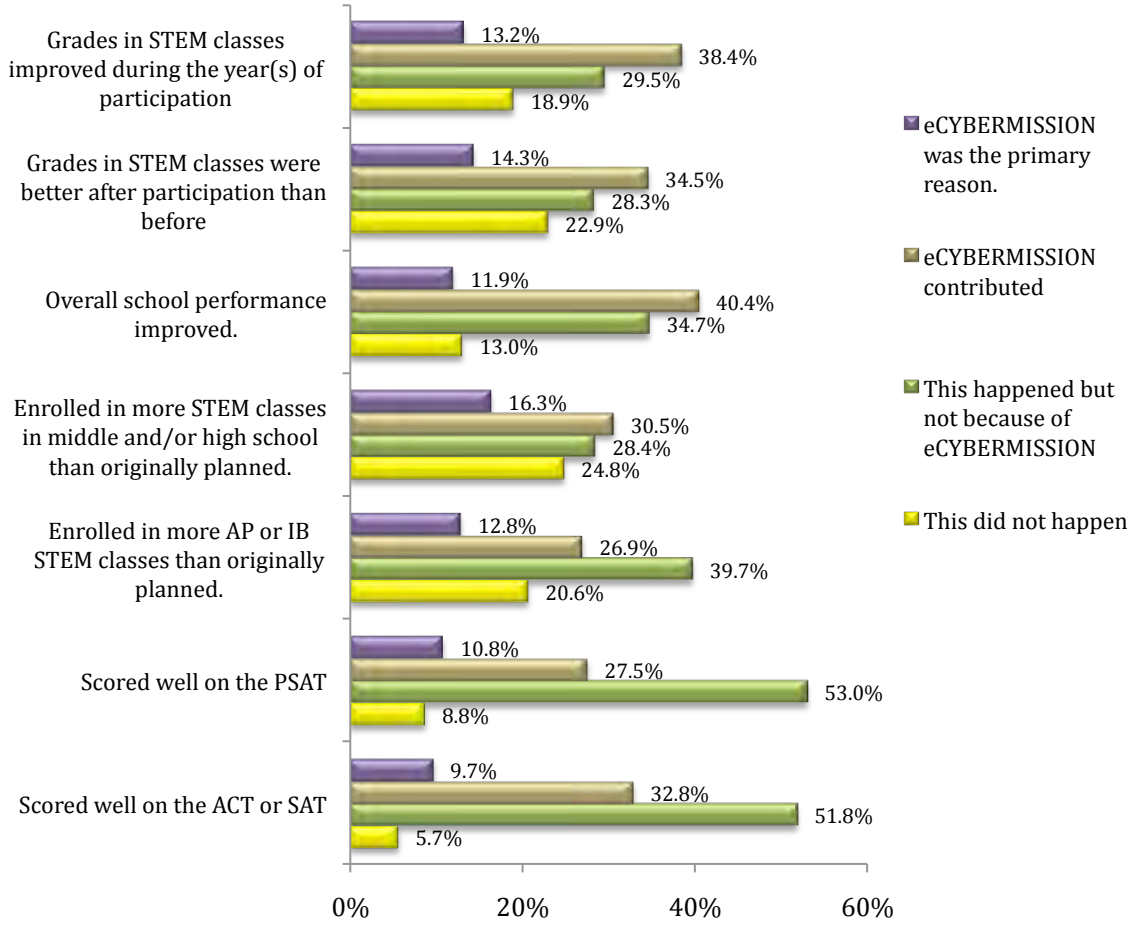


Student Achievement in STEM Disciplines

The impact of eCYBERMISSION on achievement in the STEM disciplines was assessed at the middle school, secondary, and post-secondary levels. As may be seen in Figure 10, approximately half of the respondents credited their eCYBERMISSION experience as a factor in improved grades and performance in school. In addition, nearly half (46.8%) of the respondents

enrolled in more STEM classes in high school than they had originally planned, and nearly 40% enrolled in AP or IB STEM classes (at least in part) due to their eCYBERMISSION experience. A smaller, but still significant percentage of the respondents credited eCYBERMISSION for scoring well on the PSAT (38.3%) and the ACT or SAT (42.5%).

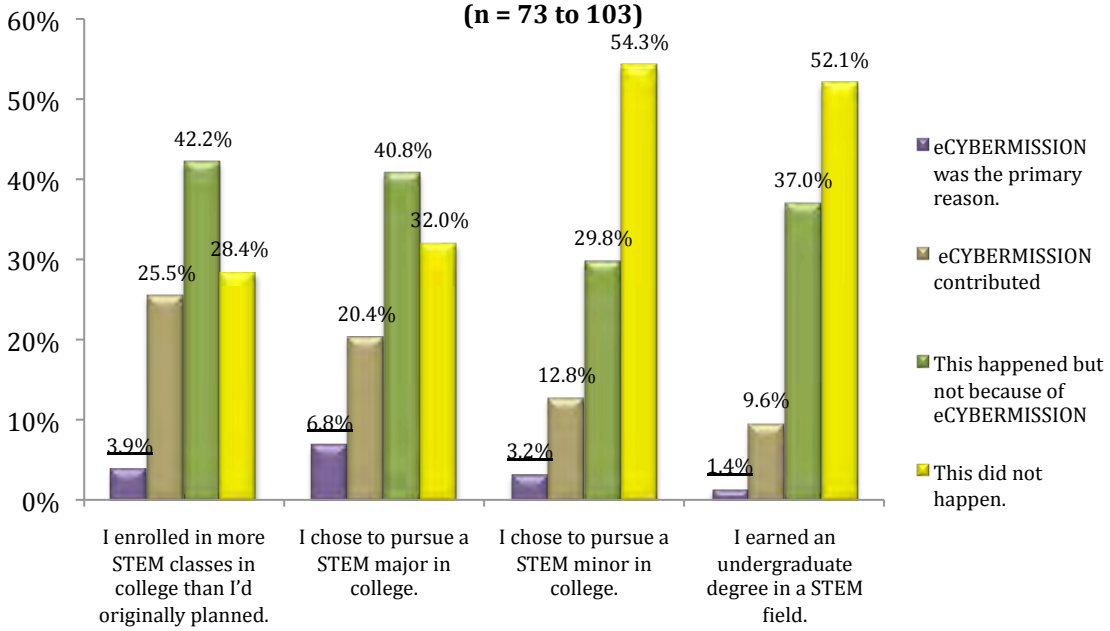
Figure 10. eCYBERMISSION and Academic Achievement (n = 253 - 370)



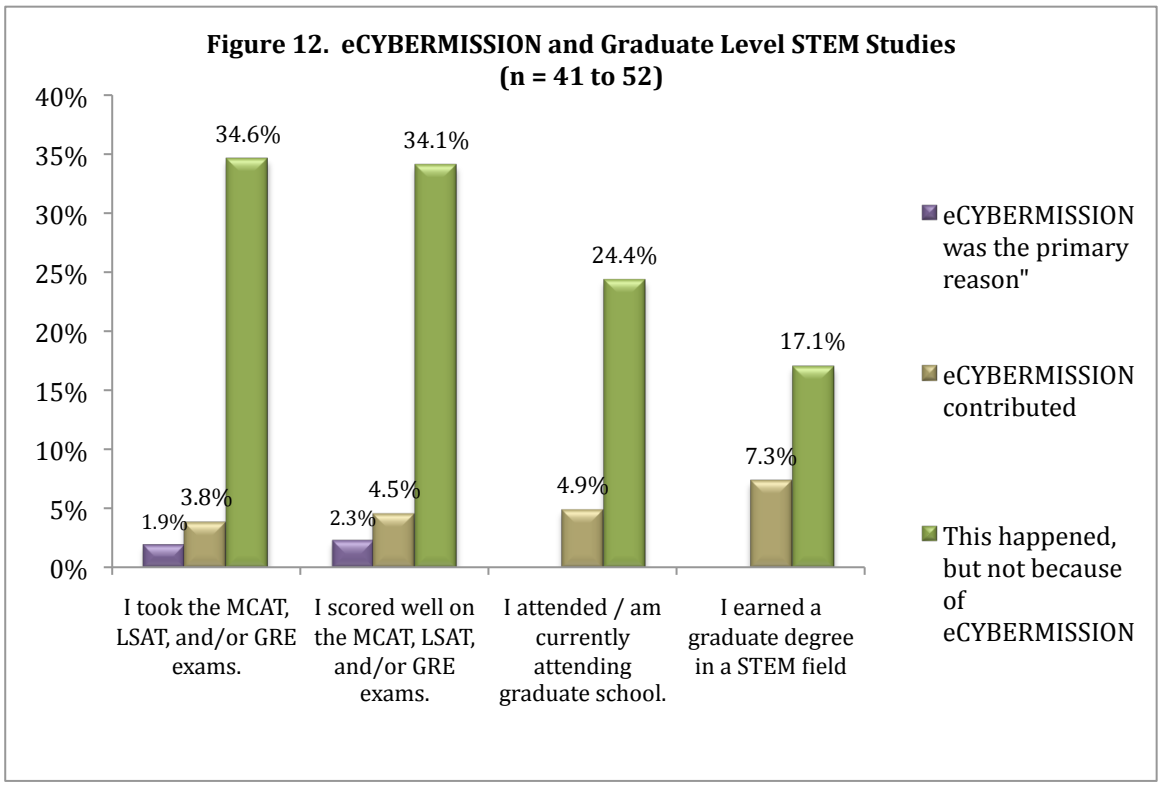
Participation in eCYBERMISSION continued to have an impact on engagement in STEM at the post-secondary level, although it was not as strong as it had been at the middle and high school levels. This is not surprising, given the number of other factors that likely influenced the eCYBERMISSION students in the intervening years. For example, 29.4% of the respondents credited eCYBERMISSION as an influence in enrolling in more STEM classes than originally planned, and only 11% of the respondents indicated that eCYBERMISSION contributed (9.6%) or was the primary reason (1.4%) for earning an undergraduate degree in STEM. However, 27.2% decided to pursue a STEM major due (at least in part) to their eCYBERMISSION experience.

Figure 11 illustrates the extent of the impact of eCYBERMISSION on the respondents' engagement with STEM disciplines at the college or university level.

Figure 11. eCYBERMISSION and Engagement with STEM in College (n = 73 to 103)



The impact of eCYBERMISSION decreases still further at the graduate level of study. Nevertheless, a few respondents indicated that eCYBERMISSION contributed to their decision to pursue a graduate degree (4.9%) and to earning a graduate degree in a STEM field (7.3%). A small number (2.3%) even attributed good scores on their graduate placement exams to their eCYBERMISSION experience. (See Figure 12.)



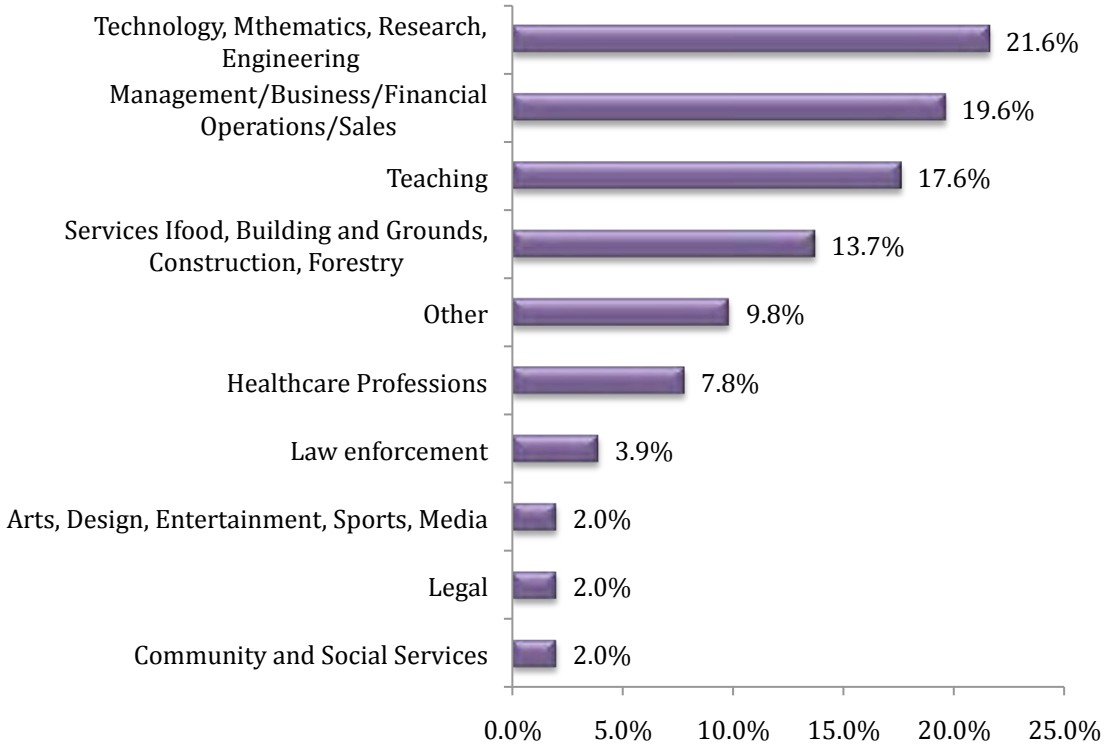
Student Engagement in a STEM Related Career

One of the goals of the eCYBERMISSION competition is to increase the number of students who pursue STEM careers. Some evidence for this was provided by the number of Past Winners who have earned or are working toward undergraduate and graduate degrees in STEM (see the previous sections). Another indicator is the number of Past Winners who have finished their schooling and are now engaged in STEM fields. Past winners who were over the age of 18 and working more than 30 hours per week (n = 51) provided information regarding their current job situation. Figure 13 on the next page presents the percent of Past Winners currently employed in each profession. When those working in the healthcare professions are combined with those employed in research, statistics, mathematics, and engineering, the percent of those pursuing a STEM career is nearly 30%. Assuming that some of those who are teaching do so in the STEM disciplines, the percent would be higher. Given that the percentage of bachelor's degrees conferred in science, technology, engineering, and mathematics fields in the United States is less than 25%, this suggests that Past Winners enter the STEM pipeline more frequently than does the general population of college graduates. It should be noted that many Past Winners who have not gone into STEM are pursuing equally challenging and worthwhile professions. One Past Winner listed “Government-U.S. Senate” as their occupation.

It is not known the extent to which eCYBERMISSION may have contributed to the numbers of Past Winners who have actually chosen STEM careers. Based on the earlier data showing

increased interest in STEM careers, it is likely that eCYBERMISSION did have some influence, even though many of these Past Winners were interested in STEM careers prior to taking part in eCYBERMISSION.

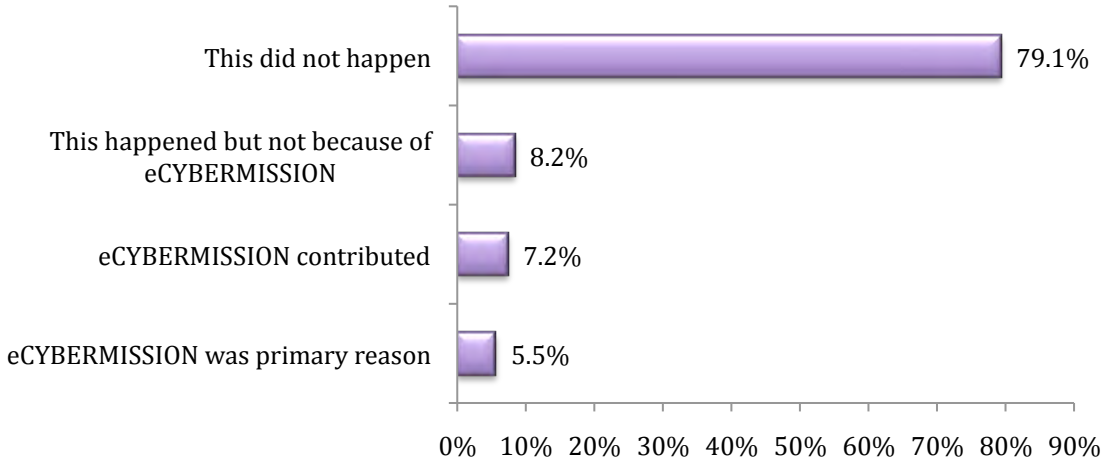
Figure 13. Percent of eCYBERMISSION Winners Currently Employed in Each Profession (n = 51)



Awareness and Interest in Other AOEP and the Military

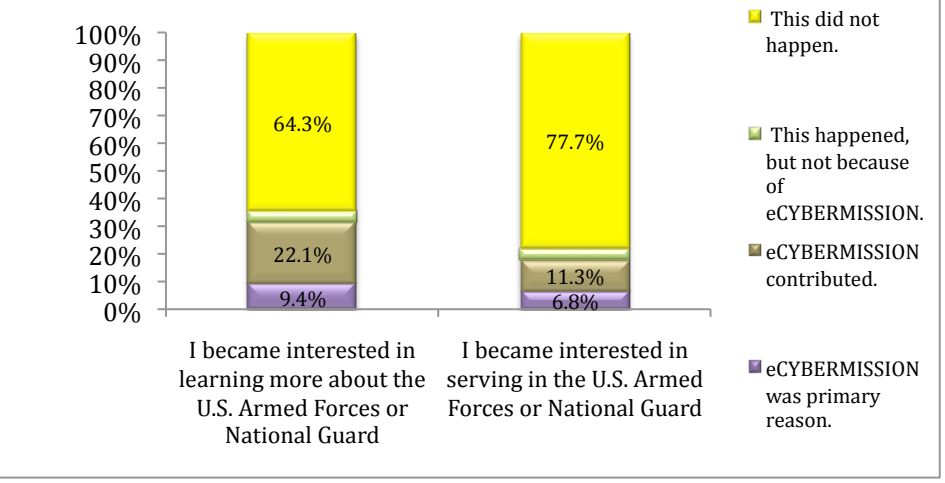
Past Winners responded to questions regarding their awareness of and interest in other Army Outreach Educational Programs (AEOP). In addition, they were asked if student interest in the U.S. Armed Forces had increased as a result of participation in eCYBERMISSION. As can be seen in Figure 14, participation in eCYBERMISSION had only a slight impact on student participation in other AEOP. Nearly 80% of the Past Winners reported that they did not participate in any other AEOP, and of the 20% who did participate in other AEOP, only 5.5% stated that eCYBERMISSION was the primary reason.

Figure 14. I have participated in other AEOP



Participating in eCYBERMISSION did have a moderate impact on student interest in learning more about the U.S. Armed Forces and/or the National Guard. Nearly one third of the Past Winners reported that eCYBERMISSION contributed or was the primary reason that they became interested in learning more about the military, and nearly 18.2% reported that eCYBERMISSION was a factor in increased interest in serving in the military.

Figure 15. Interest in U.S. Military



Summary of Part I Findings

The data collected from winners from the past ten years of the competition and Team Advisors show that participation in eCYBERMISSION contributed to, or in some cases was the primary reason for increased learning and engagement in STEM pursuits. The effect of eCYBERMISSION participation on interest in pursuing STEM studies is strongest at the secondary level of education, declines slightly at the undergraduate level and again at the graduate level. Most of the Past Winners had a pre-existing interest in STEM disciplines and careers and in attending college prior to their participation in eCYBERMISSION. However, it appears that eCYBERMISSION serves to enhance the existing interest, and expand awareness of possible areas of study. In addition, approximately half of the respondents credit their eCYBERMISSION experience as a factor in improved grades and performance in school. Nearly half enrolled in more STEM classes in high school than they had originally planned, and nearly 40% enrolled in AP or IB STEM classes (at least in part) due to their eCYBERMISSION experience.

Participation in eCYBERMISSION also impacted interest in pursuing a STEM career, at least for many of the Past Winners. Following eCYBERMISSION participation, nearly 80% of the survey respondents indicated that their interest in pursuing a STEM career increased, and more than half indicated that eCYBERMISSION contributed to or was the primary reason for the increase. Participants noted that the program strengthened their interest in STEM innovations and provided them with professional insights, reinforcing their desire to follow a STEM career path.

Among those respondents who have completed high school, 89% had been accepted to the college or university of their choice, and 44% credited eCYBERMISSION with contributing or even being the primary reason for getting into the college or university of their choice. Participation in eCYBERMISSION also contributed to or was the primary reason for earning scholarships for college and actually attending college, although the impact was not as strong as the impact on gaining admission to a college or university.

Finally, while the eCYBERMISSION experience had little effect on generating interest and participation in other AEOP opportunities, it did have a some impact on increased interest in learning more about the Armed Forces and about serving in the military.

Part II: Actionable Program Evaluation

Past and Current Project Years

The Actionable Program Evaluation evaluated eCYBERMISSION processes, resources, and activities for the purpose of recommending improvements as the program moves forward.

KEY EVALUATION QUESTIONS

- What program characteristics do the students and team advisors attribute to the program (e.g. teamwork, innovation, inclusiveness, relevance to youth, internet-rich, community-based problems)?
- What aspects of the program motivate student participation?
- What aspects of eCYBERMISSION program structure and processes (e.g. website, marketing, communications, registration, mission folder uploads, Cyberguides, judging, and prizes) are working well?
- What aspects of eCYBERMISSION could be improved?
- How is the National Judging and Educational Event (NJ&EE) perceived by students and their team advisors?
- How might NJ&EE be improved?

METHODOLOGIES & INSTRUMENTS

Past and current eCybermission competitors provided data for Part II of the study. Student winners from the past ten years of the competition contacted as part of the Alumni/Past Winner Outcome Evaluation were asked to complete a second part of the online survey addressing factors that contribute to the appeal, impact, and success of the program. Team advisors from the past 10 years of the program participated in a separate but complimentary survey focused on program elements and future improvements. Adult survey respondents were incentivized with gift certificates appropriate to the particular target audiences. Two student samples from the current competition year provided data regarding motivation for participating in eCybermission: 1) NJ&EE attendees, and; 2) students attending stipend-supported schools. In addition, a DHA evaluator attended the 2013 NJ&EE and conducted focus groups with the Team Advisors and 16 student winners (one from each team) regarding their perceptions of the strengths and weaknesses of the 2012-2013 competition and the NJ&EE event.

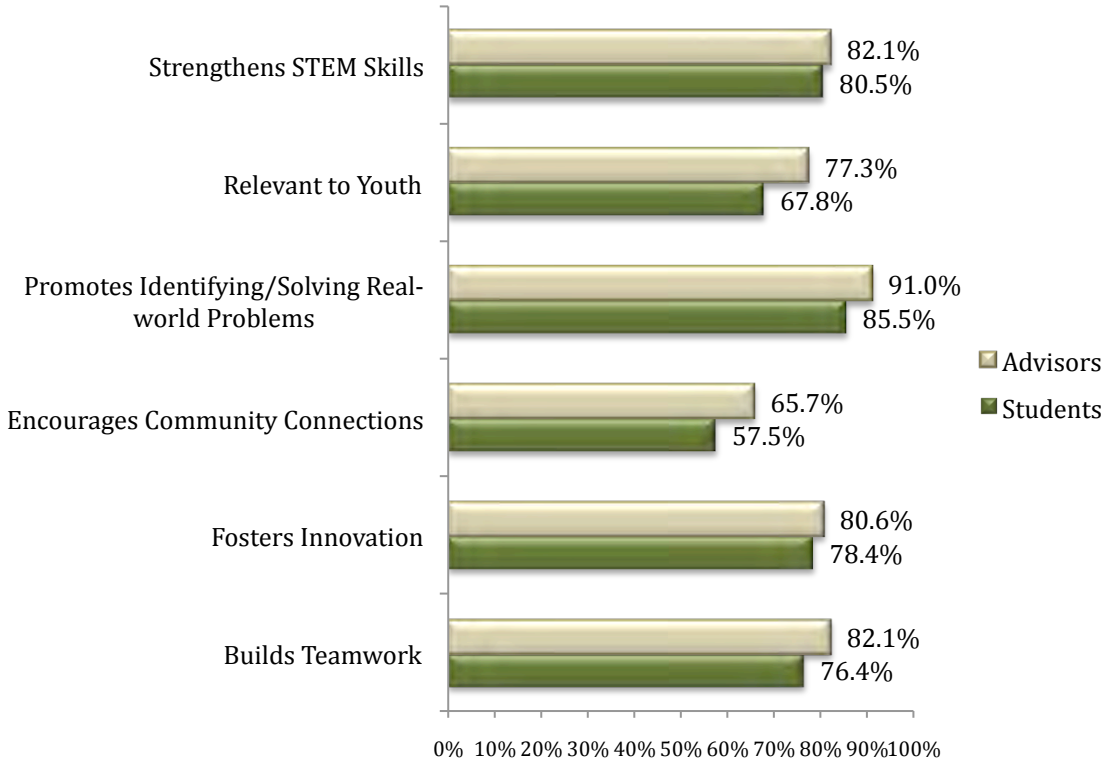
FINDINGS

Program Characteristics Attributed to the Program

Past Winners and Team Advisors were asked to rate several of the characteristics or attributes that eCYBERMISSION strives to embody. Respondents were asked to rate each attribute as "describes very well," "describes somewhat well," or "does not describe." Figure 16 shows the percent of Team Advisors and students (Past Winners) who rated each attribute as "describes very well." Team Advisors were slightly more positive than the Past Winners, but in both cases a majority of the respondents agreed that eCYBERMISSION embodies these attributes. The strongest attribute is "promotes identifying and solving real-world problems," followed by "strengthens STEM skills." There was less agreement that eCYBERMISSION "encourages community connections," but even so approximately 60% of the respondents agreed that this

was true of the program. Overall, the respondents believe that the program embodies the positive characteristics that it strives to incorporate.

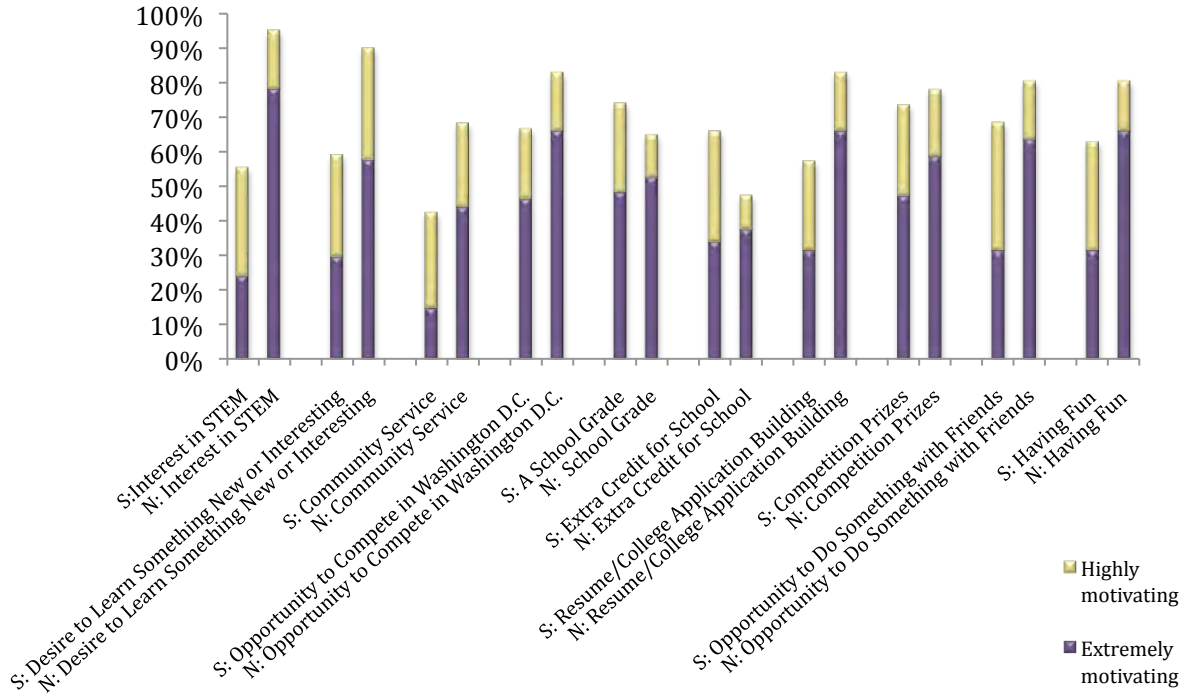
Figure 16. "Describes Very Well": The eCYBERMISSION Program



Motivating Factors

What aspects of the eCYBERMISSION program motivate eCYBERMISSION contestants? The two samples of 2012-13 student competitors (NJ&EE and stipend-supported school students) were provided with a list of possible motivators and asked to indicate which ones they found motivating on a five-point scale that ranged from "not motivating" to "extremely motivating." Figure 17 shows that, in general, the NJ&EE students found the factors to be more motivating, particularly "interest in STEM,", "the opportunity to compete in Washington, D.C.," "building a resume for college application," and "having fun." Students in the stipend-supported schools (schools with underserved populations that have typically not competed in eCYBERMISSION) were more motivated by "a school grade" or "extra credit for school." The two groups of students were fairly equally motivated by the competition's prizes and the chance to do something with friends. The differences between the two groups of students suggest that marketing the program to schools with underserved populations may need to emphasize different aspects of the program than those that have traditionally served to attract students.

Figure 17. Percent of Stipend School Students (S) and NJ&EE Students (N) "Highly" or "Extremely" Motivated by Each Factor



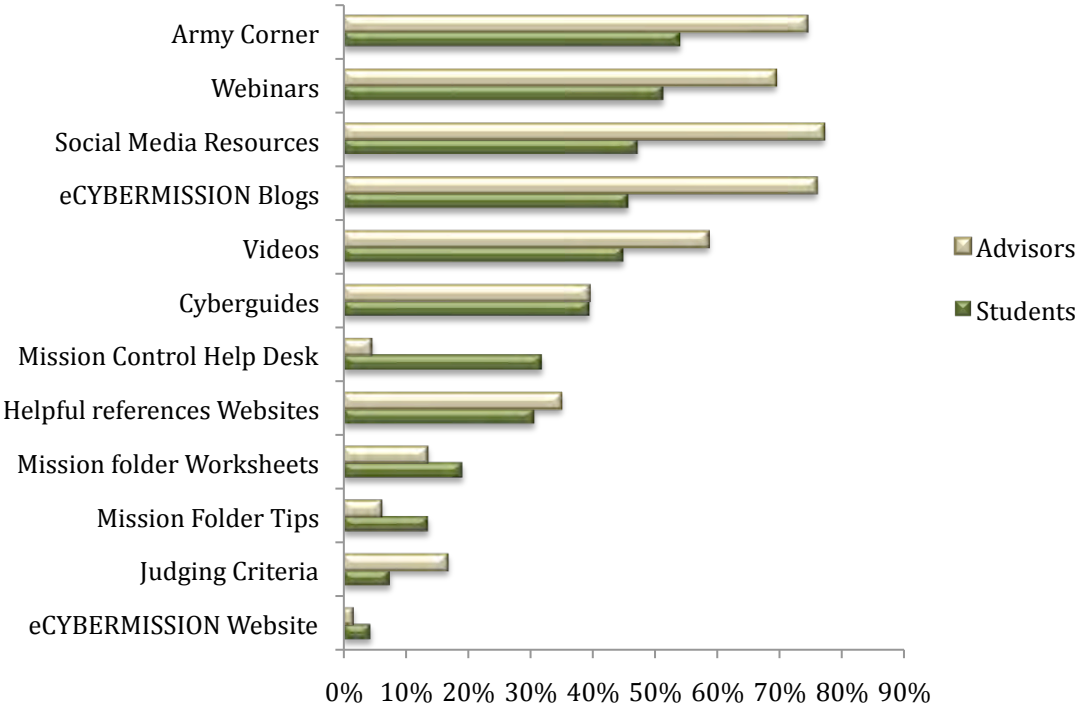
Qualitative Data: Motivating Factors. When asked, "Why did you decide to participate in eCYBERMISSION," 2013 NJ&EE students emphasized pre-existing interest in STEM and enjoyment or fun. Out of 39 responses, nine related to an interest in or love of science or STEM. An additional seven responses referred to having fun or enjoying the experience.

What Works Well and What Can Be Improved

eCYBERMISSION Resources. A large number of online eCYBERMISSION resources are available to the teams and their advisors. To assess what is working well and what can be improved, we asked past winners and their team advisors to evaluate 12 resources. To start, Past Winners and Team Advisors were asked if they had experienced or used each of the listed resources. Figure 18 shows the percent of students and advisors who indicated that they had not used the resources. Some of the resources are definitely underutilized by both advisors and team members. It is not surprising that more than 70% of the advisors had not experienced the social media resources and blogs, since these are likely student-oriented, but nearly 50% of the students had not utilized these resources. It is also possible that these resources were not available during the early years of the competition. However, more than 50% of the students had not experienced the eCYBERMISSION webinars or the "Army Corner." Videos and

"Cyberguides" were underutilized by advisors and students as well. Advisors did utilize the Mission Control Help Desk, although nearly one-third of the students did not. The under-utilization of several resources is a concern that suggests a need for improving awareness of the resources and defining how they can be utilized. This conclusion was supported by open-ended responses from Past Winners regarding how the program could be improved.

Figure 18. Percent of Past Advisors and Students Who Did Not Use Each Resource



It appears that Mission Folder Tips and Worksheets were used by most of the students and advisors, and nearly everyone had experienced the eCYBERMISSION website. Therefore, these two resources are of particular interest, in terms of how well they are working. Figure 19 shows the ratings of Past Winners and Figure 20 shows the ratings of Team Advisors for each of the resources. Clearly, the majority of both Past Winners and Team Advisors who had utilized each of the resources rated them as "good" or "excellent." The eCYBERMISSION website, and Mission Folder Tips were rated as "excellent" by approximately 40% of the Past Winners and Team Advisors, and 37.6% of the Past Winners rated the Mission Folder Worksheets as "excellent", but only 21.2% of the Team Advisors rated them as excellent. All in all, Past Winners gave more "excellent" ratings than the Team Advisors did. Past Winners also gave more "poor" ratings, however. Team Advisors gave more "good" ratings than "excellent" ratings. This suggests that there is room for improvement in the resources that are provided to eCYBERMISSION teams and their advisors.

Figure 19. Past Winner Ratings of eCYBERMISSION Resources (n = 454)

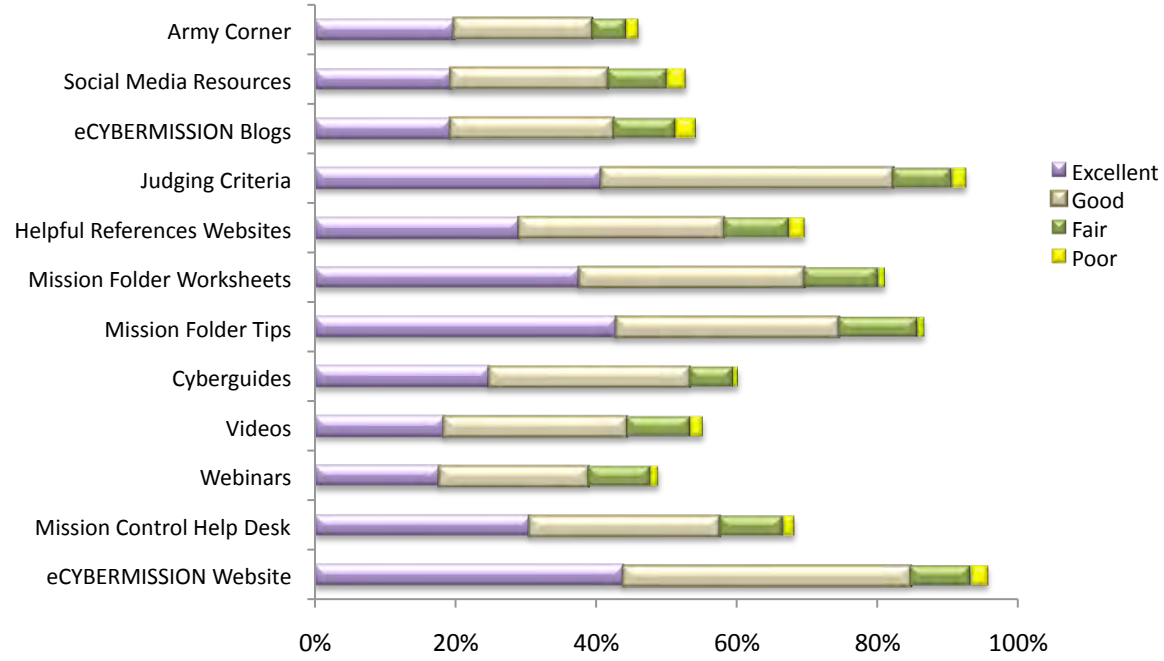
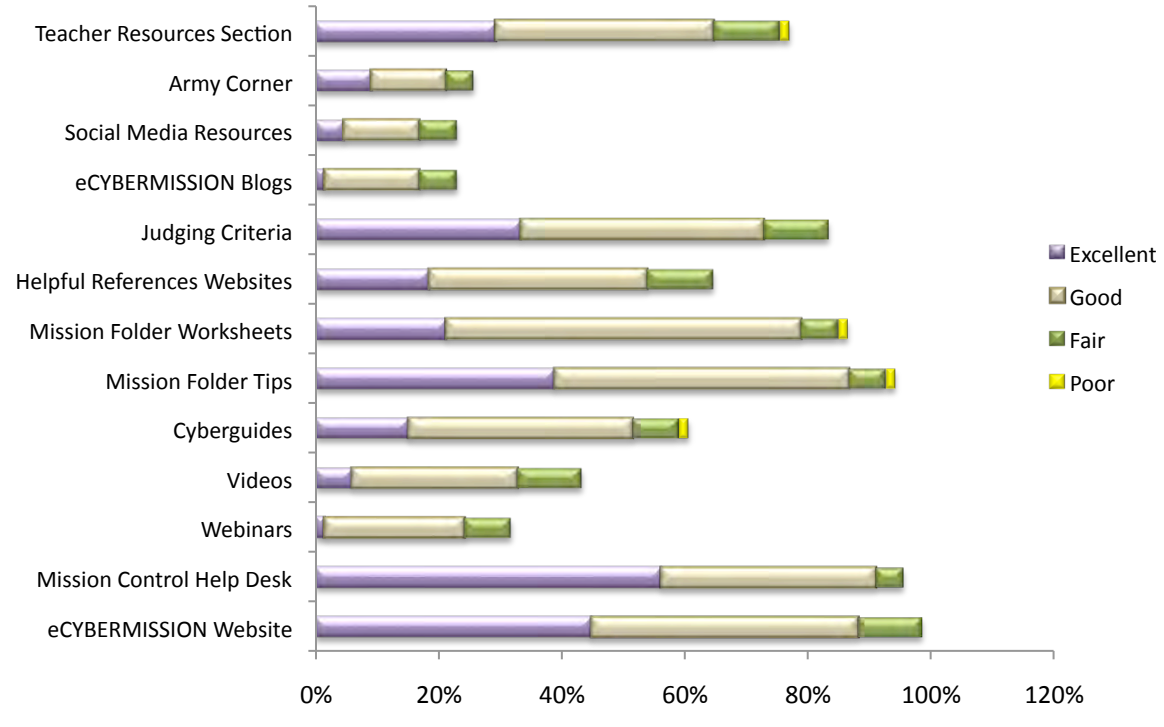
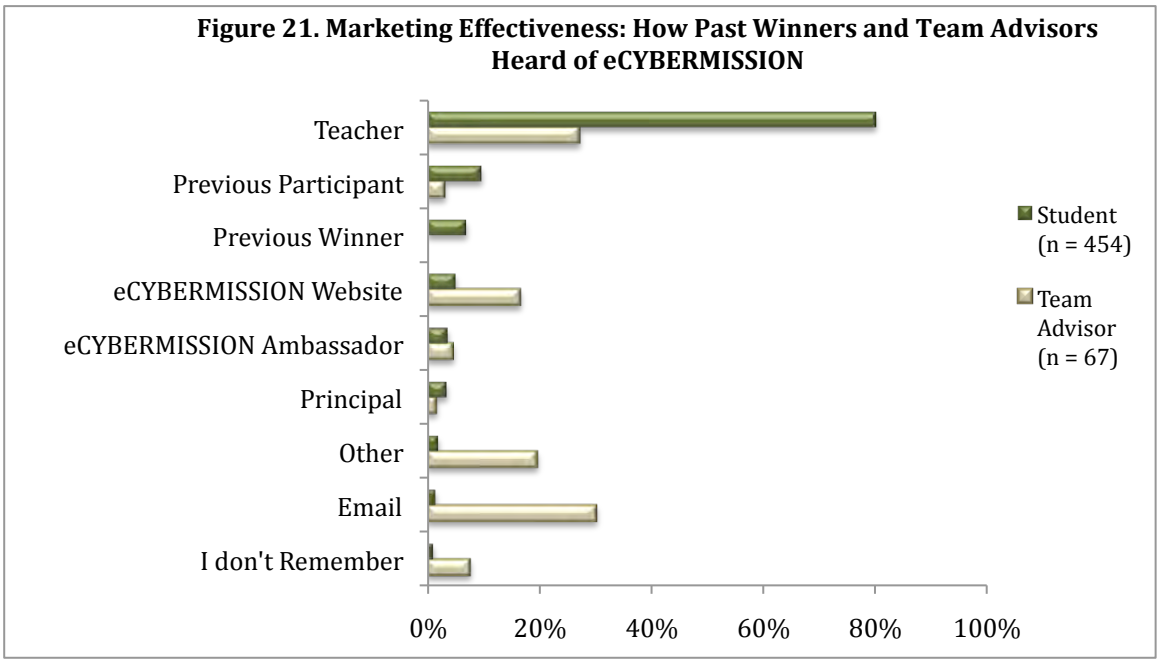


Figure 20. Team Advisor Ratings of eCYBERMISSION Resources (n = 67)



Marketing the Program. eCYBERMISSION is reaching out to schools and students that traditionally have not been involved in the program. Thus it is important to consider how the program is marketed to schools, teachers, parents, and students. Past Winners and Team Advisors were asked how they had first learned of the program, in order to get a sense of how effective past marketing of the program has been. As can be seen in Figure 21, nearly all of the Past Winners had learned of the program from a teacher. It seems clear that the program has been marketed to teachers rather than directly to students. Many of the Team Advisors had also learned of the program from another teacher, but the number one source of information was through an email. A good number of the teachers learned about eCYBERMISSION by visiting the website.

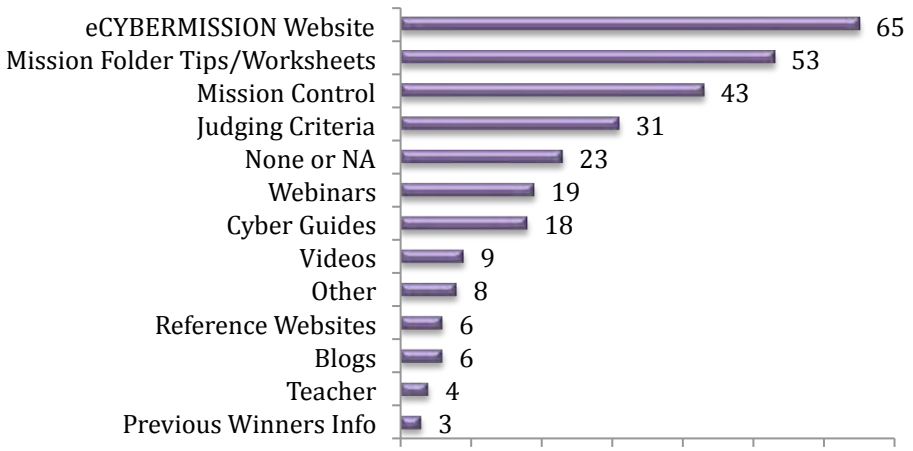
Figure 21. Marketing Effectiveness: How Past Winners and Team Advisors Heard of eCYBERMISSION



Qualitative Data: What Works Well and What Can Be Improved. Past Winners responded to an open-ended question, "Which eCYBERMISSION program supports were most helpful and why?" Two hundred and sixty-six Past Winners listed 288 program supports that they found most helpful. A somewhat smaller number (229) responded to a query regarding what resources could be improved. However, 87 of these stated, "NA," "Don't Know," or "Nothing." The number of times that program supports were mentioned as "most helpful" is shown in Figure 22. Frequencies of recommended improvements are shown in Figure 23.

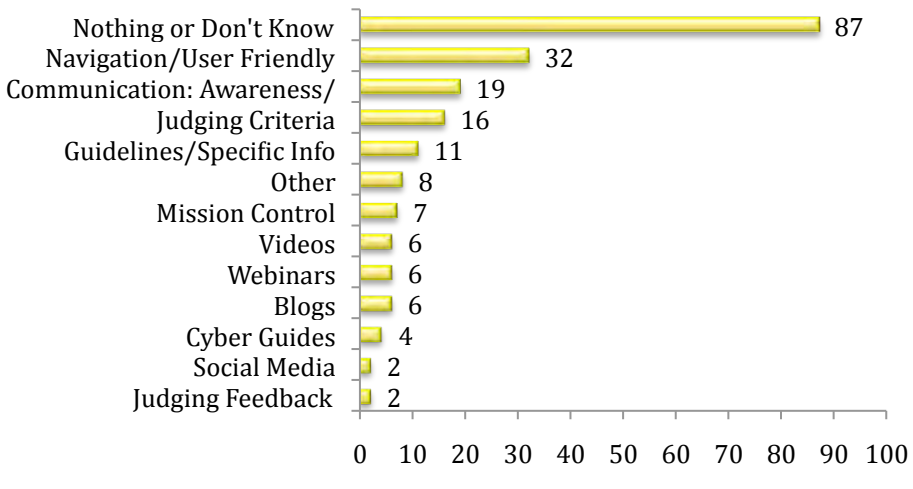
The reasons given for why the resources were helpful emphasized good communication and getting timely responses to questions. The resources were helpful because they helped the teams to get organized, do things properly, and get ideas on how to improve. The website was the resource identified as most helpful more than any other, and responses included ease of navigation and the information and examples that could be found on the site.

Figure 22. Most Helpful Supports



The most frequent criticism of eCYBERMISSION resources was that they were difficult to navigate or were not user-friendly. Interface with the website was most frequently mentioned, but some specifically mentioned difficulties in completing the Mission Folder within the constraints of the system. A common theme running through the suggestions for improvement was the need for better communication, particularly in terms of doing a better job of making participants aware of the resources that are available and providing clear criteria and specific guidelines and timelines.

Figure 23. Aspects Needing Improvement

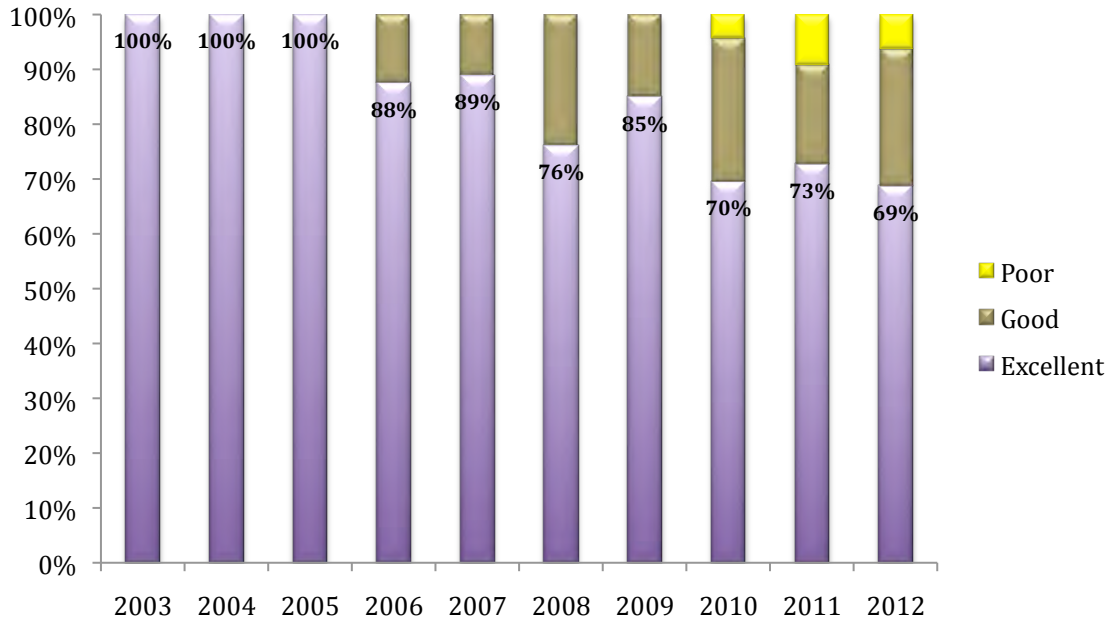


The National Judging and Educational Event (NJ&EE)

The NJ&EE showcases the regional winners at each grade level and determines the national winners. As the culminating event, it is both competition and celebration. Much of the reputation of eCYBERMISSION is based on the success of the national event. Because of the central role that NJ&EE plays, evaluation focused on how the teams who make it to the top level of the competition perceive the event and what might be done to improve it.

Winners from the past 10 years were asked to rate their NJ&EE experience, as "poor," "good," or "excellent." As can be seen in Figure 24, most Past Winners are very pleased with their NJ&EE experience, but the percent who rate it as "excellent" has progressively decreased over the past few years.

Figure 24. Past NJ&EE Participant Experience Ratings (n=105)



When team advisors from the past ten years were asked what aspects of NJ&EE had most impacted their students, they responded with comments that focused on the opportunity for students to recognize what they had accomplished, meeting others from around the country, expanding their horizons, and the exposure to the tech expo.

Team Advisors at the 2013 NJ&EE competed a survey asking them to provide their perceptions of the impact of the event on their students. Figures 25 and 26 illustrate their views of the competition.

Figure 25. Positve Perceptions of 2013 NJ&EE

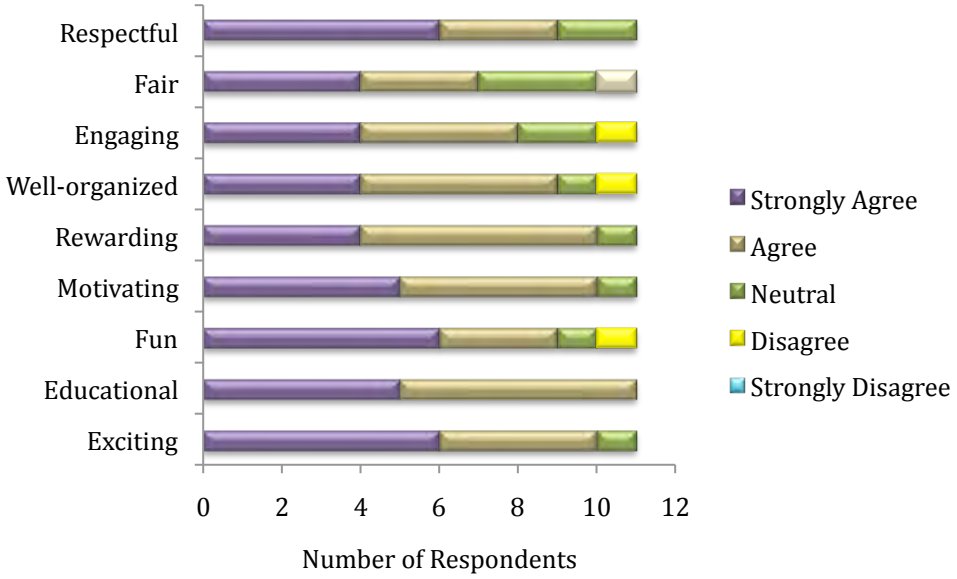
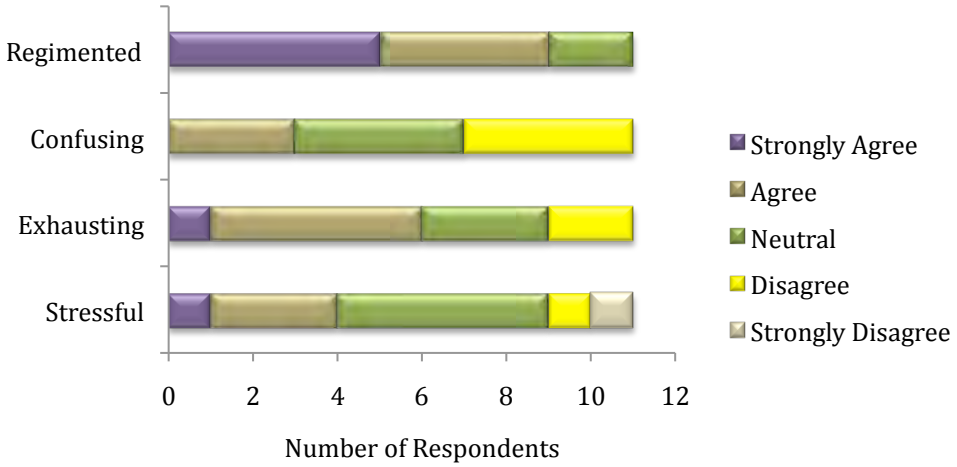


Figure 26. Negative Perceptions of 2013 NJ&EE

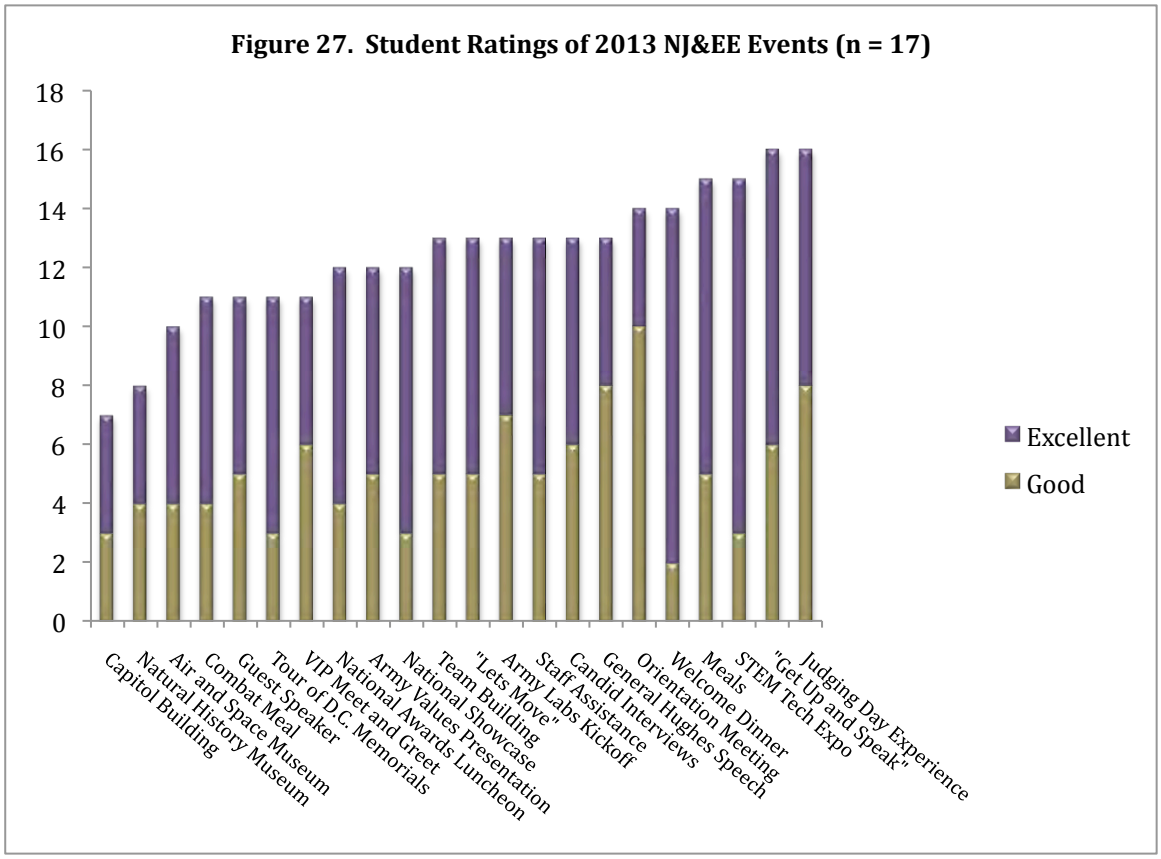


More than half of the advisors believe that NJ&EE was regimented, confusing, and exhausting for their students. Even so, only four suggested that it was stressful. Advisors showed greater agreement that NJ&EE embodied positive attributes for their students. More than 75% of the Team Advisors believe that the event was fun, engaging, motivating, rewarding, and exciting. All of the Team Advisors agreed or strongly agreed that it is educational.

Team advisors differed in their assessment of "fairness." This is probably due to some concerns about judging criteria, and also because one of the Team Advisors also served as a judge for the 2013 NJ&EE. Having a Team Advisor also serve as a judge, even though it was for a different grade level was seen as very inappropriate and an unfair advantage by a number of the other Team Advisors.

Based on survey responses and a focus group discussion, the students themselves were very positive about their NJ&EE experience, although they also made suggestions for improving it. Students were asked to rate multiple NJ&EE events or activities along a five point scale from poor to excellent. Figure 27 shows the number of students who rated each activity as "good" or "excellent." Several of these activities also received one or two "poor" ratings, including the orientation meeting, team building, "Let's Move," combat meals, the guest speaker, the tours of the Capitol Building, the Natural History Museum and Air and Space Museum, the candid interviews, and the Awards Luncheon. Students were most appreciative of the "Get Up and Speak" workshop that prepared them for presenting their projects and the judging day experience itself. The STEM Tech Expo was also highly rated, as were the meals.

Figure 27. Student Ratings of 2013 NJ&EE Events (n = 17)



When NJ&EE students were asked to list three things they gained from participating in eCYBERMISSION over the past year, the top response was "teamwork" or how to work well as part of a tem (14 of 51 responses) . This was followed closely by "life skills" (12 responses) and then "knowledge" (7 responses). Some unique responses included "inspiration," "creating something of value," and "addressing community problems." Gaining new friends, or having fun was mentioned by six students.

When asked what they gained from participating in the NJ&EE, the top response was meeting people and making new friends (9 out of 48 responses), followed by the overall experience/memories (8 responses) and learning about Army Values and military research (7 responses). There were a variety of responses:

"Knowledge about army projects.'
"I learned the army core values and to respect and follow them."
"Connections to new friends and important people."
"Public speaking skills."
"The awesome experience at the STEM Tech Expo!"
"Visit to D.C."

Students were asked to list "one thing you would do to make NJ&EE better." Their responses are listed in the text box below.

"Have less strict rules and more free time."
"Spend more time in D.C."
"Rework the schedule, provide more freedom to the contestants on their own time."
"I would allow more freedom for recreation. It was not fun to be stuck inside."
"More recreational activities, like swimming."
"I would make changes to the schedule and make more free time between each activity."
"No MREs."
"More varied activities so returning teams and in different grade levels can choose what they want to do."
"Make the curfew later."
"More breaks."
"I would have more break times, and events where teams from the same grade level can work together and learn more about one another.
"Visit the White House."
"Add slightly ore free time to the schedule, and LOOSEN UP ON THE BUDDY SYSTEM."

It is clear that meeting students like themselves from all over the country was important to the competitors. In addition, they expected the experience to be fun—a reward for all the hard work and preparation that had gone into their projects—and they would have appreciated more variety and time for activities where they could interact with the new friends they were making.

A focus group conducted with one student from each of the sixteen teams at the NJ&EE provided some detailed information of what the students appreciated and did not appreciate about the NJ&EE. The students were very mature and reflective in their discussion of the things that they thought should change. One of the least appreciated aspects of the MJ&EE was the buddy system and the restrictions that went along with it.

- *"I got really bothered by the buddy system. I have been to competitions other than eCYBERMISSION and I have also just been used to being able to walk anywhere and just go the place I need to be, when I need to be there. Not being able to go out from one hall to get a drink for myself was irksome."*
- *"That didn't sit well with me. I mean at the Smithsonian, we couldn't even go five feet away without risking a deduction of time and points."*
- *"In regards to the buddy system, when I was walking through the building with a buddy, we got lost and I found that all over in this entire facility there are plenty of janitors and other people who work here that are perfectly capable and willing to help you around. And I think the possibility of someone being lost or hurt and by themselves is kind of unlikely so that's just what I was thinking."*
- *"I felt with the buddy system and security, I felt like we were being suffocated. I had no freedom to walk where I wanted to walk. I know it is probably a liability issue but I've stayed with other science competitions and I have been able to get a breakfast muffin and come back alone."*

Scheduling and time pressures were additional concerns, along with needing some "down time" and time to engage with students from other teams.

- *"I think there were a lot of earlier comments about restricting, or not having free time, or not being relaxed but I think that one of the contributing factors was that there was a lot of time spent on the organization of people. For instance, even going to breakfast in the morning, traditionally, people would go to breakfast and eat, but what we did here is that everybody meets together in the commons first, goes on the walk together, and then eats breakfast all at the same time.'*
- *"Well at the Smithsonian I would have enjoyed at least two or three more hours because there were so many exhibits that I wanted to see. One hour wasn't enough. I mean we only had 10 minutes to look one of the exhibits that I wanted to see. I would have shortened the trip to the Air and Space Museum because it was just a lot of airplanes. And I probably would have enjoyed a few short breaks. To play catch up with friends and other grades."*
- *"I think that maybe something that you could do is extend it for another day or something so you could have more gaps between stuff so that you can spread out the schedule a little more so you could have more time to have breaks."*

- *"Maybe having a specific day where everyone flies in where there are no activities. After everyone gets in we can just have fun and maybe have one activity in the area when they come to the activity center they get to do right when they get there and even if they want to they go to their rooms and maybe take a break."*
- *"One thing that at first I wish we would have gotten to know the other grades. It was great getting to know the 7th graders but a lot of the 9th, 8th, and even 6th they are all seemed really interesting but we only had that one challenge where we got to meet the other grades. And I am sure I could have learned a lot from some of the other grades because they were many different types of projects."*
- *"I enjoyed the activities that were organized but I think they should be geared to allow people to interact with the other teams because I felt like most of the activities were kind of solitary and I felt like there was less opportunity to get to know the other grades. Also to interact with other people because they were solitary or just listening to some presentation."*

Students also thought more variation and choice of activities would be beneficial.

- *"I think the best solution it to offer a lot of variation. So variation in the speakers you want to go to, choice. Because STEM is a huge field so Joe Mill had something that was more electrical engineering. Well a lot of people like biology. So I think offering more choices, so you know if you have like 4 different speakers then teams that potentially have been there all 4 years still have choice. Everybody gets to see what they want."*

A final shared concern was that the students would have preferred to be closer to or in D.C.

- *"Being closer to DC. When I came to this competition they said that finals would be in D. C., not 30 minutes away. So that would give more time for people to see what they want to see."*
- *"I know you guys are certainly limited like every other science competition about where you can stay, where you can only host so many people." But, we expected to be in the nation's capitol, not so far away."*

Following discussion of concerns and recommendations, the students turned the conversation to what they had enjoyed or benefitted from.

- *"Speakers. They were awesome. The things that they did. They events that they participated in were amazing and having that experience to see that we can do that as well was uplifting. However, the format of presentation almost put me to sleep."*
- *"I just want to say that it has been amazing. This was my first national science competition and this has inspired me to continue to do more. It's great for everything in life."*
- *"I thought that having the NCOs guiding us… was pretty cool. For them to take time in coming back to the United States and coming down to the kids. I think that is really cool of them."*
- *"A good thing is that I really liked bonding between the teams. I feel like although we are competing its not really like we're competitors in the sense that we are all friends in the same grade."*
- *"I really enjoyed coming here. I really like the army being involved and that was really neat being able to see some of the sergeants and specialists. I thought it was really nice being able to*

see the people that design the armor and the scientists and everything that they came down just to show us a few inventions and everything that they are working with."

SUMMARY OF PART II FINDINGS

Part II of the evaluation was designed to identify eCYBERMISSION program attributes or characteristics; determine what motivates student participation; assess the effectiveness of individual program components and how the program might be improved; and determine how the NJ&EE is perceived by the participants and how NJ&EE might be improved.

Team Advisors and Past Winners agreed that eCYBERMISSION embodies a number of desirable attributes, such as "builds teamwork" and "fosters innovation." The strongest attributes were "promotes identifying and solving real-world problems," followed by "strengthens STEM skills." Program participants believe that eCYBERMISSION is achieving desired outcomes for students.

NJ&EE students were more highly motivated by several different factors than were students in stipend-supported schools, particularly regarding "interest in STEM," "the opportunity to compete in Washington, D.C.," "building a resume for college application," and "having fun." Students in the stipend-supported schools were more motivated by factors related to earning a grade in class. The differences in motivation suggest that perhaps eCYBERMISSION should be marketed differently to underserved students who do not have a strong pre-existing interest in STEM.

In terms of the effectiveness of eCYBERMISSION resources, many are definitely underutilized by both advisors and team members. The under-utilization of several resources is a concern that suggests a need for improving awareness of the resources and defining how they can be better utilized. Among those who had used the resources, a majority of both Past Winners and Team Advisors rated them as "good" or "excellent."

When asked which program supports were most helpful and why, the resources selected by the Team Advisors and Past Winners were those that provided clear communication and timely responses to questions. The eCYBERMISSION website was the resource identified as more helpful than any other, and the reasons included ease of navigation as well as the information and examples that could be found on the site.

The Team Advisors and Past Winners identified some areas where they thought the program could be improved. The most frequent criticism of eCYBERMISSION resources was that they were difficult to navigate or were not user-friendly. Interface with the website was most frequently mentioned, but several respondents specifically mentioned difficulties in completing the *Mission Folder* within the constraints of the template. A common theme running through the suggestions for improvement was the need for better communication, particularly in terms of making participants aware of the resources that are available and providing clear criteria and specific guidelines and timelines. There were also some concerns about the clarity of judging criteria and the fairness of judging criteria.

In regard to the NJ&EE, the event is viewed positively by Team Advisors and students alike. Participants agreed that NJ&EE is fun, engaging, motivating, rewarding, exciting and educational. In the focus group, students used words like "awesome," "amazing," and "uplifting" to describe their experience. Specifically, students were most appreciative of the "Get Up and Speak" Workshop, the judging day experience, and the STEM Tech Expo. Team advisors identified several benefits for students, including opportunity for students to recognize what they had accomplished, meeting others from around the country, expanding student horizons, and the exposure to the Tech Expo. Students identified meeting people and making new friends and learning about Army Values and Research conduced by the Military as the main benefits of the NJ&EE. Focus group discussions identified additional benefits, including being inspired to do more, bonding between the teams, and the opportunity to see research in action.

While the response to NJ&EE is very positive, the ratings of the event overall have been slipping slightly over the past few years, and the participants pointed out a number of areas where they believe change is needed to improve the event. The strongest criticisms from Team Advisors and the students are that the event is too regimented, too restrictive, and the schedule is too full and rushed. The students also want more variety, flexibility, and choice in the educational and recreational activities, presentations, and tour events that are offered. The students and their advisors (particularly those who had attended past events) also believe that the NJ&EE should be held in Washington D.C., rather than in Virginia. The facility in Virginia was described as a "bunker" and "prison," with not enough opportunities to explore the nation's capitol. Finally, several of the advisors questioned the ethics of inviting a Team Advisor to serve as a judge, suggesting that it provided that team with an unfair advantage.

PART III: QUALITATIVE & QUANTITATIVE DATA

PROJECT YEAR 11 (2012-2013)

A study of the impact of eCYBERMISSION on participants' attitudes toward STEM disciplines, coursework, and careers was conducted within the current program year (2012-2013). The purpose of the study was to assess if and to what extent eCYBERMISSION leads to positive changes in student attitudes and behaviors related to STEM.

KEY EVALUATION QUESTIONS

- What are the impacts of the eCYBERMISSION competition on the attitudes and behaviors of participating students?
- Do the impacts differ for students who reach the national competition (NJ&EE) level and students who complete but do not advance beyond the state level in the competition?
- Specifically, do students in both groups:
    - Perceive STEM disciplines more positively after participating in eCYBERMISSION?

- Perceive STEM coursework more positively after participating in eCYBERMISSION?
- Perceive STEM careers more positively after participating in eCYBERMISSION?
- Experience an increase in feelings of self-efficacy in regard to their abilities to study STEM disciplines and/or pursue a career in a STEM field?
- Increase their level of confidence regarding their development of 21st century skills, such as teamwork, creative problem solving, critical thinking, and communication?
- Plan to continue to participate in STEM-related pursuits, including enrolling in future STEM classes, taking part in additional competitions, and/or pursuing a STEM major/career?
- Increase their participation in STEM-related pursuits as a result of their participation in the eCYBERMISSION program?

Methodologies & Instruments

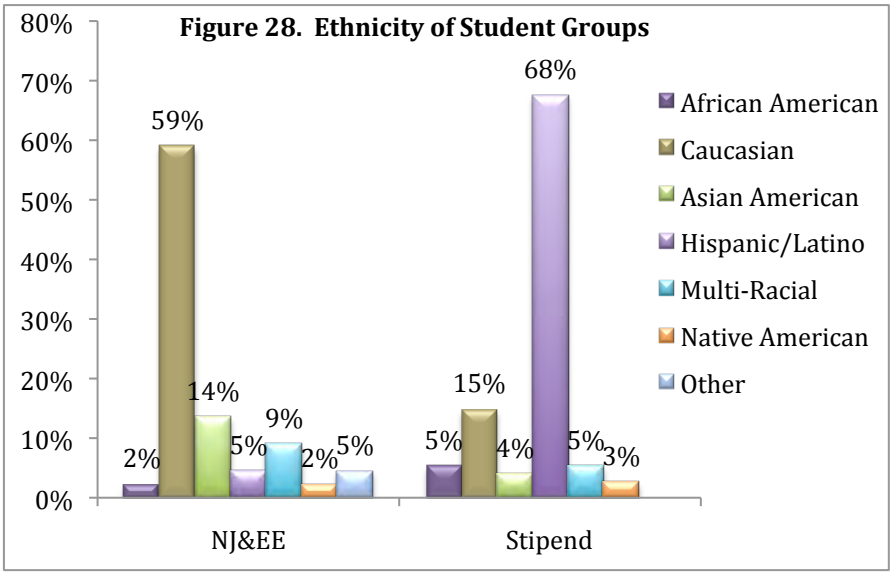
Originally a pre-post, quasi-experimental study design was proposed to compare eCYBERMISSION students to similar students who did not participate in eCYBERMISSION, in regard to the changes identified in the evaluation questions. The design was modified to fit parameters dictated by the timing of the study and difficulties in recruiting eCYBERMISSION students and comparison students. Instead, a post-measure only, comparison group design, with triangulation of qualitative and quantitative data sources was implemented. Outcomes for a statistically appropriate sample of eCYBERMISSION program participants (selected from schools that had received a stipend designed to expand the eCYBERMISSION program) were compared to students who were regional winners attending the national competition. The original intent was to assess and compare pre- and post-participation survey responses of both groups of students. Due to the timing of the contract award and delays in receiving IRB approval, students were surveyed following their participation in the program. They were asked to compare their pre-program attitudes and interests to their post-program attitudes and interests.

Data collection was accomplished through an online survey of student attitudes toward STEM, STEM self-efficacy, and interest in STEM careers. Principals and team advisors from ten of the stipend-supported schools were asked to send a letter to parents requesting that they complete an online permission form if they agreed to their child's participation in the survey. Several schools agreed to do so for their eCYBERMISSION students, but were unable or unwilling to recruit comparison group students. In some cases, this was because all of the students at a given grade level had participated in the competition. The survey was incentivized through entering survey respondents into a drawing to win gift certificates.

Sample

A total of 96 students participated in the study. Fifty-four were from stipend-supported schools and 42 were regional winners who competed at the National Judging and Education Event

(NJ&EE). The two samples differed significantly on a number of variables, including grade level, ethnicity, and type of school attended. The NJ&EE students were fairly evenly distributed between the four grade levels, reflecting the equal number of teams selected from each grade level to attend the judging event, while 50 of the 54 stipend-supported school students were in the 8th grade and attended the same school. There were two 7th grade students, and two 9th grade students in the stipend-supported school sample. In terms of ethnicity or race, the stipend-supported school students were predominantly Hispanic, while the NJ&EE students were predominantly Caucasian. Figure 28 compares the two groups of students in regard to ethnicity or race.



The majority of students in both groups attended public schools, but there was greater diversity in the NJ&EE student group. Twenty-eight of the 42 NJ&EE competitors attended public school, three attended charter schools, seven attended private schools, and four attended DoDEA schools; while 53 of the 54 stipend-supported schools students attended public school.

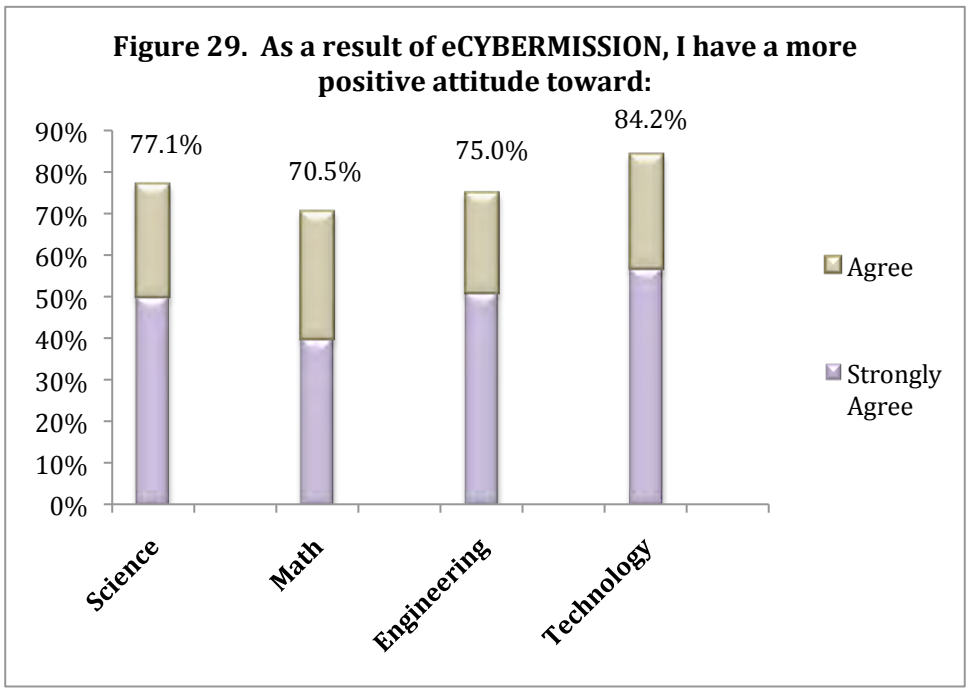
The two groups of students did not differ in terms of gender distribution. They also did not differ in terms of the number of science and math courses that they have already taken.

Findings

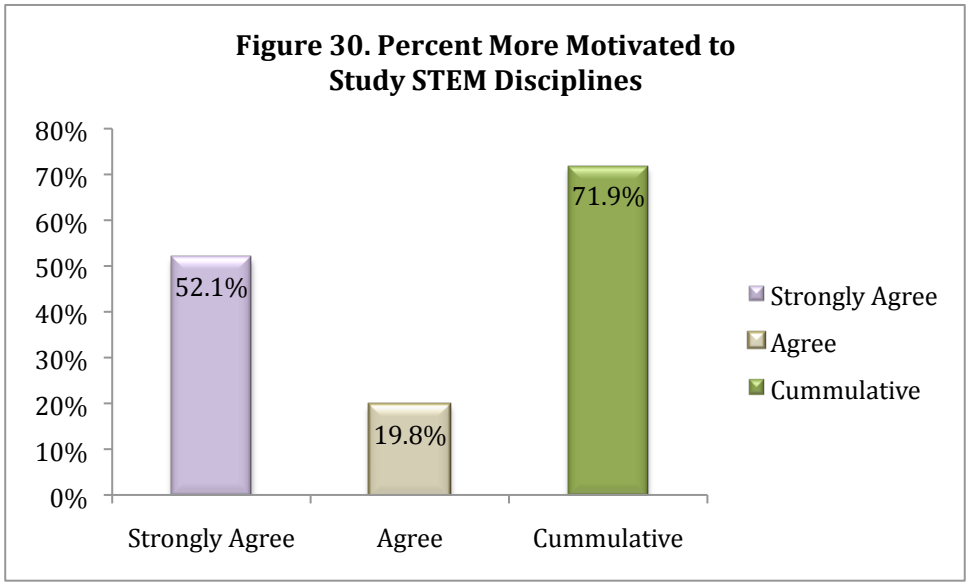
Impacts on STEM Attitudes and Behaviors

Attitudes toward STEM. The 2013 eCYBERMISSION participants reported that their attitudes toward all of the STEM disciplines had become more positive as a result of their participation in eCYBERMISSION, although the impact on attitudes toward mathematics was slightly less than for the other three disciplines. Slightly more than 50% of the students "*strongly* agreed" that their attitudes toward science, technology, and engineering had become more positive. Figure

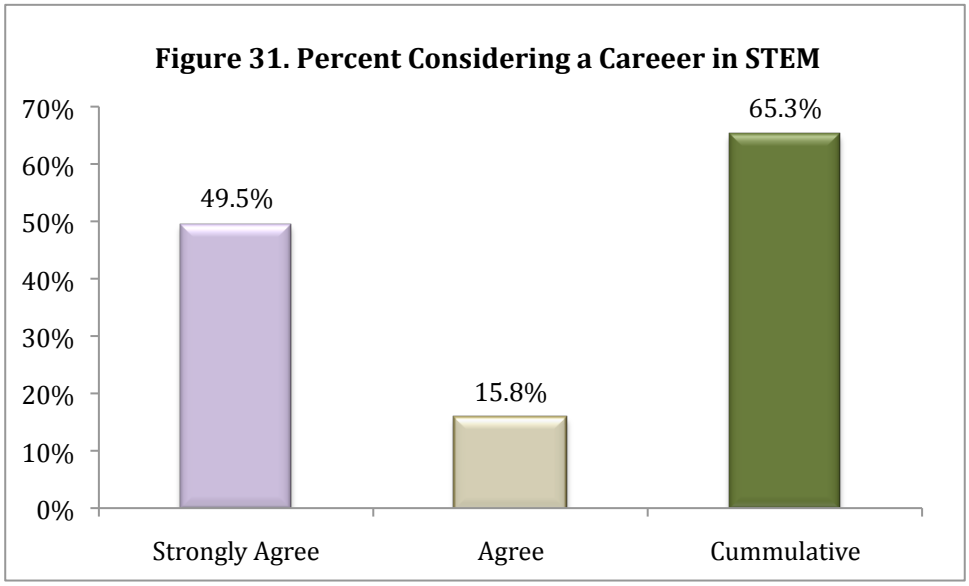
29 shows the total percent of students who agreed or strongly agreed that eCYBERMISSION had affected their attitudes toward STEM.



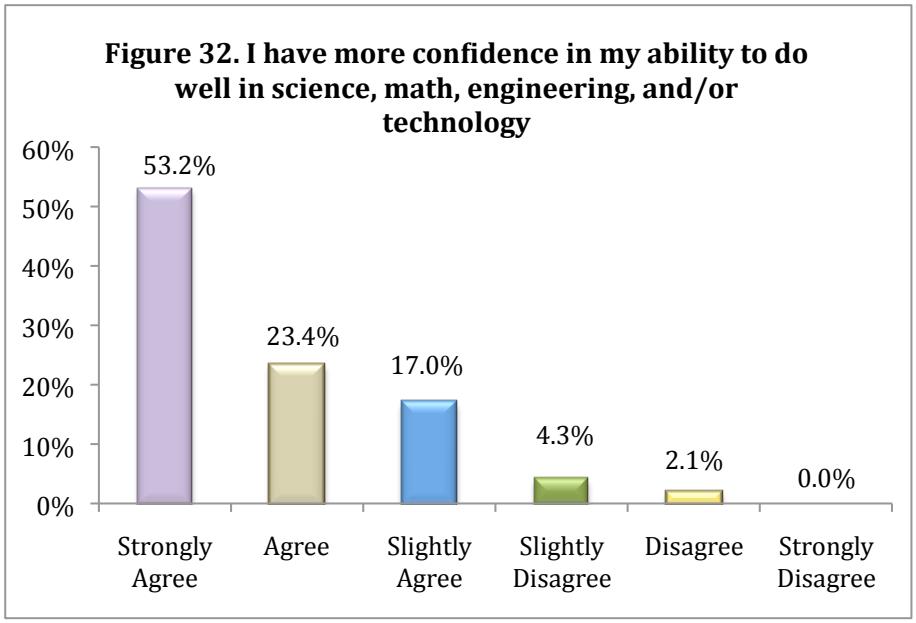
Motivation. The students also reported that they are more motivated to study STEM disciplines as a result of participating in eCYBERMISSION. (See Figure 30.)



Career Aspirations. Nearly half of the students strongly agreed that as a result of eCYBERMISSION they are considering a career in STEM, and another 15.8% agreed that this had happened. (See Figure 31.)

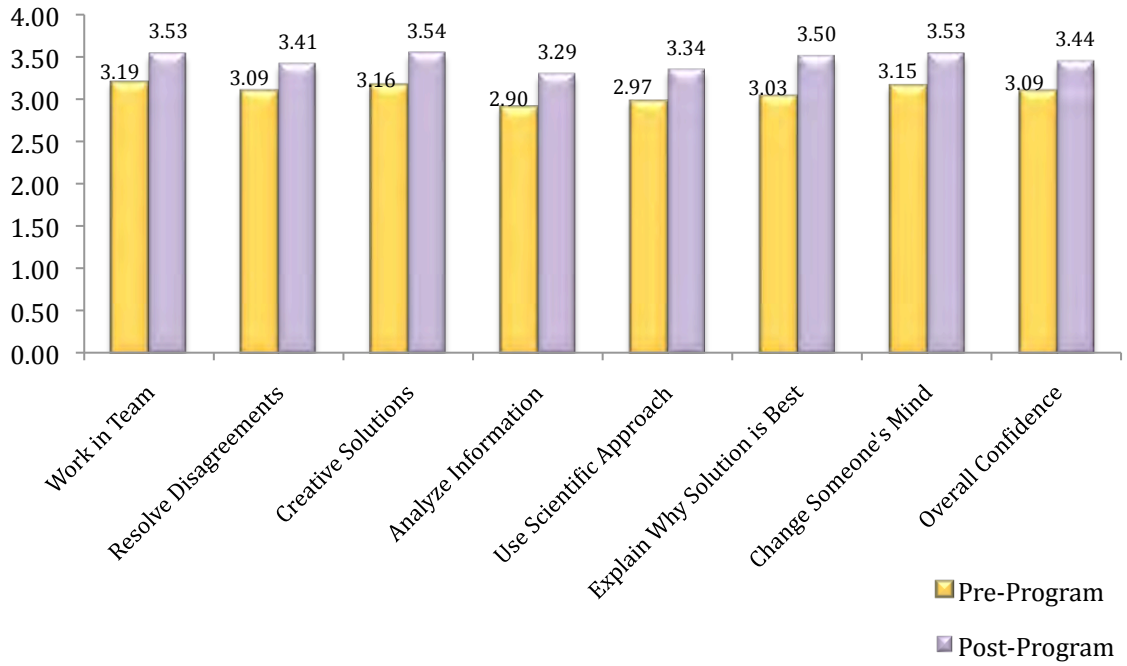


Self-Efficacy. Students became more confident in their ability to do well in STEM disciplines as a result of participation in eCYBERMISSION. Only 6.4% of the students indicated that they had not gained more confidence in their ability to do well in STEM. (See Figure 32.)



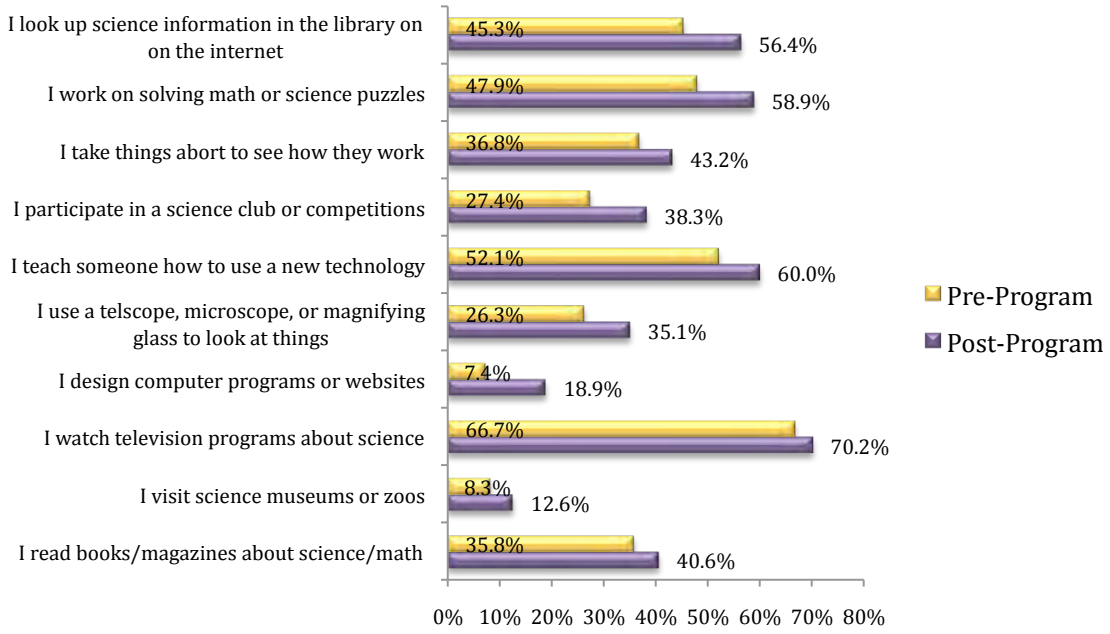
21st Century Skills. Students were asked to rate their confidence in their ability in regard to seven 21st Century Skills on a four point scale (1=not confident, 2=slightly confident, 3=moderately confident, and 4=very confident) for two points in time: prior to and following participation in eCYBERMISSION. Students reported greater confidence in applying 21st Century Skills following their participation in eCYBERMISSION. Figure 33 shows that confidence increased for every skill, and all of the changes in confidence were statistically significant at the $p < .002$ level or better.

Figure 33. Pre and Post Program Confidence in Use of 21st Century Skills

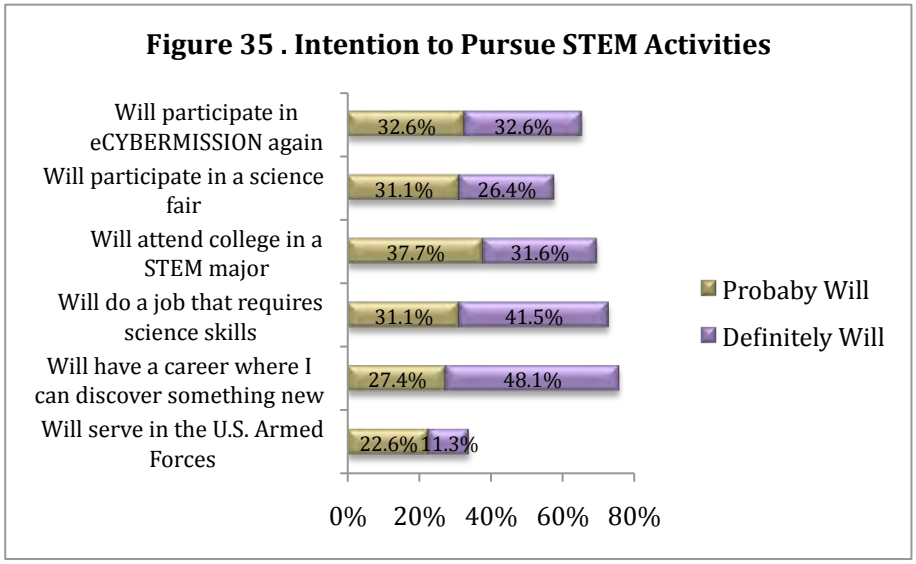


Extra-Curricular STEM Activities. Students were asked how frequently they participated in STEM activities outside of school before and after taking part in eCYBERMISSION. Figure 34 on the following page shows the percent of students who reported doing each activity at least once a month or more, before and after the competition. The percent of students participating in the activities increased for each of the activities, with the greatest increases occurring for "designing computer programs or websites," "solving math or science puzzles," and "looking up science information in the library or on the internet." Participation scores ranged from 1=Never or almost never, 2=Once or twice a year, 3=Every few months, 4=At least once a month, and 5=At least once a week. Scores for each item were totaled and averaged to produce an overall participation score. Pre- and post-program scores were then compared using a paired samples t-test to determine if students had increased their participation in STEM related activities. The increase in the mean scores from 2.83 to 3.06 was statistically significant ($t = -3.494$, $df = 83$, significance (2-tailed)= .001, $n = 84$).

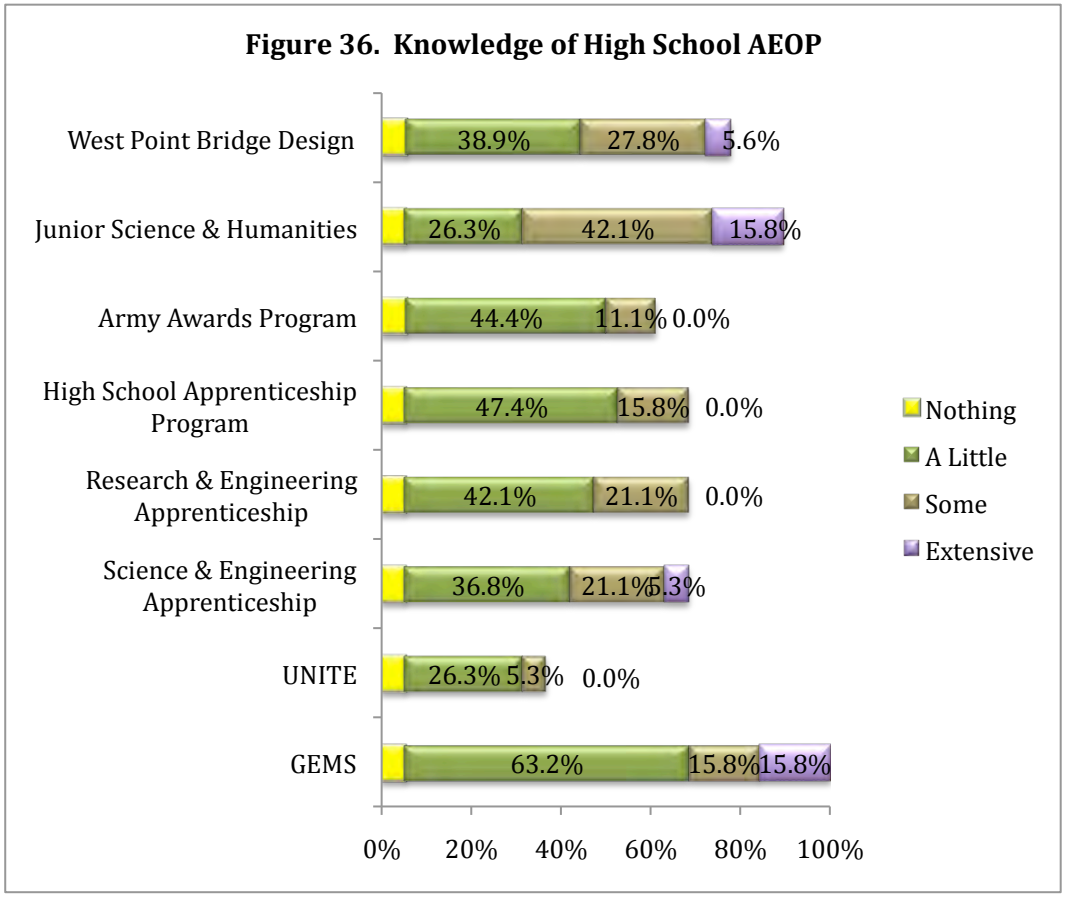
Figure 34. Percent of Students Who Do Activities at Least Once a Month or More



Intention to Engage in STEM Pursuits. A majority of the 2013 eCYBERMISSION competitors indicated that they intend to pursue additional STEM opportunities, in school and in the workplace. Approximately one-third of the participants reported that they "probably" or "definitely" will serve in the U.S. Armed Forces. This interest in serving in the armed forces is a 100% increase over the 18% of winners from the past 10 years of the competition who indicated that they became more interested in serving in the military following their eCYBERMISSION experience. Figure 35 shows the percent of students who intend to engage in additional STEM opportunities.



Other Army Educational Outreach Programs (AEOP). After participating in NJ&EE, students were asked about their knowledge of other AEOP. One hundred percent of the NJ&EE students were familiar with other middle school AEOP, including the Mobil Discovery Center, the Junior Solar Sprint, GEMS, and West Point Bridge Design. One student had participated in the Junior Solar Sprint, and two students had participated in GEMS. However, when asked to rate their level of knowledge about high school AEOP, the results were not unanimous. In fact, most students knew only "a little" or "nothing at all." (See Figure 36.) The one exception is the Junior Science and Humanities Program. These findings suggest that eCYBERMISSION and the NJ&EE could do more to familiarize students with the opportunities that will be available to them as high school students, and to encourage them to participate in other AEOP.

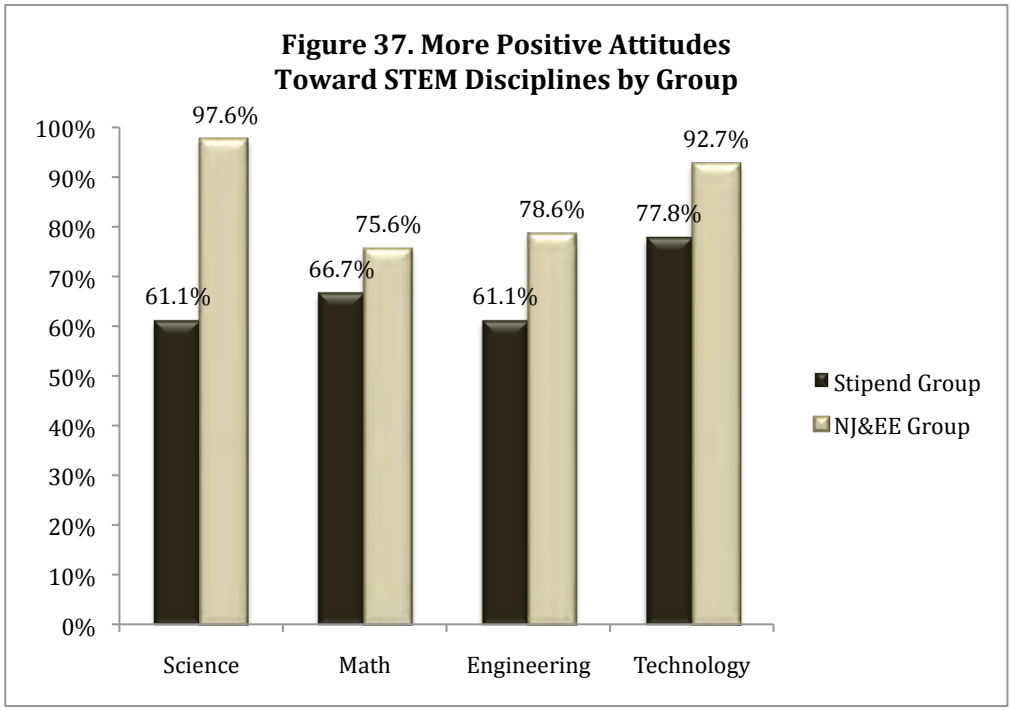


Summary Pre- to Post-Program Impacts

The 2013 eCYBERMISSION competitors attributed positive increases to their participation in eCYBERMISSION for every variable assessed: attitudes toward STEM disciplines, motivation to study STEM disciplines, career aspirations, STEM self-efficacy, 21st Century Skills, and STEM extracurricular activities.

Comparison of NJ&EE Competitors and Stipend School Students

The following series of figures illustrate the differences between the students who reached the national level of the competition (NJ&EE students) and those representing schools that were "seeded" through stipends to expand the program to underserved students. As can be seen in Figures 37 through 40, a greater percentage of NJ&EE students reported positive changes in attitudes, beliefs, and interest in STEM than did Stipend School students. Nevertheless, it is clear that eCYBERMISSION had a positive impact on the Stipend School students as well, given that a majority agreed or strongly agreed that positive changes occurred in every case.



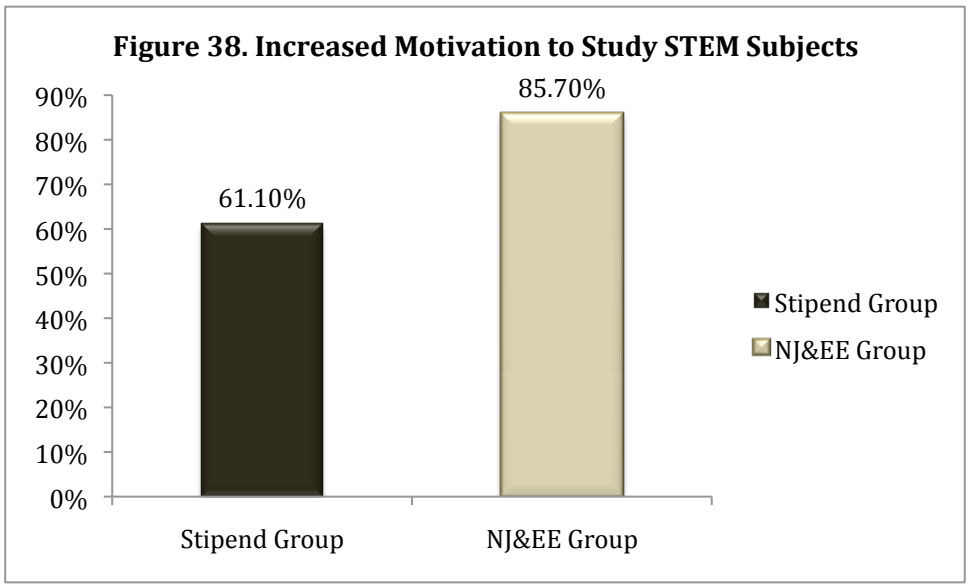


Figure 38. Increased Motivation to Study STEM Subjects
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
61.10%
85.70%
Stipend Group
NJ&EE Group
Stipend Group
NJ&EE Group

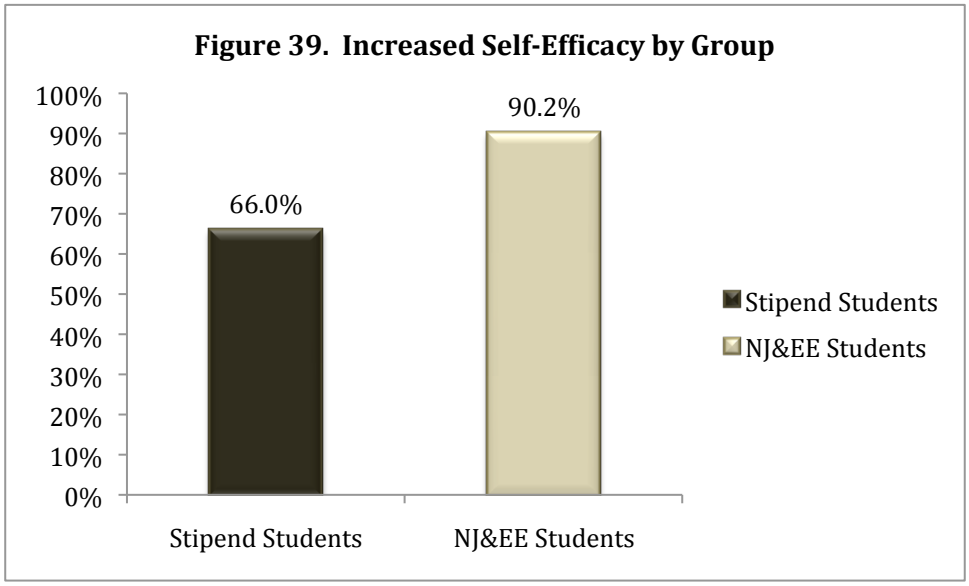
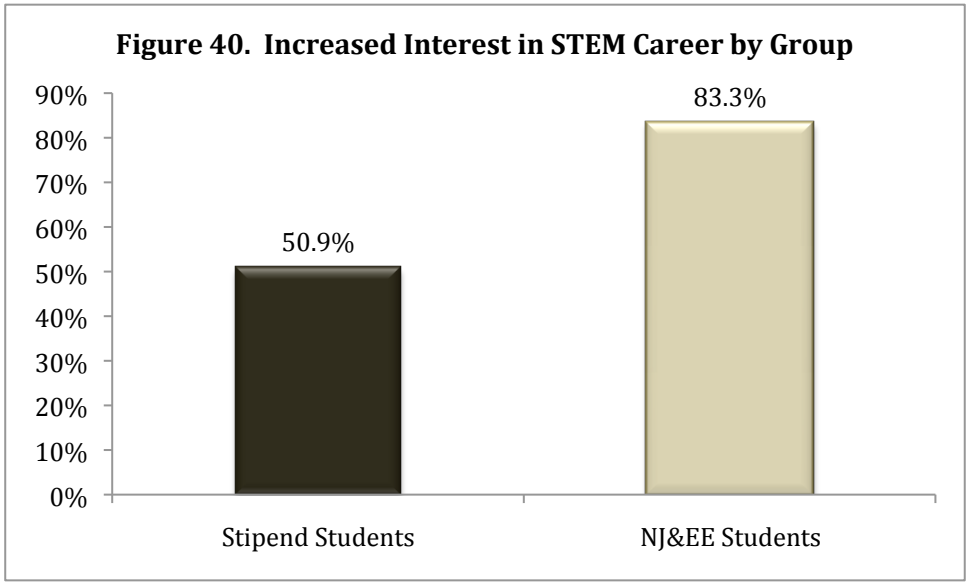
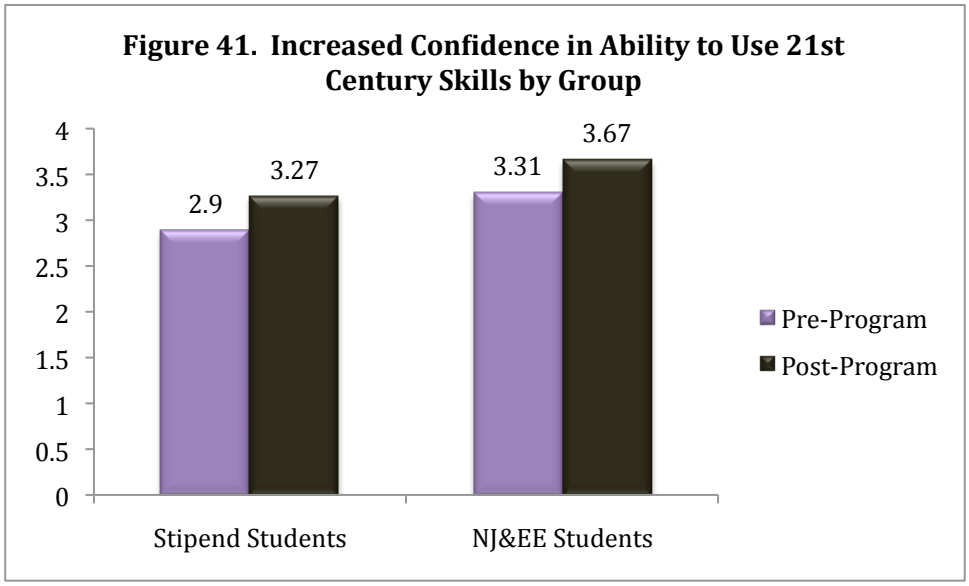
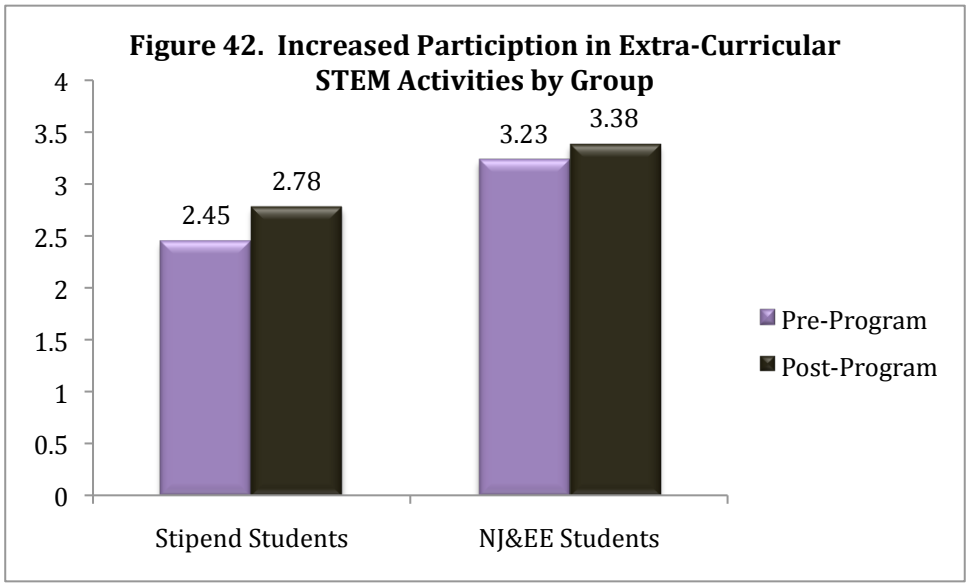


Figure 39. Increased Self-Efficacy by Group
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
66.0%
90.2%
Stipend Students
NJ&EE Students
Stipend Students
NJ&EE Students



In addition, the NJ&EE students scored significantly higher than Stipend School students on the post-program measure of average confidence in ability pertinent to 21st Century Skills ($p < .005$) and the frequency of extra-curricular STEM activities ($p < .002$). However, the NJ&EE students scored significantly higher than Stipend School students on these two measures prior to the competition as well. As can be seen in Figures 41 and 42, the Stipend School students showed equal or greater increases in their scores than did the NJ&EE students.





The two student groups also differed significantly in their intentions to continue to pursue STEM opportunities in school and in their careers. However, there was no significant difference between the two groups in their intentions to serve in the U.S. Armed Forces.

Summary: Differences Between Student Groups

Students in both groups reported positive changes in STEM attitudes, motivation, self-efficacy and confidence, and interest in STEM careers as a result of participating in eCYBERMISSION. In addition, both groups increased their confidence regarding 21st Century Skills and participation in STEM extra-curricular activities. Overall, the NJ&EE students had higher levels of pre-existing interest, motivation, and behaviors prior to and after participating in eCYBERMISSION in comparison to the Stipend School students. However, the changes in interest, motivation, and behavior for Stipend School students were equal to or greater than those found for the NJ&EE students.

Conclusions

Over the past ten years the eCYBERMISSION competition has developed into an effective and respected STEM competition for middle-school school students. Factors contributing to its success include the team approach format, a quality volunteer network of professionals (Cyberguides and Judges), a comprehensive website and infrastructure that permits quick response to questions, the prizes awarded, and the NJ&EE event, including the Tech Expo exhibits and demonstrations and the NCO volunteers. All of these factors contribute to the positive impact of the program on participants' attitudes toward STEM disciplines, self-efficacy related to STEM skills and study, motivation, improved academic achievement, and interest in and pursuit of STEM careers. Moreover, the evidence suggests that these positive outcomes are

true for previous and current participants alike. The lasing impact of eCYBERMISSION on attitudes, motivation, self-efficacy, achievement, and career choice is especially impressive given the multiple influences impacting students' choices and actions related to academics and careers, and the fact that most of the participants enter the competition with a strong pre-existing interest in science. In other words, eCYBERMISSION is one positive factor among many for most of the competitors. Efforts to expand the program to encourage underserved students who may not have this same level of initial interest in STEM are supported by the evidence that these students benefitted from the program to the same extent as the more "typical" competitor.

In spite of the overall excellence of the program, however, there are some areas where both the competition in general and the NJ&EE event could be improved. Participant satisfaction with the NJ&EE has declined slightly over the past few years of the competition, particularly among those who have attended the event multiple times. The NJ&EE maintains high standards and expectations and presents a quality program, but in order to maintain its status, the NJ&EE needs to address concerns about its structure, judging criteria/fairness, location, variety/flexibility of programming, and perceptions that it is not the "fun" and rewarding experience that it used to be. There are also issues related to the program overall. Concerns that should be addressed include the need for more effective marketing of the program, raising awareness of the benefits of the program to students, providing support to teachers and teams in schools with fewer resources, improving the web interface for submitting Mission Folders, finding ways to make participants more aware of the available resources, and providing clearer, more specific guidelines. Perhaps of greatest concern is that so many of the participants, both advisors and students, reported that they were not even aware that the various eCYBERMISSION resources existed.

Considering, implementing and evaluating changes in response to the issues uncovered by the current evaluation are likely to strengthen the appeal, reputation, and impact of the eCYBERMISSION competition.

RECOMMENDATIONS

eCYBERMISSION PROGRAM

1. The current evaluation provides valuable information regarding how eCYBERMISSION is perceived by those who have participated across the years, and how the program has impacted students through the first 11 years of the program. However, the three-part study should be considered the first step in a continuing comprehensive program evaluation. We recommend that the program explore and assess the impact of eCYBERMISSION and NJ&EE annually, so that the effectiveness of ongoing improvements to the program may be assessed. Ideally, annual evaluations will be built into registration for the online program, so that true baseline and post-program data can be collected and analyzed. Annual evaluation will also allow program planners to act

quickly to respond to identified challenges and build on definite strengths. In addition, a longitudinal study tracking cohorts of current and future eCYBERMISSION state and regional winners as they progress through middle school, high school, and undergraduate and graduate school and enter careers will allow for a rigorous and thorough assessment of the long-term impacts of the program.

2. Based on the positive outcomes for students, including those who did not advance beyond the state level of the competition, we recommend that eCYBERMISSION continue to expand its outreach to underserved schools that typically have not participated. Because most of these students are not as invested in science as more traditional competitors, strategies to engage these students should focus on what they say motivates them: school grades or extra-credit, the opportunity to work with friends, and doing something in STEM that is fun. In addition, the opportunity to win Savings Bonds that can be used for college, the online nature of the competition (that does not require traveling to weekend science fairs throughout the year), and the expenses-paid trip to the national competition should be communicated to parents.
3. When recruiting teachers at stipend-supported schools, encourage teachers to work with just one or a few teams, rather than an entire class. Teachers who worked with entire classes found that it was not possible to provide quality feedback and guidance to every team. The opportunity should be open to all students (rather than the teacher deciding who will and will not participate), but one option would be to have students go through an application process with the teacher in order to form a team, and have the teacher decide how many teams they can feasibly manage throughout the year.
4. Creative and strategic marketing is needed to increase awareness of the program. Team Advisors and students alike reported that they had learned about the program from a teacher. The eCYBERMISSION staff should spend some time brainstorming how still more schools and teachers can be reached. This is particularly important if the program hopes to reach students who are not already strongly interested in STEM. The same recommendation holds true for other Army Education Outreach Programs.
5. To encourage parents to get involved, publicize the advantages that the program provides to their children—the prize incentives (Savings Bonds for college), an expense-paid trip to Washington, D.C. for national finalists, and the now documented increases in student interest, motivation, self-confidence, and expanded opportunities that result, at least in part, from participation the program.
6. The website is the "face" of eCYBERMISSION, and as such both markets and represents the program, in addition to providing the means for students to compete. An evaluation specific to the eCYBERMISSION website and its component resources should be conducted to assess user-friendliness, ease-of-navigation, ease of submitting materials, and the use of innovative and fresh content.
7. Provide teams with timely and specific feedback, including comments, from the Cyber judges. This may require communicating clear and specific expectations to all the

volunteer judges. The teams want and need feedback that will help them better understand the strengths and limitations of their projects and their presentation of materials. Students and advisors also called for a clearer communication of the judging criteria.

The National Judging and Education Event (NJ&EE)

8. The NJ&EE is the crown of the eCYBERMISSION competition, and as such it should be exciting and fun for both the student teams and their team advisors. The event adheres to high standards and expectations, and provides opportunities for students to make significant gains in social, communication, and STEM skills. However, participants expect it to also be fun and exciting; in essence, a reward for the accomplishments of the regional winners. Students and team advisors who have participated in other national competitions believe that the NJ&EE does not measure up in this area. The NJ&EE needs to inject more fun into the experience in order for it to remain one of the key motivating factors of the program.
9. It is recommended that the NJ&EE should be located in Washington D.C., where students, advisors, and parents can take advantage of what for some is a "once in a lifetime" trip, to explore our nation's capitol and its plentiful educational opportunities.
10. Students participating in the NJ&EE appreciate and understand the need for security and safety, and that Army discipline is being modeled. But the atmosphere at the NJ&EE would benefit from a somewhat less regimented schedule and greater flexibility in how students and advisors are required to spend their time. Students, and advisors for that matter, were unhappy with the "buddy system" as it is set up now. Advisors need occasional breaks from their teams, and students want a system that holds them accountable without making them feel they are not trustworthy. They understand that they cannot be allowed to roam freely without any supervision at all, but some flexibility is called for. In fact, the students very much appreciate the NCOs and the role they play in the event. The program would benefit from lightening up a bit and finding those situations where it is safe to trust the students to adhere to Army Values.
11. Find additional ways to show appreciation to the teachers, parents, and other adults who serve as Team Advisors. They receive intrinsic satisfaction from seeing their students' excitement, growth, and accomplishments, and for some that is enough. However, in many, if not all instances, the advisors are making sacrifices to attend the NJ&EE and would appreciate some free time as well as more time to interact with other advisors.
12. While the Tech Expo content, scheduled activities, guest speakers, and tours are all highly rated, the event could be improved by injecting some new content and choice, given that several students attend more than once.
13. The overall NJ&EE schedule needs to be expanded or evolve to provide more time for students to interact with students from other teams, to provide more breaks, and to

explore the stops on the tour of D.C. An alternative for the tour would be to provide some choice to the teams on where they would like to spend their time. It is also recommended that travel arrangements be made in such a way that all teams, especially those that travel a great distance, arrive on the same day and that everyone has time to rest up, relax a bit, and start to get to know one another before jumping into the NJ&EE program.

14. Notifying the teams that they will be competing in the NJ&EE needs to happen sooner, if possible, in order for teams to complete the necessary paperwork to get approval from their school districts.
15. Perhaps most important, the judging process must not only be fair, but must be perceived as fair by all who participate. Allowing a Team Advisor to serve as a judge is inappropriate and raises questions regarding how this may have impacted her own team's performance and ratings. At the very least, the other advisors believe that serving as a judge provided that advisor's team with inside information that gave them an unfair advantage. At worst, other competitors may suspect that the advisor's interaction with the other judges may have influenced their ratings of her team. It's a good idea to have one or more teachers serving as judges, but any advisor to a team competing at NJ&EE should not be invited to serve as a judge.

"ECYBERMISSION has increased my confidence and passion that I can excel and contribute towards the STEM fields, and has no doubt increased my desire to attend a STEM-based high school and college."

-- *A* 2012-2013 Competitor