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They Choose to Attend Academic Summer Camps? A Mixed Methods Study Exploring the Impact of a NASA Academic Summer Pre-Engineering Camp On Middle School Students in a Latino Community

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Keywords

pre-engineering camp, motivation, middle school students, Latinos, STEM careers, informal learning, NASA

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Abstract

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Introduction

Students' attraction to and retention of science, technology, engineering, and mathematics (STEM) disciplines along the full length of their education is a national imperative. Many efforts to improve STEM education have traditionally been targeted at high school students, and while helpful, it is also important to motivate and prepare students at even younger ages. Elementary-aged students have the ability to understand and learn about engineering concepts, practices, and careers at a very young age. This learning can be further motivated when parents and teachers are involved in both formal and informal learning spaces. The emphasis of engineering at the K–8 level is critical to addressing the academic preparation challenges faced by college students in STEM courses, and serves as a response to the prominent placement of engineering in the new Framework for K–12 Science Education (National Research Council, 2012). Additionally, effective instruction

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can reaffirm students' cultural, ethnic, and linguistic heritages (Jordan, Tharp, & Baird-Vogt, 1992; Lucas, Henze, & Donato, 1990), even in the context of STEM subjects.

Informal learning experiences are ones that take place outside of the formal classroom. For example, many informal learning experiences focus on science learning, including the educational experiences delivered by science museums, zoos, and hands-on children's museums. Some researchers (Bhattacharyya, Mead, & Nathaniel, 2011) have found such experiences to make significant contributions as learning opportunities for students. Academic summer camps can fall somewhere in between informal and formal learning environments based on the setting, the instructional organization, and the curricula. In this study, the STEM summer camps take place in a classroom setting, instructed by teams of teachers, but the curriculum is a uniquely designed learning program that integrates NASA scientific contexts with grade-appropriate algebraic concepts to create exciting hands-on engineering design activities. The design of the summer camps in this study (NASA science and algebra summer camps) is based on prior studies that have explored the impact of the summer camp learning experience on students' career awareness and interest in STEM fields. Martinez Ortiz and colleagues (2015) presented a summer program for underrepresented students in STEM that was purposefully designed to integrate green energy concepts with engineering design. Findings indicated that the camp experience was indeed informative in clarifying students' understanding of the field and increasing career interests. Other STEM summer camp program studies have shown how these types of experiences have increased student motivation and interest in careers in STEM fields (Mohr-Schroeder et al., 2014).

The NASA science and algebra summer camps, which will be further described in the following sections, offered early space-based STEM learning experiences for upper elementary and middle school students, bilingual outreach initiatives for their families, and professional development for the teachers who served as camp instructors. The consistent curricular framework for these camps was grade appropriate and standards based, with a distinct space theme and an underlying framework that focused on algebraic reasoning and engineering problem solving and design. The overall summer program was a no-cost, six-day camp organized by grade level for student teams of up to 15 participants from third to eighth grade. This study will report on the experiences of participants in these camps, including changes in their self-reported motivation, self-efficacy, and self-determination regarding STEM skills, and connections to career aspirations.

Importance of Algebraic Reasoning

According to the 2005 National Assessment of Educational Progress (NAEP, 2005) results, the discrepancy in scores between White and African American eighth-grade students, as well as those between White and Latino eighth-grade students, has persisted over the last ten years (Loveless, 2008; NAEP, 2008). This is concerning, since mathematical literacy is considered to be a critical factor or gateway for students, and is linked to college readiness and success in higher education, careers, and social stability (Allexsaht-Snider & Hart, 2001; Chazan, 2000; Moses & Cobb, 2001). Algebraic reasoning is one of the mathematics learning strands supported by standards in most states for children in Grades K–12. In essence, teaching students to develop skills in algebraic reasoning means that students are taught the various topics of mathematics, including number sense and numeric operations, in a manner that requires a higher level of in-depth critical thinking. By familiarizing students with abstract algebraic ideas applied in realistic, engaging contexts, students learn more deeply and perform better in the mathematics classroom (Brizuela & Earnest, 2008).

The NASA science and algebra summer camps are guided by principles of constructivist learning theories (Piaget, 1965), social constructivist theories (Vygotsky & Cole, 1978), and constructionist approaches (Papert, 1980). Piaget's constructivist learning theory proposes that children construct their own knowledge through active physical and sensory experiences, leading them to construct and organize patterns of ideas (logico-mathematical knowledge) and through social experiences (social-conventional knowledge; Piaget, Henriques, & Ascher, 1992). The activities utilizing design in engineering education serve as a potential context for providing the kinds of experiences Piaget alluded to in his research, as these experiences allow the learner to: (1) actively engage in his or her own learning process, (2) reflect on the use of existing structures of knowledge, and (3) benefit from constructed learning in an environment that values participation and interaction among students, teachers, and other resources (de Miranda, 2004; Ball, 2000).

Engineering Problem Solving and Design as Context

Curricular units and engineering activities have been successfully developed and introduced in elementary classrooms, as well as secondary mathematics and science classrooms. In a series of hands-on investigations for middle school students, Wong and Brizuela (2006) offer integrated engineering design activities in which students collect and analyze their own mathematical data while considering real-world situations. These research-based activities allow students to develop algebraic thinking skills in engineering-integrated contexts.

Research has indicated that engineering curriculum and instruction in classrooms for Grades K–12 can serve as a vehicle to teach other content areas in a cross-curricular fashion (Martinez Ortiz, 2011). For example, certain engineering curricula have been found to impact learning in the specific content areas of mathematics and science.

The National Science Education Standards and Benchmarks for Science Literacy (AAAS, 1993), and now the Next Generation Science Standards (2013), call for a learning environment that is student-centered and engages students in asking their own questions and designing experiments to solve problems. They also call for students to make physical system models that demonstrate their learning and understanding. K–12 engineering education experiences may facilitate meeting these objectives, and efforts have already resulted in novel curricular approaches that include formally structured activities and learning objectives guided by state curricular standards in mathematics and/or science (American Association for the Advancement of Science, 1993).

In addressing the numerous factors that contribute to unequal participation of minorities in science education, many are in agreement that early exposure to STEM careers is essential (Heckman, 2006; Kazakoff, Sullivan, & Bers, 2013; Nadelson et al., 2013). Throughout the last decade, researchers have recommended that career exploration and awareness begin before high school (Castellano, Stringfield, & Stone, 2002; Fouad, 1995; O'Brien, Dukstein, Jackson, Tomlinson, & Kamatuka, 1999). A study using nationally representative longitudinal data suggests that to attract students to science and engineering, close attention should be paid to their early exposure to science at the middle and even earlier grades (Tai, Liu, Maltese, & Fan, 2006). The concept of elementary school career education has gained momentum in recent years. According to Ediger (2000), "the elementary school years are not too early to begin to achieve a vision of what one desires to do in life contributing to the world of work" (p. 1).

Community partnerships are mentioned by career education experts as one of the "tools" that can increase students' awareness of their own interests and help them learn about a wide variety of occupations (Hogan, 1995). Furthermore, research on cultural-historical factors and their influence on Latino student educational success points to community as a particularly important element (Goldenberg, Reese, & Gallimore, 1992). The NASA science and algebra summer camps included a strong community partnership element and featured a career awareness component by exposing young children to role models from various NASA digital resources, "Engineering is Elementary" storybooks (Cunningham, Lachapelle, Lindgren-Streicher, & Martinez Ortiz, 2005), as well as local Latina/o speakers who are professionals in the STEM fields. It is indeed powerful for children to hear from someone who looks like them, and to learn from their story, their journey, and their career. It is expected that exposing children to STEM careers at a young age and over a period of a year or more will reap enormous benefits for participating individuals. Such career awareness is essential for students to learn the skills they need to succeed in the 21st century.

Standards Aligned Curriculum

Alignment of curricula across disciplines from Grades K–12, through the integration of mathematics, science, and the engineering process, has been recognized as a way to improve STEM education (Duschl et al., 2007). The curricula designed for the summer programs are aligned with the Texas Essential Knowledge and Skills (TEKS; TEA, 2010) and the Common Core State Standards for mathematics (National Governors Association Center for Best Practices, 2010). Teachers who serve in the summer camps as camp co-leads also participate in professional development opportunities designed specifically to prepare them for the objectives of the summer camps. At the summer camp professional development sessions, teachers receive training on the curriculum, instructional strategies, and research regarding best practices in STEM education. The purpose of the professional development sessions and teacher participation in the summer camps is to give teachers the tools to effectively implement STEM education in their summer classrooms, and possibly into their year-round classrooms as well. The resources shared with teachers at the summer camps can easily be implemented and adapted to their teaching environments.

Methodology

Context of Study

The NASA science and algebra summer camp participants in Grades 3–8 received 36 hours of instruction in integrated algebraic reasoning, science, and engineering design. This study focused on the six-day middle school summer camps (Grades 6–8). Each grade had a themed session: robotics for sixth grade, life in space for seventh grade, and rocketry for eighth grade. This study employed a mixed-methods approach to analyze how changes in middle school students' affective characteristics might be linked to their future career decision-making following participation in an integrated STEM summer camp. This article focuses on participants' responses to the Engineering Motivation Questionnaire (EMQ, adapted from the Science Motivation Questionnaire ii; Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011) and Middle School Students' Attitude to Mathematics, Science, and Engineering Survey (MSE; Gibbons, Hirsch, Kimmel, Rockland, & Bloom, 2004), along with participants' responses to post-intervention interviews.

Study Participants

Sixty-five students participated in the NASA science and algebra summer camps, of which a total of 52 participants' pre- and post-data were matched. The demographics presented represent only the 52 matched records. Participants were rising sixth through eighth graders from local middle schools. Data shows that 35% were female

Table 1
Demographics of 2016 summer camp participants by grade level.

	Female	Male	Latino	White	African American	Other
Grade Six	52.9%	47.1%	76.5%	17.6%	5.9%	0.0%
Grade Seven	27.8%	72.2%	55.6%	22.2%	5.6%	16.6%
Grade Eight	23.5%	76.5%	35.3%	41.2%	5.9%	17.6%

and 65% were male. As represented in Table 1, as the grade level increased the number of female participants decreased. The ethnic makeup of the participants reflected the demographics of the local school district, with 56% Latino participants, 27% White participants, 5% African-American participants, and 12% Other.

Data Collection

Data collection took place at the beginning and at the end of the six-day middle school summer camps. Quantitative data was obtained through the administration of pre- and posttest surveys. Pretest surveys were administered on the first day and posttest surveys were administered on the last instructional day (the very last half day of the camp was devoted to participants' presentations of their work). The following three measures were administered to the participants: (1) Iowa Algebra Aptitude Test (Schoen & Ansley, 2006), (2) Engineering Motivation Questionnaire (EMQ; Glynn et al., 2011), and (3) Middle School Students' Attitude to Mathematics, Science, and Engineering Survey (MSE; Gibbons et al., 2004). The results of the EMQ and MSE will be explored further in this article.

Qualitative data was obtained through one-on-one, semi-structured interviews with summer camp participants at the end of each summer camp session. These interviews probed participants' understanding of the mathematics, science, and engineering concepts covered in the camp, along with their attitudes and beliefs about engineering and engineering careers. Researchers and camp staff, who were trained on implementation of the camps-specific interview protocols, conducted the one-on-one interviews with camp participants, which averaged 20–30 minutes in length. After data collection, each participant was assigned a unique identifier and the data corpus was anonymized.

Data Analysis

Quantitative

Engineering Motivation Questionnaire (EMQ)

The Engineering Motivation Questionnaire (EMQ) was adapted from the Science Motivation Questionnaire ii (Glynn et al., 2011). The word "science" in the original SMQii was replaced with "engineering." The EMQ was administered to 67 students. Forty-eight participants, matched by a unique identifier, had both pretest and posttest surveys. Only these 48 records were used for the data analysis of the EMQ results. This survey probed students on the constructs of motivation and self-efficacy concerning the following components: intrinsic motivation, self-efficacy, self-determination, grade motivation, and career motivation. Each question had three collapsed categories ranging from zero (I Don't Know) to one (Disagree) and two (Agree). A scale score for each aforementioned component was calculated by averaging the scores of the questions that probed that component. Therefore, each component scale score ranges from zero to twenty, with a higher mean being desirable.

Middle School Students' Attitude to Mathematics, Science, and Engineering Survey (MSE)

The MSE (Gibbons et al., 2004) was also used to investigate participant attitudes. Sixty-three records, matched by a unique identifier, had both pretest and posttest surveys. Only these 63 records were used for the data analysis of the MSE results. The survey probed participants' knowledge of engineering careers, exposure to engineering careers, and attitudes and beliefs about engineering. The MSE probed the following six components: interest-stereotypic aspects, interest-non-stereotypic aspects, positive opinions, negative opinions, problem solving, and technical skills. Each component included a varying number of questions. Consequently, the scale score for each component was calculated by adding up participants' scores for all questions within a component and dividing it by the number of questions. Therefore, each component's scale score ranges from zero to two.

To determine whether there were any significant changes in students' responses in both the EMQ and the MSE, a paired *t*-test and a Cohen's *d* test were conducted using the IBM SPSS statistical application. For pre-post design data analysis of numerical data, a paired *t*-test was used as the simplest form of analysis to determine statistically significant results (Arifin, 2014). Running paired *t*-tests is an analytical technique that can be used for normally distributed data and does not require large sample sizes. The most commonly used critical value for the *t*-test is .05 or less. The Cohen's *d* is an effect size that accompanies the reporting of the *t*-test and was conducted to determine the practical significance of the EMQ and the MSE results for statistically significant findings. The relatively low number of participants can artificially deflate the statistical significance, and therefore the practical significance was also calculated. As a general guideline, a value of Cohen's *d* below 0.20 is considered small, 0.50 medium, and 0.80 large (Cumming, 2012).

Qualitative

We used qualitative methods to examine changes in middle school camp participants' motivation, self-efficacy, and self-determination, which may be linked to career decisions and course choices in their future. The qualitative findings were based on transcripts from 53 interviews of sixth- through eighth-grade camp participants, conducted during the last two days of the summer camp. There were 17 participants in sixth grade, 19 participants in seventh grade, and 17 participants in eighth grade who were interviewed. Each interview lasted approximately 20–30 minutes and was conducted one-on-one by a researcher. Each interview included both a clinical task portion and an affective characteristic portion. For the purposes of this study, only the affective characteristic portion is reported.

In order to analyze text data of the interviews of the participants, a qualitative content analysis technique referred to by Hsieh and Shannon (2005) as "directed content analysis" was used. While content analysis, in general, interprets meaning from the texts of the data, the directed content analysis "starts with a theory or relevant research findings as guidance for initial codes" (Hsieh & Shannon, 2005). The research team was informed by studies in motivation, self-efficacy, and self-determination to guide the analysis of the interview texts. The following are the working definitions for the qualitative analysis conducted.

- Motivation "is an internal state that arouses, directs, and sustains students' behavior. The study of motivation by science education researchers attempts to explain why students strive for particular goals when learning science, how intensely they strive, how long they strive, and what feelings and emotions characterize them in the process" (Glynn & Koballa, 2006, p. 25). Operationalized for middle school students, the middle school participants' reasons for "wanting to" do something were investigated.
- "Self-Efficacy is a person's belief about his or her capabilities to produce designated levels of performance that exercise influence over events, e.g., accomplish or succeed in a task or situation" (Bandura, 1997, p. 160). Operationalized for middle school students, participants' words were investigated for when they felt they "could" do something.
- Self-Determination "is the ability to have choices and some degree of control over what we do and how we do it" (Koballa & Glynn, 2010, p. 38). Operationalized for middle school students, instances where participants had decided they "would" do something were investigated.

Quantitative Findings

Participants' pre- posttest responses to the Engineering Motivation Questionnaire (EMQ) and Middle School Students' Attitude to Mathematics, Science, and Engineering Survey (MSE) were collected at the start and end of the summer camp program (Glynn et al., 2011; Gibbons et al., 2004). Table 2 displays participants' pre- and posttest scores, along with results from *t*-tests comparing the pretest and posttest scores.

The participants' pretest scores were not statistically ($p < 0.05$) or practically (Cohen's *d* greater than 0.5) different from the posttest scores on any of the five subscale measures or overall. Differences in scores between the genders were also not statistically or practically significant ($p < 0.5$).

The Middle School Students' Attitude to Mathematics, Science, and Engineering Survey (MSE) probed participants' attitudes and beliefs about engineering and engineering careers along six components. Table 3 shows each MSE component's scale scores and *t*-test results.

Similar to the EMQ results, the pretest scores were not statistically ($p < 0.05$) or practically (Cohen's *d* greater than 0.5) different from the posttest scores on any of the

Table 2
EMQ responses and *t*-test results ($n = 48$).

	Intrinsic Motivation	Self-Efficacy	Self-Determination	Grade Motivation	Career Motivation	Overall
Pretest *M* (*SD*)	13.19 (4.077)	15.19 (3.648)	12.42 (4.292)	14.35 (4.045)	14.52 (4.000)	69.67 (16.753)
Posttest *M* (*SD*)	13.92 (4.404)	15.29 (3.946)	12.98 (5.349)	14.67 (4.982)	14.82 (4.088)	71.67 (19.126)
t (*df*)	-1.92 (47)	-.26 (47)	-1.35 (47)	-.67 (47)	-.60 (47)	-1.33 (47)
p	.061	.799	.185	.507	.553	.189
Cohen's *d*	.172	.026	.115	.071	.072	.111

Note: Items were phrased such that a higher mean is more desirable.

Table 3
MSE responses and *t*-tests results ($n = 63$).

	Interest: Stereotypic Aspects	Interest: Non-Stereotypic Aspects	Positive Opinions	Negative Opinions	Problem Solving	Technical Skills
# of Questions	7	4	4	6	3	3
Pretest *M* (*SD*)	1.10 (.51)	1.14 (.57)	1.09 (.61)	1.02 (.22)	1.30 (.68)	1.34 (.56)
Posttest *M* (*SD*)	1.12 (.53)	1.13 (.62)	1.14 (.60)	1.05 (.25)	1.32 (.70)	1.34 (.63)

Table 4
Who talked to the participants about engineering careers responses and *t*-test results.

N = 63	TV Movies	Friends	Teachers (Personal)	Teachers (Class)	Parents	Counselors
Pretest *M* (*SD*)	1.40 (.64)	.68 (.62)	.68 (.80)	.97 (.72)	1.11 (.76)	.41 (.64)
Posttest *M* (*SD*)	1.19 (.59)	.73 (.67)	.65 (.72)	1.03 (.72)	.95 (.77)	.35 (.63)
t (*df*)	2.51 (62)	-.60 (62)	.39 (62)	-.63 (62)	2.45 (62)	.94 (62)
p	.015*	.553	.698	.531	.017*	.350
Cohen's *d*	.35	.08	.04	.08	.21	.09

*Statistically significant. Higher mean implies more times heard about engineering careers.

six subscale measures. This shows similar results between the two measures. Participants' motivation was probed more deeply by analyzing their responses to open-ended questions (presented in the Qualitative Findings section).

The MSE survey also asked participants to rank how many times they had heard about engineering careers from various sources. The sources included television and movies, friends, personally from their teachers, teachers to the whole class, parents and/or guardians, and school counselors. Participants were asked to rank the number of times they had heard about engineering careers on a scale where zero is equivalent to "never," one is equivalent to "1–2 times," and three is equivalent to "many times." Table 4 shows the average responses from participants along with a comparison of participants' pre- and posttest scores (*t*-tests).

Participants' responses were statistically significantly different in pre- and posttest results for TV/Movies (t (62) = 2.51, p = 0.015) and Parents (t (62) = 2.45, p = 0.017). Focusing on the parental difference, this implies that parents talked with participants significantly more by the end of the camp than at the start of the camp. This shows a positive effect of the camp on the participants and their families.

Qualitative Findings

In order to decrease bias and minimize variability in interpretation of the codes, we chose a small sample to code prior to coding all 53 transcripts. For the purposes of interrater reliability and determination of coding consensus of the affective characteristics, three of the researchers independently coded nine of the 53 interview transcripts. Three transcripts were randomly chosen from each grade level. We were able to reach agreement on our codes before coding the remaining 44 transcripts.

In the following section, the findings are broken down by the three characteristics and participant quotes are provided to illustrate how participants expressed the effect the camp had on them in terms of each affective characteristic.

Motivation

Camp participants reported how excited they were to conduct projects and experiments, which combined working hard with having fun: "Playing with Legos (is my favorite part), because I get to create things. I love creating things." This seventh-grade participant recognized the need to use their brain to be innovative: "I feel like not just to be smart, but to be healthy, to be strong [*sic*]. It isn't all about the brains. Most of it's the brains, otherwise who'd come up with NASA and stuff like that."

An eighth-grade participant reported, "I was already thinking about it (a STEM career) but I think it made me for sure that I want to be an engineer later on [*sic*]." The participant enjoyed the rocket launch experiment, as (s)he reports, "I think it was just really fun to launch them (rockets) because my group worked really well, and I was just proud that I built something like that."

A sixth-grade participant was surprised that engineering could be so much fun and that there were so many kinds of engineers. (S)he says, "I thought it [camp] was so much fun and so now I'm thinking that my job in the future would be fun, because, I want to be a robotics engineer." Another sixth grader hadn't previously known about engineering careers, as s(he) related in the interview: "I didn't really know what engineers do much before and now that I do, I really want to become one. The one I like the most is environmental engineering."

In summary, the camp provided a setting for participants to creatively experience science, engineering, and mathematics learning while working within a friendly team structure. Some participants were surprised that their projects were related to ones that engineers work on in the real world, and reported considering career options along these lines.

Self-Efficacy

Many of the participants mentioned that they were confident in their mathematics and science abilities. The following is an example stated confidently by a sixth grader: "I'm great at math, and I like it!" Others expressed the desire to take advanced math classes, including this eighth-grade participant: "I already do [take advanced math classes], so I was planning on it, to still do that." While their sense of confidence in mathematics and science may not be completely attributable to their NASA science and algebra summer camp experience, the camp may have contributed to building their sense of efficacy even more, as they challenged themselves in new settings.

Other participants felt greater confidence in their ability to independently design and build some of the objects that they had built at camp. One eighth-grade participant was asked if (s)he could build a rocket—to which the participant replied, "On my own, yeah!"

In summary, most of the participants seemed to feel very confident in their mathematics and/or science abilities and reported affirmatively that they would challenge themselves with advanced courses in their future schooling.

Self-Determination

Using the working definition of self-determination as the ". . . ability to have choices and some degree of control over what we do and how we do it" (Reeve, Nix, & Hamm, 2003), we observed participants who would elect to take advanced math and science courses or to join a STEM club. An eighth grader indicated that a path toward a STEM career involved an ". . . attempt to get the highest grades you can, and then just—and do lots of extracurriculars, depending on which kind— which field you want to go into, and research the best college for whichever field that you want [*sic*]."

Others were weighing their career options and reported becoming more certain of their choice. When asked what kind of career they were considering, one sixth grader reported, "Scientist maybe. I'm still holding on to what I've wanted to be since I was like five."

In summary, the participants had a sense that the path toward a STEM field would involve intense study, college, and learning about science and math. Their determination seemed palpable, as stated in the words of a sixth-grade participant: ". . . you need to go with your goals, and stick to them, until you've passed it, and go for greater, like foremost and beyond."

Discussion

The constructs of motivation, self-efficacy, and self-determination of NASA science and algebra summer camp participants were measured quantitatively and qualitatively. Participants' responses to the EMQ and SME did not show significant differences in participants' intrinsic motivation nor in their interest in engineering careers over the course of the camp. One factor that may have affected these quantitative results is methodological, regarding the timing and method of data collection. It is often challenging to motivate students to participate as enthusiastically in the data collection aspects of a program as in the program activities. During the first and last days of the summer camp, participants were asked to complete both the EMQ and the SME. Compared with the entertaining and exciting engineering activities of the summer camp, the participants found the pre-post testing to be significantly less enjoyable. This could have affected the participants' performance on the pre-post testing due to lack of commitment to reading and answering the questions on the surveys accurately. This is an area of opportunity for improvement, and shorter survey sections will be administered in the future.

Although no statistically significant differences were found among the participants' pre- and posttest responses to motivation or career decision making, the interview data provided qualitative evidence that participants' experiences during camp did indeed impact their outlook toward engineering and other science, technology, and mathematics careers. While research about children's career development is limited (Watson & McMahon, 2008; Porfeli, Hartung, & Vondracek, 2008), the qualitative study by Rowan-Kenyon, Swan, and Creager (2012) examined social cognitive factors, support, and engagement of early adolescents' math interests as precursors to career choices. Their findings indicate that using group work and extrinsic motivation in middle school math classes broadened interest. This is consistent with our findings across the three middle school grades, which show that group projects challenged participants to think creatively and collaboratively, and allowed them to experience the joy of successful rocket launches or responsive robots—aspects that could now be viewed as part of an engineering career. This also provided motivation for participants to consider engaging in such "fun" projects with an eye toward future careers as engineers and scientists.

Participants' responses to the EMQ and SME did not show significant changes in their self-efficacy over the course of the camp. Therefore, participants' responses during qualitative interviews were investigated to further understand participants' self-efficacy. From our interview findings, we determined that due to self-selection, many of the participants arrived at camp with an existing high sense of self-efficacy. For example, when asked about their confidence in succeeding in the advanced math classes, participants across grades were generally confident in their ability and inclination toward taking the advanced math and science classes offered in their schools. The summer camp opportunities that invited participants to perform and complete specific tasks, particularly as group projects, further reinforced their perceptions of their ability to persist. For example, research by Britner and Pajares (2006) found that participants' mastery experiences were the only statistically significant predictor of science self-efficacy.

Similar to motivation and self-efficacy, statistically significant differences in participants' self-determination were not found. Our qualitative data provided evidence that the camp raised an awareness of requirements for pursuing a STEM career such as entrance into college, as a seventh grader indicated that (s)he was "going to try a little bit more harder" and an eighth grader voiced his/her intent to "pick the best college . . . and learn about engineering or to become one." Another eighth grader planned to work harder and participate in projects to learn more about science so that (s)he can become a scientist. In light of research showing that academic intrinsic motivation decreases from

Grades 3–8 (Lepper, Corpus, & Iyengar, 2005), the opportunities provided at the summer camp suggest such informal, out-of-school experiences may help to increase rather than decrease motivation and self-determination of its participants. Future studies will follow these students longitudinally to measure sustained interest, record academic choices taken, and administer post-post responses to the same surveys and constructs.

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