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Paving the Road into College and STEM for Latino Students

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ABSTRACT: The purpose of this study is to thoroughly describe a program designed to strengthen the pipeline of Latino students into post-secondary science, technology, engineering, and mathematics (STEM) education, and present evaluation data to assess multiyear effectiveness. The program includes a suite of interventions aimed at students and families, and was implemented in a low-income school cluster with a high Latino population in metro Atlanta. Our intervention includes a high school and middle school mentoring program, STEM-focused extracurricular activities (summer camps, research and community service opportunities), and college and STEM career-focused community events for families. Results suggest that GoSTEM has a positive impact on students and families with respect to college and career awareness. The mentoring program components also increase students' college readiness and self-regulatory skills at the high school level. The extracurricular programs support this effort by increasing students' STEM-related content knowledge and learning, and their understanding about STEM careers for both high school and middle school students. Lessons learned are also presented to help guide other practitioners of Latino outreach programs.

INTRODUCTION

Latinos remain vastly underrepresented in STEM fields (NSF, 2013), despite their rapid population growth in the U.S. (Passel and Cohn, 2008). Numerous factors and barriers have been identified as contributors to Latino underrepresentation in STEM, including issues of inadequate high school preparation, inadequate or insufficient guidance and mentoring (Taningco et al., 2008), pervasive achievement gaps that start very early in education (Gándara, 2006), limited access to role models (Simard, 2009), parents' socio-economic level (Taningco et al., 2008), immigration status, lack of information on college financial aid opportunities, and limited access to college preparation courses (Zárate and Fabienke, 2007). Because of the multifaceted and complex interrelation between these factors, researchers describe the conditions experienced by many Latino students in the U.S. as one of "accumulated disadvantage" (Schneider et al., 2006). STEM outreach programs that attempt to level the playing field for underserved students and to increase college access and career interest in areas of underrepresentation, such as STEM, therefore need to address these multiple factors simultaneously.

Many college pipeline programs focus on promoting student interest and access to college (Bonous-Hammarth and Allen, 2005). Mentoring, a common strategy employed by many programs, has been found to be effective when used over a long period of time and when it includes financial and cultural considerations (Gándara, 2001). Calaff (2009) has noted the importance of providing students with information, resources, and preparation, and concluded that college preparation programs often provide Latino students with resources that would not otherwise be available to them.

Because Latino students are often at risk for negative perceptions of social identity threat (Gándara and Contreras, 2009), interventions that address those risks can help students be protected against the negative effects of identity threat (Hernandez et al., 2017). In addition, many students have been shown to develop or lose interest in STEM fields earlier than high school (Lindahl, 2007). Therefore, informal educational opportunities for younger students play an important role in providing venues for improving STEM engagement (Cleaves, 2005; Tierney et al., 2005). Another critical component for Latino outreach programs is the need to include culturally relevant programming for families that foster parental and community engagement in education (Fann et al., 2009), and provide students with access to positive role models (Rivoli and Ralston, 2009; Moskal and Skokan, 2011).

Literature also suggests that the problem of Latinos' ac-

cess and underrepresentation in college (Oliva, 2008) and STEM careers (Gándara, 2006) can be partially addressed by creating collaborative and long-term relationships between pre and post-secondary educational institutions (Moskal and Skokan, 2011). Some examples of these collaborations include partnerships between K-12 teachers and STEM college students (Parry et al., 2004; Tomanek, 2005; Moskal and Skokan, 2011), and colleges organizing after-school programs for K-12 students that provide hands-on learning activities and access to positive role models (Rivoli and Ralston, 2009; Moskal and Skokan, 2011). The program we describe and evaluate in this study addresses the multiple needs of Latino students by implementing a wide array of interventions targeted at middle and high school students.

PROGRAM DESCRIPTION

The GoSTEM program, begun in 2011, is a partnership between the Georgia Institute of Technology (Georgia Tech), a large suburban K-12 school system, and a philanthropic foundation sponsor. The program has been primarily implemented in a school cluster where Latino students constitute more than 65 percent of the student body at the middle and high school levels. The conceptualization, implementation, and evaluation has been led by Georgia Tech's Center for Education Integrating Science, Mathematics and Computing (CEISMC). The program mission is to strengthen the pipeline of Latino K-12 students into post-secondary STEM education, and it includes a suite of initiatives that were designed to support Latino students and families. From its inception, GoSTEM was conceived of as a research-based program, and program staff rigorously evaluated the various initiatives annually, iteratively modifying the activities based on the formative data. Researchers also documented and evaluated the overarching intervention, so that lessons learned from the program could serve as a model for others interested in STEM outreach to Latino communities.

The purpose of this paper is twofold: 1) to report findings from the GoSTEM program interventions with respect to the effectiveness of these programs on our study participants; and 2) to share lessons learned from program implementation with other practitioners. This paper reports data primarily from the fourth year of the program (2015-2016) and highlights those findings that constitute data trends we have consistently captured throughout the previous four years of implementation.

Although GoSTEM includes different interventions for different target audiences (middle and high school students and families), all these separate programmatic elements share key components that work in concert to address several overarching goals. These overarching goals are to:

- increase awareness of college, the college application process, and careers;
- increase college readiness
- increase interest in STEM content, STEM careers, and learning in STEM fields
- increase student school motivation
- reduce perceptions of ethnic identity threat

The following is a description of the different programmatic aspects of GoSTEM grouped by programs geared towards Latino K-12 students, and programs geared towards Latino families. It is important to note that this is not an inclusive list of all the GoSTEM initiatives, but we will focus on these programs for the purpose of this paper.

Programs for Latino K-12 Students

Pathways to College Program. Pathways to College is a high school mentoring program designed to increase Latino students' knowledge, interest and engagement in STEM fields and careers, and provide resources and guidance that contributes to their college preparation and readiness. The curriculum is implemented by undergraduate student mentors who are hired and trained at CEISMC but who travel to the partner high school to meet with students.

Latino students in good academic standing are selected into the Pathways to College program at the beginning of their freshman year on the basis of teacher recommendations and demonstrated student interest, with the intention of keeping them in the program throughout high school. As there is attrition from the program each year, new students are also added at later grade levels. In the early years of GoSTEM, the Pathways mentoring occurred during the school day, with high school students being pulled out of their elective courses to meet one-on-one with their mentors. Because formative evaluation data showed poor student attendance and dissatisfaction by teachers with this model, the mentoring program was modified in Year 4 and became strictly an after-school program, with students primarily meeting in group settings after classes. During the year reported in this study (Year 4), 15 mentors worked with 101 Pathways to College students distributed across four grade levels at one high school, with each Pathways student attending one after-school session per week.

The high school Pathways to College curriculum and its focus varies for students at each grade level. The freshman and sophomore programs focus on study skills and organization, as well as career exploration. When students enter the program, they take assessments to identify areas for improvement with regard to study and other school and interpersonal skills. They set academic, social, community service, and communication goals for the year. Throughout the year, they participate in workshops and work on strategies to improve their study and interpersonal skills. Students in 10th and 11th grade prepare for the Preliminary Standardized Assessment Test (PSAT) by engaging in activities that help them learn vocabulary, enhance their essay writing skills, and sharpen

their test taking preparation strategies. As students progress through the program, they also create and begin completing a college organizer spreadsheet that helps them identify colleges of interest and enrollment information such as deadlines for application, entrance exams and other college requirements. Students can then assess which colleges are within reach, and which require additional academic preparation or requirements. Based on this information, students can adjust their goals for the current high school year with an eye toward their future accomplishments. Mentors also help students prepare for end-of-year tests, and assist them with completing applications for summer programs, internships and jobs. In their senior year, students work on their college applications, personal statements, entrance exam preparation, and scholarship applications. They also have the opportunity to share any concerns regarding the process, and they are encouraged to analyze the benefits and costs of attending different colleges to which they have been accepted. Students are also able to participate in activities and workshops about financial aid and other college financing opportunities, about general money management, and to engage in discussions about college life.

Extracurricular Enrichment Opportunities for High School Pathways to College students. Pathways to College students are eligible to participate in additional STEM-focused programs that provide them with enrichment and exposure to experiences not available in a typical classroom. Because many of these programs occur during the summer months and space is limited, students are required to have good program attendance throughout the year, complete an application and demonstrate commitment to participate. Free transportation is provided for all programs. Below is a description of the extracurricular enrichment opportunities available for Pathways to College high school students and the number of participants enrolled in the fourth year of the program:

1. Research, Experiment, Analyze and Learn (REAL) program: Students who are selected to participate in the R.E.A.L. program (n = 10) spend five weeks working in teams of two or three students in a research laboratory at Georgia Tech alongside one of their high school teachers, a university faculty member, and undergraduate and/or graduate students. During this experience, students participate in science and engineering research seminars and workshops on topics such as the college admissions application process, research paper writing, and creating science fair poster presentations. At the end of their research experience, students create a poster summarizing their research and present it at a program luncheon in conjunction with other student teams. They are also encouraged to write and submit a research paper to the Siemens Competition in Science, Math and Technology. Participating students receive small stipends or free computer technology for successfully completing their summer experience.

2. Pursuing Urban Sustainability at Home (PUSH) Summer Institute: PUSH is a two-week program held on the Georgia Tech campus in which students explore the application of STEM+Arts (STEAM) to sustainability and how issues of urban sustainability can impact their community. The program features interactions with professionals currently working in the field, hands-on experiments that connect sustainability to the everyday experiences, field trips that demonstrate how individuals can be sustainable in their everyday lives, and a problem-based design challenge. PUSH culminates with a Sustainability Symposium to showcase the solutions students have developed to address problems in their communities. In the summer of 2016, 12 Pathways to College students participated in the PUSH program.

3. Fun summer of service: Through this program, Pathways to College students (n = 29) can participate in additional community service activities during the summer. They engage in service activities such as facilitating hands-on science for elementary school students in summer camps, doing nature conservancy projects, packaging books to be shipped to other countries, and volunteering at assisted living communities.

4. Pathways college tours and Georgia Tech field trips: In the fourth year of the program, 25 freshman and sophomore Pathways to College students participated in a tour of six colleges and universities within the state of Georgia. Over spring break, 22 sophomores and juniors visited six out-of-state universities. Throughout both college tours, students wrote reflections about the similarities and differences among colleges, with the goal of helping them identify the characteristics of their ideal college. They also participated in debriefing sessions that provided additional opportunities for reflection and discussions about their hopes and concerns. In addition, 25 high school Pathways students attended field trips to Georgia Tech. These field trips allow students to visit research labs while enabling university faculty, graduate students and other STEM professional partners to connect with Latino students and engage in outreach initiatives that promote broadening participation in STEM.

Middle School STEM Pathways Program. The middle school STEM Pathways program is an afterschool program for the two feeder middle schools in the cluster that provides students with engaging STEAM-focused hands-on activities and experiments. The program also provides students with access to Latino role models in STEM by inviting minority scientists, researchers and engineers as guest speakers to the program.

During Year 4, 15 undergraduate student mentors worked with 105 Latino middle school students. Students were selected into the program on the basis of teacher recommendations, good academic standing, and demonstrated student interest, with the intention of keeping them in the program

throughout middle school and then transitioning them to the high school Pathways to College program. Students meet after school with undergraduate mentors for 90 minutes, one day per week. In addition to the STEM experiments and activities, during Year 4 there was also a writing component in the program, in which students were asked to reflect on the activities, demonstrate their understanding, and communicate this information to others using a blog.

*Extracurricular Enrichment Opportunities for Middle School STEM Pathways Students***.** Similar to the high school Pathways to College program, the STEM Pathways students were eligible to apply to additional enrichment programs. These programs included attending field trips to Georgia Tech research labs during the school year and engaging in community service projects. In addition, some STEM Pathways students were provided scholarships and transportation to enroll in one-week STEM-focused summer camps at Georgia Tech, through the Programs for Enrichment and Accelerated Knowledge in STEM (PEAKS) program. PEAKS camps offer students unique STEM experiences that are typically not included in most schools. These programs are developed and facilitated by Georgia Tech professors, graduate students, Atlanta-metro area teachers, and CEISMC team members. Typical topics include App/Game Development, LEGO Mindstorm Robotics, Biomedical Engineering, and Rollercoaster Physics. During the year of study, 75 middle school students participated in a field trip to Georgia Tech, 69 students participated in a community service opportunity, and 31 students attended STEM-focused summer camps at Georgia Tech.

Programs for Latino Families and the Community. Parent and Community Programs are events hosted by GoSTEM in partnership with faculty and student organizations at Georgia Tech, as well as with other Hispanic organizations in the greater community. The goals of these events are to promote Latino families' interest in STEM, increase their college and career awareness, and increase Latino cultural awareness and community building among our various stakeholders.

During the year of this study, GoSTEM hosted two community programs with bilingual programming: The Latino STEM Education Day, held at the high school and attended by 55 adults plus their children, and the Annual Latino College and STEM Fair, held at Georgia Tech and attended by 256 adult family members and teachers, as well as large numbers of their children. At the Latino STEM Education Day event, parents and extended family members of students attended a bilingual workshop on how to prepare their children for college at the elementary, middle and high school levels. At the same time, children participated in STEM activities and learning stations facilitated by Georgia Tech students, faculty, and staff. The Annual Latino College and STEM Fair at Georgia Tech is a free event for metro Atlanta K-12 students and their families. Activities include a college and community organizations fair, where attendees can talk with representatives from colleges, universities and organizations that serve the Latino community; a STEM majors fair with information about different STEM majors and programs of study; a panel with Latino college students, parents, professors and other professionals; a workshop about college financing and financial aid; and a variety of STEM hands-on activities facilitated by Georgia Tech students, faculty, and staff. All events are conducted bilingually, or in Spanish, with English translation available. Attendees are provided with free lunch and free parking.

METHODS

Participants. This paper reports data for the fourth year of the GoSTEM initiative (Rana et al., 2016). These data capture the experience of students and families who engaged in the previously described components of the GoSTEM program during the academic year 2015-2016. Information was collected from students and families using parental consents and student assents approved by the Georgia Tech Institutional Review Board. Therefore, the total number of participants attending our programs exceeds the number of research participants reported below, since data was only collected and analyzed for those who agreed to participate in the research study. Table 1 shows program participant numbers and demographics by program. For some analyses, data were analyzed separated by student cohorts based on their years in the program, since due to the longitudinal nature of the project and to student turnover, students in the same grade might have participated in the program for varied lengths of time (one to four years).

Measures. To evaluate our programs and achieve triangulation whenever possible, we used a combination of qualitative and quantitative data sources (Creswell and Plano Clark, 2007). We collected surveys each year from students participating in our high school and middle school programs. Pre-surveys were given to the students when they first started the program and post surveys were collected each May. Survey questions are aimed at capturing students' perceptions of self-efficacy for college going, math and science self-efficacy, sense of school membership, perceptions of stereotype threat, and STEM interest. These instruments were developed using a combination of items from established and validated measures, such as the Is Science Me Scale (Aschbacher et al., 2010), the Motivated Strategies for Learning Questionnaire (Pintrich and DeGroot, 1990), and the Psychological Sense of School Membership Scale (Goodenow, 1993), plus new items and open-ended questions created by our evaluation team. We also conducted

Table 1. *Participant Demographics by Programs (2015-2016)*

Program Name	Type of Program Participants	Program Participants *n*	Participants Enrolled in Study *n*	Female *n*	Male *n*	Grade *(n)*
High School Pathways to College Program	Students	101	95*	65	28	9th (21) 10th (27) 11th (25) 12th (22)
	Parents	14	14	N/A	N/A	N/A
	Math and Science Teachers	-	27	N/A	N/A	N/A
Middle School STEM Pathways Program	Students	105	90	49	41	6th (31) 7th (26) 8th (33)
	Parents	16	16	N/A	N/A	N/A
Extracurricular Summer Experiences	Students in two-week sustainability camp	12	12	N/A	N/A	N/A
	Students in one-week STEM camps	31	24	N/A	N/A	N/A
	Students in community service program	29	27	N/A	N/A	N/A
	Students in research experience	10	6	N/A	N/A	N/A
Family and Community Programs	Guardians and teachers	311	83	61	22	N/A

**From the 95 respondents, we only obtained gender information from 93 participants. The number of pre-post matched cases for each analysis depend on the specific variable analyzed as not all participants answered all questions in both the pre and post surveys.*

focus groups with both high school and middle school students in April, 2016 during their after-school program. We conducted eight focus group discussions at the high school, and four focus group discussions at the middle schools. Focus groups ranged in size from two to 15 students and questions focused on student experiences in the program, program impact on students (including activities such as field trips and college tours), and suggestions for improvement. High school focus groups also included questions regarding students' plans for the future, possible challenges, and the program's impact on future plans.

To more thoroughly capture perceptions of student satisfaction and impact for our program, we also surveyed parents of these high school and middle school students using an instrument developed by our evaluation team that includes five open-ended questions. In this survey, parents are asked to report any perceived changes in their children that they can attribute to program participation, including changes in study habits and interest in college and career. In addition, we captured teacher perceptions by surveying the math and science teachers of the high school Pathways to College students. This survey consists of four open-ended questions that gather information about teachers' knowledge of the program, perceived changes in students that they could attribute to program participation, and recommendations for program improvement.

To evaluate extracurricular activities such as summer camps, summer research internships and service programs, we primarily collected post surveys from students who participated in these activities. Different surveys were developed by evaluators using a combination of Likert type scales and open-ended questions to capture students' experiences in these programs. Survey questions were tailored to program goals and activities, and some questions were geared towards capturing specific learning goals. Surveys also included items designed to capture STEM career interest and satisfaction with their extracurricular experience.

Lastly, we evaluated our community events by administering surveys to parent and community participants. These measures aim to capture satisfaction and impact of the community events for families. In this survey, participants can rate the usefulness and value of each aspect of the event and offer feedback and recommendations for future programming. Descriptive and inferential tests (parametric and non-parametric) were used to analyze quantitative data, while qualitative data from focus groups and open-ended questions were analyzed using thematic analysis (Braun and Clarke, 2006).

RESULTS

As described in the previous section, data were collected from participants to capture their experiences within specific GoSTEM programs. However, since individual GoSTEM programs often contribute to more than one of its five overarching goals, we will report in this section our findings about how each program contributes to each of those central objectives.

Goal 1: Increase Awareness of College, the College Application Process, and Careers. Results suggest that several of our programs help increase college and career awareness in Latino students and families. Based on the data provided on post- surveys from students who participated in the middle school (MS) STEM Pathways and the high school (HS) Pathways to College programs, we found that the program mentoring components of both programs helped increase student awareness of college, of the college application process, and of STEM careers. Students agreed that the program helped them learn how to make decisions about their future (MS: 94%, HS: 100%), learn how to choose the right college (MS: 90%, HS: 96.2%), learn how to choose the right career (MS: 91.4%, HS: 92.1%), and learn about STEM careers (MS: 95.5%, HS: 94.7%).

High school students also reported learning how to apply to college (88.3%) and fill out scholarship applications (72%). When asked on surveys to describe the impact of the Pathways to College program on their college decision-making, most high school students reported how the program helped them explore more college options, provided them with information on what to consider when choosing a college, taught them about college requirements and helped them with college applications and financial aid. For instance, one student stated if it was not for Pathways, s/he would not be "going to the college I am" and "applying to the scholarships I am."

Data from high school and middle school focus groups corroborates the student perceptions captured in the surveys. In focus groups, middle school students agreed the program helped them plan for college by helping them think about their future goals, what they want in life, and how college might help them achieve their goals (e.g., help them get a well-paying job). Students also mentioned how the program has shown them different college options and that their mentors, outside speakers, and Georgia Tech trips provided them with valuable information about college. High school students were asked in their focus groups to offer their views on the college tours, and their lessons learned from the experience. Students' perceptions of their college tour experience were overwhelmingly positive. Students stated the program provided them with the opportunity to explore options for colleges they would not have considered otherwise, to better understand what to look for in a college when making a decision (e.g., in-state vs. out-of-state, majors offered), to learn more about financial aid, and to see what college life actually looked like.

Parents who were surveyed also shared their perception that their childrens' interest in college had increased as a result of their participation in the Pathways to College program. Five parents of high school students (35.7%) identified increased motivation to work towards a career as a change they had seen in their children, and another three parents (21.4%) described more general increases in interest displayed by their children since starting Pathways. Quotes include "I see how important it is for her, the desire to improve herself, to achieve that goal of outdoing herself and to become someone in life," and "He started with little interest but now he is very interested in going to college." One parent (7.1%) observed that the college tour provided by GoSTEM positively influenced his/her child, "The college tour where they got to see universities has helped her a lot so she now can choose the college she would like to attend."

In terms of family education and awareness, findings from our community event surveys suggest that these events served to increase knowledge about colleges and careers in Latino families. Specifically, parents who participated in several of the STEM and college-focused community events reported that the most useful things they learned from the programs was information related to college access, careers, scholarships, and the college application process.

Goal 2: Increase College Readiness. Within GoSTEM, both the high school and middle school Pathways programs carry the strongest focus on the development of college readiness and associated competencies such as self-regulatory skills and college-going self-efficacy. This focus is more explicit in the high school program where students also receive tutoring to strengthen their academic performance in school and increase their self-efficacy for math and science areas. In the middle school program, support for math and science self-efficacy and academic achievement are an implicit part of their STEM-focused afterschool programming.

Students in the high school Pathways to College program reported that the program improved their self-regulatory skills. They agreed that the program improved their planning skills (92.7%), organizational skills (91.4%), time management skills (92.7%), study skills (92.4%), and their ability to set goals and take steps to achieve them (95.1%). In focus groups, students expressed that the Pathways program showed them the importance of college, and helped prepare them for higher education by helping them improve their study skills, showing them what to expect, and providing ACT test preparation. Teachers also reported that Pathways to College students were observed to set goals and follow through with them (n = 3; 11.1%). One teacher said about

the Pathways students in her/his classes "All of them seem to have set goals for their lives after high school."

Since the Pathways to College program has an explicit focus on helping students increase their perceptions of competence for college-going behaviors, we conducted analyses to explore to what extent the program had a positive impact on students' college-related self-efficacy. This scale was developed by adapting items from the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich and DeGroot, 1990) to college-going related tasks. Some sample items included "I understand what steps I need to follow to complete my college application," "I know what I need to do to identify the college I would like to apply to," and "I understand how to apply for financial aid/get a scholarship." Results show that the trend towards increased college self-efficacy was positive for all students in all three years, and that some of the time comparisons were statistically significant for students in their first and second years in the program (See Table 2).

High school Pathways to College students also agreed that the program helped them improve their overall GPA (93.3%), math grades (83.3%), and science grades (86.3%), and to a lesser extent, their English (77.1%) and social studies (75.4%) grades. In focus groups, most students stated that mentors helped them with their schoolwork and grades. Several students said that it was helpful to get the one-on-one attention from mentors when they were having difficulty understanding a concept, and said mentors often explained concepts in a "different" manner they could understand. Math and science teachers also mentioned their Pathways students' academic abilities (n = 6; 22.2%) and stated either that their students were high achievers or they had improved their academic abilities since being in the program. For instance, one teacher wrote, "About 50% of the students have completely "ramped up" their willingness to participate in more challenging projects and participate in enrichment activities. This has definitely been demonstrated in an increase in their grades....Whereas these students were mainly solid "B" students in the past, they have now progressed to "A" students who have developed a greater ability to analyze and solve complex problems."

Students in the middle school STEM Pathways program were surveyed about their perceived academic abilities in areas such as math, science, computers, reading and writing. T-tests showed that there was a general decline in middle school students' perception of their own academic ability in all subjects from pre-survey (Fall 2015) to post-survey (Spring 2016; Table 3). Declines tended to vary by school and program year. For example, we found statistically significant declines in perceived ability for students in their 1st year in one middle school for science and writing. In the other middle school, we found a statistically significant decline in perceived ability with computers in third year students, and for math in first year students. In contrast, middle school parents (n = 9, 56.3%) indicated in surveys that, as a result of the mentoring program, their children showed both higher levels of effort and improvement in their grades at school. The task-specific nature of self-efficacy and the variation between schools and cohorts suggests that students might be grounding their perceptions in particular experiences with certain academic areas at their respective schools. The general decline in perceptions of self-efficacy is also consistent with literature showing that many students struggle with their motivation and performance in the middle school years (Eccles and Midgley, 1989), with declines impacting several academic and social areas. A targeted program like GoSTEM might prove insufficient to buffer students from such experiences.

Goal 3: Increase Interest in STEM Content, STEM Careers, and Learning in STEM Fields. Similar to the previous goal, the degree to which individual programs specifically focused on STEM content, STEM learning and STEM careers varied by program. For example, while Pathways to College students focus more on general college and career explorations, middle school STEM Pathways students are primarily exposed to activities designed specifically to increase STEM interest. Some, but not all, participating GoSTEM students at both the middle and high school level also participated in extracurricular GoSTEM opportunities that might increase their interest in STEM content and STEM learning. Some of these programs emphasize STEM

Table 2. *College self efficacy in high school students between Fall 2013 and Spring 2016 per Length of Time in the Pathways to College Program*

Length of Time in the Program*	*n*	Fall 2013 *M (SD)*	Spring 2014 *M (SD)*	Fall 2014 *M (SD)*	Spring 2015 *M (SD)*	Fall 2015 *M (SD)*	Spring 2016 *M (SD)*
3rd Year	6	3.05 (.52)	3.17 (.69)	-	3.36 (.41)	-	3.67 (.32)
2nd Year	13	-	-	2.7 (.72)**	2.84 (.67)**	-	3.23 (.61)**
1st Year	53	-	-	-	-	2.6 (.63)***	2.83 (.47)***

*Sample sizes were too small to do an analysis for students in their 4th Year of the program. Scale: 1 (Not at all confident) - 4 (very confident)
**A repeated measures ANOVA showed statistically significant differences between Fall 2014 and Spring 2016, and Spring 2015 and Spring 2016 ($F(1.917, 23.006) = 5.139$, $p = .015$)
***A dependent t-test showed statistically significant differences between Fall 2015 and Spring 2016 ($t(52) = 2.595$, $p = .012$)

Table 3. *Statistically significant pre-post differences in perceived academic ability for middle school students between Fall 2015 and Spring 2016 by length of time in the STEM Pathways Program.*

Middle School ID	Length of Time in the Program	Academic Area of Perceived Ability*	Pre-test *M (SD)*	Post-test *M (SD)*	*t*	*df*	*p***
School A	1st Year	Science	3.61 (.61)	3.33 (.59)	-2.56	17	0.02
		Writing	3.26 (.87)	2.95 (.91)	-2.26	18	0.03
School B	1st Year	Math	3.68 (.57)	3.32 (.48)	-2.35	21	0.03
	3rd Year	Computers	3.50 (.71)	2.90 (.57)	-2.25	9	0.05

*Scale: 1 (Strongly Disagree) – 4 (Strongly Agree)
**Statistical significance established at .05.

learning just within a particular field (e.g., PUSH summer program in sustainability), and some are more general. This variability can make it difficult to tease out specific program effects.

Many of the high school students participating in GoSTEM programs enter already interested in STEM careers. Even so, survey data shows a trend towards increased interest in a STEM careers from pre to post (Table 4). Pathways to College students were asked in an open-ended survey how the program had helped them make decisions about their career. Most students stated the program had helped them explore career options and make career choices by guiding them to do research on different careers and ask questions that will help them determine which careers were a good fit for them. Only a few students mentioned that they are now considering STEM careers. In focus groups, when students were asked if they learned anything about STEM careers, several students agreed and explained they had learned how broad and varied STEM fields are, especially engineering. We also assessed the impact of the Pathways to College program on STEM interest by presenting students with a list of specific tasks related to STEM careers and asked them to rate their interest in doing these tasks. The overall results from that study indicated no change in interest in having a job where one would be involved with these specific STEM related activities.

Similar to their high school counterparts, 92% of our middle school Pathways students start the program interested in STEM careers. For middle school students, surveys show a small, negative pre-post change in their interest in STEM careers, regardless of how long they had been in the program (92% to 87.5%). However, when they were asked about their career choices on post surveys, their top choices were doctor or surgeon, engineer, and marine biologist. When surveyed, students stated the program helped them explore different careers, including STEM careers. One student stated, "This program has let me explore new careers that I would have never even thought about before," and another wrote, "It exposed me to careers in STEM and their advantages." Nine parents of middle school students (56.3%) expressed that, since participating in Pathways, their children's career interests have gravitated towards STEM or STEM related careers. One parent wrote, "Well, he likes technology, mathematics, and engineering. Maybe an engineer!"

High school and middle school students also had the opportunity to participate in a variety of STEM focused extracurricular activities organized by GoSTEM. High school students participating in STEM-focused summer programs and community service learning opportunities specifically reported increased learning about STEM fields and careers. High school students participating in the R.E.A.L. program reported gaining first-hand experience in conducting STEM research, thereby increasing their conceptual understanding of STEM concepts, their understanding of the appropriate uses of technology, and their awareness of the ethical responsibilities and importance of collaboration within the research process. One student wrote, "I found it useful because I was able to see firsthand how things such as calculus and physics can be used in a real world setting and gave me a push to try harder in school." Another said, "I have learned that research is so much more than doing experiments. I learned…things such as background research, analyzing data, and also creating models to describe our findings." Students who participated in the PUSH summer program reported that they felt confident or very confident defining sustainability (58%), identifying steps to be sustainable in their communities (75%), understanding how STEAM can be applied to real world situations (58%), understanding the application of science to real world situations (100%), and understanding the application of engineering to real world situations (100%). High school students enrolled in the Fun Summer of Service program agreed that the program had increased their interest in science (77.8%), math (66.7%) and engineering (51.9%).

Middle school students who enrolled in one-week STEM summer camps also agreed that their participation had increased their interest in STEM related fields (69%), particularly engineering (91.7%), computers (87%), science (83.3%), and math (73.9%).

Goal 4: Increase Student School Motivation. We collected self-reported data from both middle and high school students through pre- and post- surveys regarding their in-

Table 4. *Pre-Post Comparisons of STEM Career Interest for High School Pathways Students between Fall 2015 and Spring 2016 by Length of Time in the Program*

Students length of time in the program (*n*)	STEM Career Interest	Pre	Post
4th Year (4)	Interested in a STEM Career	75%	100%
	Not Interested in a STEM Career	25%	-
	No Response Provided	-	-
3rd Year (14)	Interested in a STEM Career	50%	64.30%
	Not Interested in a STEM Career	42.90%	35.70%
	No Response Provided	7.10%	-
2nd Year (14)	Interested in a STEM Career	85.70%	85.70%
	Not Interested in a STEM Career	7.10%	14.30%
	No Response Provided	7.10%	-
1st Year (51)	Interested in a STEM Career	82.40%	92.20%
	Not Interested in a STEM Career	13.70%	7.80%
	No Response Provided	3.90%	-

trinsic and extrinsic motivation to learn. Intrinsic motivation is a desire to engage in activities and learning that are of the student's interest and therefore rewarding and satisfying in themselves. Extrinsic motivation is a desire to engage in activities and learning to the extent that they lead to another outcome, like receiving a reward or avoiding a punishment (Ryan and Deci, 2000). In this study, we examined students' intrinsic and extrinsic motivation to learn, and conducted time series analysis across all data collection points. None of the results were statistically significant for either intrinsic motivation to learn or extrinsic motivation to learn for high school students.

In contrast to the quantitative survey data, some parents of high school students specifically mentioned that they thought the program had impacted in their child's level of motivation. Three parents (23.1%) indicated they saw an increased motivation to succeed in school in their children. One said, "He shows more interest in completing his schoolwork on time and in obtaining high grades." Two parents (15.4%) responded that their children exerted more effort at school as a result of the Pathways to College program. Two parents (15.4%) also felt their child was paying more attention to schoolwork since participating in Pathways. One said, "Yes, of course. She is more focused on her school work." Likewise, teachers (n = 9; 33.3%) listed students' motivation to do well in school and work hard as the most common attribute of Pathways students (e.g., "The majority of these students have worked hard and seem to take the idea of grades, effort, and school much more seriously that before.").

Middle school motivation analyses show that for students in their 3rd year in middle school A, we found statistically significant results for two questions: a decrease (t (8) = -3.16, p = 0.01) in "getting good grades is important to me" from pre-survey (M = 4.00, SD = 0.00) to post-survey (M = 3.44, SD = 0.53), and a decrease (t (9) = -3.00, p = 0.02) in "getting good grades is important to my family" from pre-survey (M = 4.00, SD = 0.00) to post-survey (M = 3.50, SD = 0.53). For the middle school B, the only statistically significant result was for students in their 1st year for one question: a decrease (t (25) = -3.33, p = 0.00) in "the most important thing about school is learning as much as I can" from pre-survey (M = 3.96, SD = 0.20) to post-survey (M = 3.65, SD = 0.49). These results indicate that school motivation either remained stable or declined for some students from pre to post survey (Spring 2016). These findings are consistent with previously described literature documenting motivational declines in middle school students (Eccles and Midgley, 1989). However, parents of the middle school students also reported positive changes in their children's interest in schoolwork as a result of Pathways. As mentioned before, nine parents (56.3%) reported that their child increased their school work effort. One parent noted, "She is more responsible and more motivated to do better each day and to improve her grades." Two other parents (12.5%) noticed changes in their children's mood or ability to handle stress. One wrote, "She has surprised me in a positive way because they have given her a lot of projects and I haven't seen her being frustrated. On the contrary, I've seen her at ease and finishing all her assignments."

Goal 5: Reduce Ethnic Identity Threat. We also explored to what extent program participation could help reduce perceptions of social identity threat in students (Steele et al., 2002). On pre- and post-surveys, we asked students participating in the high school and middle school Pathways programs, two identity threat related questions: "How likely do you think it is for people who share your ethnic background

to get a job in this country?," and "How likely do you think it is for people who share your ethnic background to become a scientist?" High ratings on this instrument indicate lower perception of identity threat, since students in that case are stating they believe it is very likely for people of their ethnic background to get a job or become a scientist. During the second year of the GoSTEM program, we implemented two interventions specifically aimed to reduce students' perceptions of identity threat using a Latino role model intervention and a self-affirmation task. Data showed that these targeted interventions were effective (Hernandez et al., 2017). Therefore, we repeated those same interventions in Year 4 (Spring 2016) at the high school. Findings showed slight but non-significant decreases in perceptions of social identity threat for students from all years with regards to becoming a scientist (pre M=2.54, post M= 2.72). That is, students were more likely to think someone from their background could become a scientist. However, results showed a slight decrease in their perceptions of the likelihood of getting a job in the country (pre M=2.95, post M= 2.87). Perhaps the reasons this trend is positive for the "scientist" variable is because one of the interventions (role model) entailed a Latino Georgia Tech researcher speaking with students about his background and working in a lab now at Georgia Tech. An additional explanation for the more negative results vis-à-vis getting a job could be that since the tenor of public dialog in the United States about immigrants in general, and Latino immigrants in particular, had become more negative during Year 4 of GoSTEM, students in our program had heard these negative voices and were increasingly, but realistically, pessimistic about their opportunities for working in the United States.

LESSONS LEARNED, AND ADVICE TO PRACTITIONERS

Over the four years that GoSTEM has been in operation, there have been many lessons learned regarding how to develop and implement outreach programs for Latino students. The programmatic lessons can be grouped in three major themes: maintaining partnerships between universities and schools, engaging in culturally relevant practices, and breaking barriers to participation through logistics. Program evaluation lessons revolve around the challenges of conducting evaluation on longitudinal studies and programs that are constantly evolving and that operate within complex systems that include many uncontrollable variables. Below we discuss each of these areas:

Maintaining Partnerships Between Universities and Schools. University-school partnerships that hope to elicit meaningful change must, first and foremost, be diligent in cultivating and maintaining sustainable relationships based on common goals, trust, and a willingness of all to cross boundaries to seek understanding from alternate perspectives. Literature on Research Practitioner Partnerships (RPPs) and Design-Based Implementation Research (DBIR) has shown that interventions brought to schools, even those well-grounded in research, only work and are sustainable if they are the result of true collaborations between the university researchers and school-based practitioners (Penuel and Fishman, 2012; Penuel et al. 2015). This type of partnership can be labor intensive and requires constant work, as programs to change behaviors and attitudes aren't widgets that can be inserted and ignored. However, honestly listening to input from multiple stakeholders and acting on their feedback generally means that the intervention will morph over time as practitioners balance proposed programs and activities with participants needs and local constraints. Engaging in formative evaluation processes and sharing these results regularly through face-to-face conversations helps maintain the partnership and ensure the program is aligned with the goals and the interests of partners and stakeholders. Program changes should also be informed by collaborations with other school-serving organizations, universities, and groups to ensure that efforts to change the educational landscape are purposeful and concerted rather than redundant.

Engaging in Culturally Relevant Practices. While our research has demonstrated that the Latino parents and families in GoSTEM strongly support academic engagement and achievement in their children (Hernandez et al., 2016), it is nonetheless crucial that all programming be grounded in cultural considerations and practices that are welcoming to Latino students and families. Much of the knowledge students gain through GoSTEM has the potential to be unfamiliar to their parents, and specific programmatic components, such as encouraging career and college exploration, that focus solely on students' interest can be inconsistent with collectivistic self-construals found in Latinos within the U.S. (Oyserman et al., 2002), and that constitute important aspects of Latino culture. Such explorations can also lead students to develop aspirations that could be in conflict with cultural expectations, such as considering colleges located at long distances from the family. Bringing families explicitly into the conversation helps allay these fears. GoSTEM family events offer parents information about financial aid and college admission, highlighting different options and what they might entail, so both students and parents can fully partake in family conversations about post-secondary options.

For Latino students to be allowed to participate in extracurricular activities, parents also have to personally know and trust the people coordinating the activities. This is especially true for experiences that take the students away from their local school, like going on an out-of-state college tour, or attending a university summer camp. Building

this trust requires multiple one-on-one conversations, generally in Spanish, between parents and staff members who are trained to understand and be respectful of cultural differences. Building trust with the students requires that staff be physically present at the school regularly and have time available for informal discussions. Both activities are labor intensive and require skilled staff who can provide students and families with support born out of cultural understanding and value.

Another important consideration for creating a welcoming and authentic environment is to acknowledge and accommodate language practices and needs. GoSTEM events are conducted bilingually or primarily in Spanish. In cases where a family activity must be conducted in English, we provide Spanish-speaking staff and volunteers who can be easily identified by tags reading "Hablo Español" (I speak Spanish), so that Spanish speakers can easily obtain translation assistance or engage in conversations without fearing language barriers.

Breaking Barriers to Participation Through Logistics. To be effective, interventions must be truly accessible to students and families. The biggest barriers to participation are often logistical in nature and include issues such as lack of transportation or lack of childcare to participate in activities. Offering university-based summer camp scholarships without arranging for daily transportation from the local school can be of limited value. Likewise, arranging an event for parents of high school students without providing appropriate activities for children of all ages, and without providing food during the event, can limit the attendance. Other logistical barriers become evident when dealing with students and parents who might be undocumented. Students who do not possess a social security number might hesitate to take advantage of an opportunity, such as participating in a paid internship at a university, for fear of revealing his or her immigration status. In these cases, it is important to consider equitable solutions that level the playing field for all students, such as allowing all students applicants to select either a stipend or a computer (of similar value to the stipend) as compensation for their work.

Program Evaluation. GoSTEM is a complex effort requiring a multifaceted evaluation. The longitudinal nature of the program across several schools requires careful and consistent tracking of students from year to year and across activities and programs. Student retention is a challenge since students often come and go from our different programs, so this tracking requires close communication and cross-training between evaluators and program staff. Establishing "dosage" is also challenging, as "active engagement" can be defined in many ways: years in GoSTEM, attendance level within Pathways, number of different types of activities attended, etc. Program attendance criteria ("dosage') should be defined from the beginning to be able to consistently capture program impact throughout the years, and should always bear in mind that longitudinal studies can be affected by external threats to validity, such as the effects of educational transitions, developmental changes in students, and from external, societal events.

Lastly, because programs need to constantly adapt to the changing needs of participants, the evaluation needs to be regularly re-aligned with the program activities and the goals so that the evaluation instruments can be revised to capture the impact of those programs. While most of our measures across years remained constant, the evaluation instruments needed some updating to accurately capture participants' experiences.

CONCLUSIONS

Our results suggest that GoSTEM has a positive impact on students and families with respect to college and career awareness. The mentoring program components also increase high school students' college readiness and self-regulatory skills. The extracurricular programs support this effort by increasing middle and high school students' STEM-related content knowledge and learning, and their understanding about STEM careers. Most students enter GoSTEM already interested in STEM, and high school students sustain and slightly increase that interest while in the program. However, we see mixed results for middle school students when we compare their survey responses to their reporting of top careers interests. The program seems to have limited impact in helping middle school students improve their competence perceptions across several academic areas, or in improving either middle or high school students' self-reported school motivation. More research is needed to help determine what factors are driving competence perceptions in middle school students and motivational processes in our students, and how those factors interact with program components.

A complex program such as GoSTEM is only possible with a multidimensional approach that recognizes that the only way to impact the graduation and college trajectory of Latino students involves engaging parents and ensuring they are informed about the college and career choices available to their students. This enables them to provide the parental support necessary for student success (Peña, 2001). This work would also be impossible without high levels of communication, collaboration and commitment of both the K-12 and higher education institutions involved in the program, and a shared understanding of what it takes to provide students with the necessary conditions to inspire their educational journeys and help them pave the path to the future.

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ABBREVIATIONS

STEM: Science, technology, engineering and mathematics; NSF: National Science Foundation; Georgia Tech: Georgia Institute of Technology; CEISMC: Center for Education Integrating science, mathematics, and computing; PW: Pathways to College program; PSAT: Preliminary Standardized Assessment Test; R.E.A.L.: Research, experiment, analyze and learn; PUSH: Pursuing Urban Sustainability at Home; PEAKS: Programs for Enrichment and Accelerated Knowledge; MS: Middle School**;** HS: High School

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