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The Benefits of a Science Support Program for Low-Income Latina/o Students

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The Benefits of a Science Support Program for Low-Income Latina/o Students

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Abstract

A current national priority is to increase the number of students prepared for careers in science, technology, engineering, and math (STEM; U.S. Department of Education, 2015). Unfortunately, Latina/os are underrepresented in STEM fields (National Science Foundation, 2010). STEM support programs may be one avenue for increasing the number of Latina/o students who enter the STEM pipeline (Afterschool Alliance, 2011), but few studies have examined the benefits of participation in a STEM program for Latina/o youth, and very little is known about the specific program activities that are related to beneficial outcomes. Social cognitive career theory offers a model of career development that emphasizes the importance of learning experiences, which in the context of STEM programs are program activities.

In the current study, one-on-one, in-depth qualitative interviews were conducted with 39 participants who were involved in a science support program to investigate the following research questions: 1) What are the benefits of a science support program for Latina/o youth? and 2) What are the program activities that are related to these benefits? Results revealed 12 benefits of program participation: 1) access and exposure, 2) mastering science knowledge and skills, 3) academic outcomes, 4) broadened worldview, 5) confidence, 6) exploration opportunities, 7) higher order thinking, 8) professional development, 9) science interest, 10) science self-efficacy, 11) science is achievable, and 12) technical skills. Six activities were found to be related to the benefits: 1) math and science coursework, 2) oral presentations, 3) college visits and field trips, 4) presentations by professionals, 5) lab activities, and 6) mentoring. The results of this study provide important information about the activities, or learning experiences, that are related to the benefits of participating in a science support program, and they have important implications for the development and refinement of STEM programs for youth who identify with groups that are underrepresented in STEM.

Keywords: Latina/o youth; science programs; STEM; positive youth development; social cognitive career theory; benefits; program activities; qualitative study

The Benefits of a Science Support Program for Low-Income Latina/o High School Students

A current national priority in the United States is to dramatically increase the number of students prepared for careers in science, technology, engineering, and math (STEM; U.S. Department of Education, 2015). It is expected that there will be one million new jobs created in STEM fields in the US between 2012 and 2020 (Vilorio, 2014). In order for the US to maintain its competitive position in a global economy, the US needs to produce enough skilled STEM workers to fill these newly created positions. This would require a 35% per year increase in the number of students earning STEM degrees compared to current rates (Crisp & Nora, 2012; President's Council of Advisors on Science and Technology, 2012). Unfortunately the US has one of the lowest rates of STEM bachelor's degree production worldwide—17% compared to the international average of 26% (Kuenzi, 2008), and several racial/ethnic minority groups in the US, including Latina/os, are severely underrepresented in STEM fields (National Science Foundation, 2010). In order to increase Latina/o representation in STEM, and thereby address the increasing demand for skilled STEM workers in the US, it is imperative that Latina/o youth are given meaningful opportunities to explore STEM during childhood and adolescence, before their career interests stabilize in late adolescence or early adulthood (Lent, Brown, & Hackett, 1994).

Latina/os and STEM Participation in the US

Latina/os are the largest and youngest ethnic minority group in the US. Currently, Latina/os represent 17.4% of the U.S. population, and it is expected that Latina/os will represent 28.6% of the population by 2060 (Colby & Ortman, 2014). The median age of Latina/os in the US is 27 years old, which is a full decade younger than the median age of all people in the US (37 years old; Krogstad, 2014). Consequently, Latina/o representation in the U.S. work force will increase substantially in the near future.

Despite being the largest ethnic minority group in the US, Latina/os are disproportionately underrepresented in STEM education and careers, making up only 7% of the STEM workforce (Landivar, 2013). Latina/o students are equally as likely as White students to major in STEM subjects in college, but they are significantly less likely to persist and earn a degree or certificate in a STEM field. Among students who began college in 1995 as STEM majors, only 16% of Latina/o students completed a bachelor’s degree in a STEM field by 2001, compared to 30% of White students (Chen & Weko, 2009).

Interestingly, research on ethnic group differences in STEM students’ pathways toward a bachelor’s degree revealed that it is not until after the third year of college that Latina/o students start to fall behind their White and Asian peers (Anderson & Kim, 2006). A closer examination of this trend suggested that the students who failed to earn a bachelor’s degree in a STEM field within a six-year period tended to be less academically prepared for college, older, from a lower socioeconomic background, worked more hours per week, and were less socially and academically integrated at their university than those students who earned a bachelor’s degree in a STEM field within six years (Anderson & Kim, 2006). Latina/os were overrepresented in the group that failed to earn a bachelor’s degree in a STEM field within six years, and the authors argued that this was predominately due to socioeconomic status—Latina/o students are more likely to come from lower income backgrounds and are less likely to have at least one parent who attended college (Anderson & Kim, 2006; National Poverty Center, 2010). Socioeconomic status is an important indicator of whether one will earn a bachelor’s degree in science because low-income students are less likely to attend academically rigorous high schools and their parents may have fewer college financing options to fund their education (Anderson & Kim, 2006). As a result, students from low-income backgrounds may have to work more hours each week to pay for their education, and the more hours students spend working the less time they have to foster positive academic and social connections within their institutions, which negatively affects the likelihood of degree completion (Anderson & Kim, 2006). Although there are certainly other explanations, these factors help to explain why Latina/o students are underrepresented in STEM fields in the US.

In response to the underrepresentation of Latina/o students in STEM education and careers is the development of out-of-school time (OST) programs designed to provide exposure to and experiences in STEM. In general, OST programs and staff utilize a positive youth development perspective in their approach to working with youth (Zeldin, 2000). Thus, positive youth development is one framework that is appropriate for examining the benefits of participating in an OST science support program for low-income Latina/o students.

Positive Youth Development

Historically, research on adolescent development has tended to focus more on the elimination of pathology and deficit in developing adolescents rather than on the promotion of attributes, skills, and competencies that they need in order to become productive members of society (Benson, Scales, Hamilton, & Sesma, 2006a). Critics of the deficit-based model of adolescent development argued that this perspective was insufficient because “problem free does not equal fully prepared” (Benson et al., 2006a). From this dissatisfaction emerged positive youth development (PYD), which is an approach to adolescent development that focuses on the promotion of youth’s strengths, skills, and possibilities (Benson et al., 2006).

The interaction between the developing adolescent and his/her community is a core principle of PYD. PYD posits that adolescents affect their communities just as much as the communities affect adolescents’ development (Benson et al., 2006a). An important issue in PYD research is identifying nurturing community contexts, such as OST programs, that promote adolescent wellbeing and social good and provide adolescents with meaningful opportunities to develop their strengths and positively impact those around them (Benson et al., 2006a).

STEM programs are an example of a supportive community context in which young people can grow, thrive, and develop their innate strengths. STEM programs can be particularly beneficial for low-income Latina/o youth because they typically have access to fewer resources and opportunities to explore science than their peers from higher socioeconomic strata (Anderson & Kim, 2006; National Poverty Center, 2010). Hence, a positive youth development perspective is critical to increasing Latina/o students' representation in the STEM pipeline, as is social cognitive career theory, which helps to explain *how* Latina/o youth may choose to pursue a STEM career.

Social Cognitive Career Theory

The overarching goal of STEM programs is to prepare and encourage youth to pursue education and careers in STEM fields. Social cognitive career theory (SCCT) provides a framework for understanding the process of choosing an academic major and/or career (see Figure 1; Lent, Brown, & Hackett, 1994), and it identifies factors that may influence an adolescent's decision to pursue a career in a STEM field. SCCT highlights the mechanisms that shape career related interests and decisions, and it acknowledges the influence of demographic factors (e.g., race/ethnicity and gender) that can cause variations in the career development process for people from historically underrepresented backgrounds. Given the attention to the role of race/ethnicity and the emphasis on explanatory mechanisms (i.e., learning experiences) in the SCCT framework, SCCT provides a particularly helpful model to consider when exploring the activities that lead to the benefits of participation in STEM programs for low-income Latina/o adolescents.

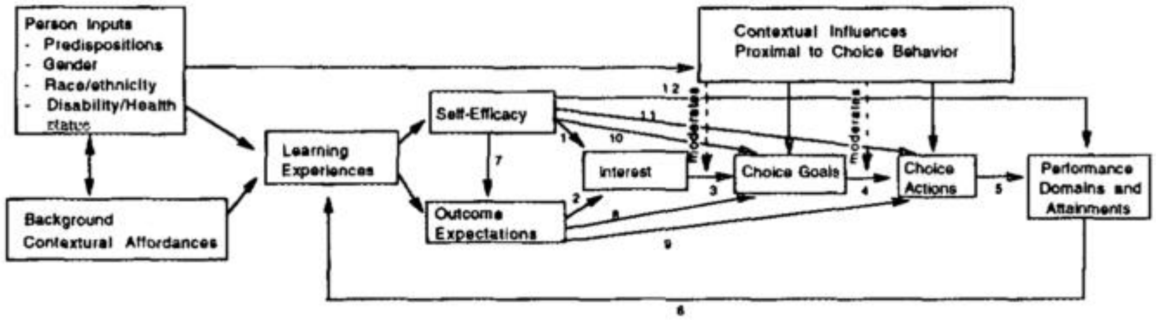


Figure 1. Social Cognitive Theory of Career Development (Lent et al., 1994).

SCCT proposes five steps in the career development process that begins with the environment in which a child is raised (Lent et al., 1994). During childhood, an individual is exposed to an array of activities related to potential careers, they see and hear about the jobs and careers of important people in their life, and they are reinforced when engaging in particular play activities that have implications for future career development. Then, through these activities, they begin to form ideas about the jobs or careers they may one day attain. In the second step, children begin to refine their skills and self-appraise their strengths and weaknesses, which leads to a sense of self-efficacy and expectations about the outcomes of their performance on certain tasks. The third step in career development is the formation of interests. The self-efficacy and outcome expectations formed in step two lead to interest development. Lent and colleagues (1994) posit that individuals form interests in activities that they believe themselves to be efficacious in and in which they anticipate positive outcomes. In the fourth step, individuals develop intentions and set goals for themselves related to a particular career, and these goals lead to the fifth step, which relates to action, or engagement in career-related activities. Involvement in these activities will produce successes and/or failures, and oftentimes, steps two through five repeat themselves throughout adolescence and early adulthood as individuals reappraise their sense of self-efficacy and outcome expectations.

This process is susceptible to repeat itself throughout the lifespan, but it is particularly important that children and adolescents are given opportunities to engage in this process because interests regarding broad domains of work tend to stabilize in late adolescence (Lent et al., 1994). A foundational component of the SCCT framework is the role of learning experiences, which directly influence the development of self-efficacy and outcome expectations. Lent and colleagues (1994) describe four types of learning experiences: personal performance accomplishments, vicarious learning, social persuasion, and physiological states and reactions. Personal performance accomplishments refer to an individual's experiences of success or failure while partaking in an activity, and vicarious learning takes place as an individual observes similar others (people to whom the individual perceives him/herself as being similar) succeed or fail at a given activity. Social persuasion refers to the influence of people and settings on attitudes and behaviors, and physiological states and reactions refer to the positive feelings (e.g., happiness, satisfaction, or accomplishment) or negative feelings (e.g., anxiety, depression, boredom) that one feels while engaged in a given activity. These learning experiences are important in determining the direction of an individual's career development.

The activities that take place in STEM programs are examples of learning experiences that affect the development of STEM self-efficacy and outcome expectations, STEM interest, goals and intentions to achieve a career in a STEM field, and ultimately STEM career related activities. Given the dearth of research on the activities, or learning experiences, in STEM programs that contribute to benefits such as science self-efficacy and science interest, a primary aim of the current study was to identify the activities that are related to the benefits of participation in a science support program for low-income Latina/o youth.

The Role of STEM Programs in Youth Development

The benefits of extra-curricular participation on youth development are well documented (Mahoney, Vandell, Simpkins, & Zarrett, 2009). There is less known, however, about how STEM programs in particular affect youth development. In 2010, the U.S. government invested over $3 billion in 209 programs focused on increasing knowledge of STEM fields and attainment of STEM degrees (Mathematica Policy Research, 2011). Unfortunately, these programs have been largely unmonitored—66% of those programs had not been evaluated since 2005 (Mathematica Policy Research, 2011). Therefore, little is known about the effects of these programs on youth.

There are, however, OST STEM programs that have employed evaluation strategies to monitor the progress of their youth participants. Afterschool Alliance (2011) analyzed evaluation reports from STEM programs across the US to identify common trends and strengths of these programs. The 19 programs that provided evaluation reports targeted primary and secondary school aged youth (K-12) and had a focus on science. The gender, race/ethnicity, and geographic location of the youth in these reports varied, as did the program characteristics (e.g., duration, intensity). Therefore, it was not possible to know which program activities were related to particular outcomes. Three clear outcomes did emerge, however. The results of Afterschool Alliance's (2011) analyses revealed that STEM programs positively affected youth in three ways: 1) increased interest in and improved attitudes toward STEM fields and careers, 2) increased STEM knowledge and skills, and 3) a higher likelihood of graduating from high school and pursuing a STEM career. Due to the lack of information about the methodologies employed, however, it is difficult to know if these programs are causing these positive outcomes, or if they are simply co-occurring with program participation and would have occurred regardless. For example, it is possible that these programs attracted students who were academically inclined and would have graduated from high school and gone to college with or without participating in the STEM program.

In response to the increased number of STEM programs developed for youth, there is a growing body of literature that is focused on exploring the impact of STEM programs on youth. In general, the results of these studies corroborated the results reported in the Afterschool Alliance evaluation (2011), suggesting that STEM programs positively impact youth by increasing STEM interest and improving attitudes toward STEM, increasing STEM knowledge and skills, and positively affecting academic outcomes. Each of these areas is discussed further.

STEM interest and attitudes. Two ways in which STEM programs consistently affect youth are by increasing youth's interest in STEM fields (Bystydzienski, Eisenhart, & Bruning, 2015; Christensen, Knezek, & Tyler-Wood, 2015; Duran, Hoft, Lawson, Madjahed, & Orady, 2014; Murray, Opuni, Reininger, Sessions, Mowry, & Hobbs, 2009; Sahin, Ayar, & Adiguzel, 2013; Tyler-Wood, Ellison, Lim, & Periathiruvadi, 2012) and by influencing their attitudes toward STEM fields and careers (Christensen et al., 2015; Sorge, Newsome, & Hagerty, 2000; Tyler-Wood et al., 2012).

In a large-scale comparison study of three different types of STEM programs, the authors assessed participants' attitudes toward STEM (Christensen et al., 2015). One program focused on energy monitoring activities, another program was an afterschool robotics program, and the last program was a highly competitive residential STEM program for junior and senior high school students. The authors concluded that participation in these programs was associated with improved attitudes toward science for girls and maintenance of already positive attitudes toward science for boys. With regard to science interest, the authors concluded that a variety of hands-on, active learning STEM activities relevant to the real world can be effective in promoting and retaining interest in STEM content and careers for youth.

Similar findings were reported in two other studies of programs designed to increase opportunities for underrepresented students to learn about and have hands-on experiences in the information technology (FI^{3}T program; Duran et al., 2014) and health sciences fields (HEADS UP; Murray et al., 2009). Participants engaged in hands-on activities alongside high school teachers and local STEM experts, and in both cases participants' STEM interest increased. In the FI^{3}T program participants' interest in math and science increased, with 55% of participants reporting increased or sustained interest in IT and/or STEM fields at the end of the program (Duran et al., 2014). In the HEADS UP program, results revealed that despite initially reporting lower levels of interest in science in 6th-grade, program participants reported significantly higher science interest in 8th-grade than their peers in the control group (Murray et al., 2009).

Because women are underrepresented in STEM fields, some STEM programs are developed specifically for girls and young women. Two of these programs, Bringing Up Girls in Science (BUGS; Tyler-Wood et al., 2012) and Female Recruits Exploring Engineering (FREE; Bystydzienski et al., 2015), provided participants with OST programming that focused on environmental science (BUGS) and engineering (FREE). These programs were effective in increasing participants' interest in STEM fields and helped to improve their attitudes toward science and science careers. In both studies, program participants' STEM interest and attitudes were compared to those of similar peers who did not participate in the programs, and in both cases, the program participants' STEM interest and STEM attitudes were significantly higher than those of the control group.

Not every program is successful in maintaining participants' positive attitudes toward STEM. In a science program focused on space exploration, both male and female middle school students reported significantly more positive attitudes toward science and scientists midway through the program than at the beginning of the program (Sorge et al., 2000). This increase in positive attitudes toward science persisted only for male participants, however. The positive attitudes among female participants witnessed midway through the program disappeared by the end.

In one of only two qualitative studies of STEM programs, Sahin et al. (2013) explored the effects of six OST STEM programs for students in grades five through nine. The interview data revealed that students demonstrated increased interest in STEM majors and careers, and they developed collaboration and communication skills. More examples of STEM knowledge and skills that students developed while participating in STEM programs are described in the next section.

STEM knowledge and skills. The FI^{3}T program was aimed at increasing participants' opportunities to learn, experience, and use IT in STEM fields, and it was successful in increasing participants' IT/STEM knowledge and skills in several ways (Duran et al., 2014). Participants improved their common technology skills (e.g., using word processing software), developed advanced IT/STEM technology skills (e.g., using robotics simulation software), and increased the frequency with which they used these skills in their daily lives (Duran et al., 2014). The participants in the FI^{3}T program gained a better understanding of what IT as a field entailed, learned more about IT/STEM careers, and they gained a better understanding of how IT and STEM can be applied to real world settings.

In a qualitative study aimed at understanding students' experiences in a summer STEM and career development program, Blustein and colleagues (2013) found that the nine high school students they interviewed increased their STEM content knowledge and began to think about STEM more broadly. They also gained more knowledge of STEM careers, and they became more motivated to explore STEM careers in the future.

Academic benefits. The last major area in which STEM programs benefited students was in their academic performance, including high school GPA, standardized test performance, high school graduation, and college enrollment (Bystydzienski et al., 2015; Murray et al., 2009; Olsen, Seftor, Silva, Myers, DesRoches, & Young, 2007; Tyler-Wood et al., 2012; Winkleby, 2007). In the FREE program for girls, among those who remained in and completed the FREE program at the end of their senior year, approximately one fifth (21%) enrolled in an engineering program in college, and one third enrolled in another STEM discipline (Bystydzienski et al., 2015). However, many of these participants experienced a variety of barriers and discontinued their studies in either engineering or STEM.

In the BUGS program, the girls in the program scored significantly higher on the science section of the Iowa Test of Basic Skills than a comparison group of demographically similar peers. Similarly, in their investigation of the HEADS UP multimedia health education program, Murray and colleagues (2009) found that the HEADS UP students reported significantly higher scores on the SAT 10 science test than the comparison group of demographically similar peers.

The Stanford Medical Youth Science Program (SMYSP) is a biomedical pipeline program aimed at diversifying the health professions by providing very low-income students with academic support and opportunities to explore the medical sciences during a five-week residential summer program (Winkelby, 2007). Since 1998, 100% of the 405 participants have graduated from high school, and 99% are attending (or have attended) a two- or four-year college. Among those participants who were admitted to and not currently attending college, 81% graduated from college, and 52% of those college graduates were either attending or graduated from medical school or another graduate program. Similar to some of the other studies reviewed (Bystydzienski et al., 2015; Duran et al., 2014; Sorge et al., 2000), a limitation of this study of the SMYS program is the lack of a comparison group. It is possible that the students who chose to participate in the program were more motivated to attain higher education than their peers. Despite the lack of a comparison group, the statistics surrounding student success are impressive given the fact that participants in the SMYS program come from backgrounds that are underrepresented in STEM fields.

The Upward Bound Math and Science program (UBMS; Olsen et al., 2007) is a STEM support program for low-income and/or first-generation youth. As of 2007, the UBMS evaluation (N = ~1500) was one of the first to use an experimental design to measure the effects of a federally funded STEM program. Results revealed that UBMS students were more likely to take upper-level high school courses in science, their average GPA in math courses increased from 2.7 to 2.8, and their average GPA in science courses increased from 2.7 to 2.9. Program participation also contributed to an increased high school graduation rate (from 96%-99%), increased the likelihood that participants would attend a postsecondary institution from 90% to 95%, increased the likelihood that participants would attend a four-year institution instead of a two-year institution by 11%, and reduced the likelihood that participants would attend a two-year institution by 5%. For female participants in particular, UBMS program participation increased their bachelor's degree attainment rate from 32% to 40%, and it increased the likelihood that they would major in, or intend to major in, math and science from 23% to 33%.

In sum, the literature on STEM support programs suggests that STEM programs positively impact youth by increasing students' interest and improving students' attitudes toward STEM, increasing youth's STEM knowledge and skills, and positively affecting students' performance in high school and college. One of the limitations of this body of literature is the absence of research that identifies the particular program activities that contribute to these benefits. Without this information, it is unclear how these science support programs positively affect youth development.

Rationale

There is an increasing demand for skilled STEM workers in the US, but there are not enough STEM graduates to fill the increasing number of newly created STEM jobs (Crisp & Nora, 2012; U.S. Department of Education, 2015). Latina/os are underrepresented in STEM fields, and they continue to graduate from college with STEM degrees at lower rates than White and Asian American students (Anderson & Kim, 2006). In order to increase the number of underrepresented students in the STEM pipeline, OST STEM programs have been implemented to target these students. Guided by a positive youth development perspective and SCCT, the present study explored the role of a science support program in promoting positive youth developmental outcomes in a sample of low-income, Latina/o youth.

The literature on STEM support programs suggests that students benefit from participating in these programs. There are limitations to this literature, however. First, only three studies focused on Latina/o students' experiences in STEM programs (Bluestein et al., 2013; Murray et al., 2009; Sorge et al., 2000). Because Latina/o students are underrepresented in

STEM fields, it is particularly important that more research investigates their experiences in STEM programs to better understand the unique factors that promote or inhibit their continued participation in the sciences. Of the three studies that explored Latina/o students' experiences, two utilized a quantitative methodology (Murray et al., 2009; Sorge et al., 2000), while only one took a qualitative approach (Bluestein et al., 2013). Many quantitative studies are confirmatory rather than exploratory in that the researcher chooses measures based on preconceived ideas about what s/he expects to find. In the predominately quantitative research on STEM programs, researchers tend to investigate variations of the same types of variables (e.g., interest, attitudes, knowledge, and academic performance), and there has not yet been a comprehensive qualitative exploration of all the possible ways in which students benefit from participating in a science support program.

Another limitation of the literature is that there are no studies that have linked STEM program activities to outcomes. Therefore, it is unclear how STEM programs are contributing to outcomes. A study that identifies the "active ingredients" of a STEM program and links those program activities to outcomes would provide a more comprehensive understanding of how STEM programs positively affect students, and it would greatly assist with STEM program development and refinement. Finally, all the published studies on STEM programs focus exclusively on student perspectives. A strength of this approach is that it gives students voice and an opportunity to share their perspectives on their own experiences, but a study that assesses other stakeholder perspectives (i.e., student, instructor, staff) as well would contribute to a fuller understanding of how students benefit from participating in science support programs.

In the current study, I addressed these gaps in the literature by conducting an in-depth, qualitative exploration of the benefits of a STEM program for Latina/o youth. In this study, the perspectives of multiple groups (e.g., students, graduate student mentors, faculty mentors, and staff members) were considered. Finally, this investigation helped to expand the literature on STEM programs by explicitly linking program activities to program outcomes (i.e., benefits of participation). The research questions explored were 1) What are the benefits of a science support program for Latina/o youth? and 2) What are the activities in a science support program for Latina/o youth that are related to these benefits?

Method

The current study was part of a larger investigation that evaluated STEMulate, a science support program for low-income Latina/o students. The purpose of the larger investigation was to learn more about what students gained from participating in the program, students' educational and career aspirations, the relationships that participants had with others in the program, and participants' perceptions of the roles of gender and race/ethnicity in science. An external team of evaluators (including myself) who were unaffiliated with the STEMulate program conducted the larger investigation. My role on the evaluation team was that of project coordinator, and I was involved in the study design and tool development activities, recruitment, and data collection. Although the larger investigation assessed several topics, the current study focused on the benefits of participating in STEMulate and the activities that were related to those benefits.

A qualitative methodology was used to explore the research questions in the current study. A qualitative approach was particularly useful because it allows for an in-depth understanding of the issue, which was needed to further develop the literature on science support programs. A qualitative approach is also well suited for understanding processes, which was helpful in the current study given the aim of understanding the processes (i.e., activities) through which the science support program positively affected student outcomes.

Further, qualitative research seeks to empower individuals to share their personal stories and experiences, and it acknowledges the importance of understanding the context in which the topic of interest takes place (Creswell, 2007). Most of the preexisting research studies on science support programs used a quantitative methodology, and because there is great variation in science support programs, a detailed understanding of the context in which the science support program takes place is integral in gaining a comprehensive understanding of how youth benefit from participating in these programs.

The qualitative approach used in the current study is a modified grounded theory approach that allowed for both an in-depth exploration of the benefits of participating in a science support program, as well as the development of a framework that linked specific activities to particular benefits. Grounded theory is a qualitative methodology in which the primary goal is to produce a theory, or general explanation, of a process, action, or interaction that is grounded in data from participants who have all experienced a shared process (Creswell, 2007; Charmaz, 2006). Oftentimes the theory that emerges from grounded theory helps to explain practice and/or provides a framework for future research (Creswell, 2007).

Researcher's Perspective

One of the benefits of using a qualitative methodology is the explicit acknowledgement of the influence of the researcher's perspective in the development of the research study and in the interpretation of the results. Therefore, I provide a brief description of my background and beliefs that are related to the proposed research study.

I am a White woman who was born and raised in a predominately White, politically conservative, upper-middle class suburb of Chicago. I was raised Catholic in a very loving and supportive home environment, and most of life's difficult questions were discussed and explained from a religious perspective. Outside of family vacations, I did not spend much time outside of my hometown. Each year, however, I did spend a few long weekends with my aunt who lived in Chicago. Each time I visited her I was both enamored by allure of city life and upset by the homelessness that I witnessed. I could not understand how it was permissible for fellow human beings to live in such deleterious conditions. I realized from these trips that the world wasn't as simple and straightforward as I believed it to be.

Since before I was born, my mom has worked in the restaurant industry. Over the past 30 years, she has met and formed friendships with many undocumented workers from Mexico. My mom has a natural inclination toward helping others, and I remember several instances in which she assisted her undocumented friends with issues related to housing, childcare, education, or employment. Even as a child, I could tell that my mom was different than many of the other adults in my community, and I admired her for that. I believe she sparked a desire within me to do my part to help others less privileged than myself.

I excelled in high school and college, and when it came time to choose a topic to research for my undergraduate honors thesis, I knew that I wanted to investigate the educational experiences and decision-making of Latina/o students. I took an individual-focused perspective when designing my research study and expected that I would uncover individual difference variables that explained why fewer Latina/o students chose to go to graduate school than White students. I was a bit perplexed to find no differences between Latina/o students' and White students' intentions to go to graduate school. What else could be causing the disparity in the educational attainment rates of White and Latina/o students?

Midway through my honors thesis research, I was fortunate to meet a newly hired assistant professor, a Community Psychologist, who introduced me to an ecological perspective. She familiarized me with systems-level thinking and engaged me in difficult, yet invigorating conversations that challenged the ways in which I was taught to view the world. For the first time in my life I was thinking about intangible societal forces that differentially affected various groups of people. This change in thinking was a pivotal point in my development as a human being, student, and researcher, and I was convinced that Community Psychology was the field I should pursue.

My first few years of graduate school were incredibly overwhelming, in part because I was exposed to new perspectives that challenged my worldview and identity. For the first time in my life I found myself in settings in which I was no longer part of the racial/ethnic majority group. I had to think deeply about what it meant to identify as White and the implications of that identity, and I reflected on issues of privilege, power, and powerlessness. Although difficult, this transformation was both necessary and productive in that my default perspective became ecological, and I began to think critically about potential solutions to social problems rather than thinking of them as inevitable misfortunes. I recognize the power of affluence and privilege associated with my White, middle class identity in promoting positive developmental outcomes, and I acknowledge that non-White and/or lower socioeconomic groups experience less privilege.

This perspective has permeated my research and led me to strongly endorse the belief that all children have the potential to succeed if given the resources and opportunities to develop their innate talents and strengths. Unfortunately, the reality in the US is that fewer opportunities and resources are available to those in lower socioeconomic strata than those in higher socioeconomic strata, and Latina/os are overrepresented among those who live in poverty (National Poverty Center, 2010). This suggests that Latina/o children and adolescents are less likely to have access to the resources and opportunities that can help them develop their innate strengths and talents. In terms of the present study, I believe that science support programs (such as the one investigated in the present study) can positively affect underrepresented students' science education development and serve as a resource that can provide these students with greater opportunities in the future.

Philosophical worldview. Given the central role of the researcher in qualitative research, it is important to acknowledge my philosophical worldview, which influenced the design and interpretation of the results in the current study. This study takes on a social constructivist approach (Charmaz, 2006; Creswell, 2007) in that I acknowledge the existence of multiple realities and believe that people develop subjective meanings of their experiences, which are influenced by their identities and social forces. Given this assumption, I expected that the participants in the current study would have diverse experiences in STEMulate, and open-ended interview questions were asked to encourage participants to share their perspectives and interpretations of their experiences.

Context

The science support program that is the focus of the current study is STEMulate. The program takes place at a medical university in the Midwest. STEMulate was developed by a faculty member who recognized the need for an intensive science support program for low-income Latina/o high school students in order to increase the number of Latina/o students who enter the STEM pipeline. The long-term goal of STEMulate is to increase the number of qualified students from underrepresented populations who complete advanced degree health programs and serve the community as practicing health professionals.

STEMulate is a multi-year, paid program that students typically begin the summer after their sophomore year of high school and continue each summer until they graduate from college. The program takes place for eight weeks each summer, and students are expected to participate on Monday through Thursday from 9:00 a.m. until 4:00 p.m. Students are typically given Fridays off, but there are occasional fieldtrips scheduled on Fridays that students are required to attend. Throughout the summer, students engage in applied research experiences in the field of biomedical science while receiving mentoring from faculty advisors and graduate students. Students also receive other supportive services, such as math and science courses, life skills training (e.g., CPR, emergency response skills), and information about different science careers and educational trajectories that lead to those careers. When designing the program, the STEMulate staff recognized that many students who are targeted for the STEMulate program are expected to work during the summer and contribute financially to their families. To acknowledge this and ensure that it did not impede qualified students from participating, students receive an hourly wage to compensate them for their time in the program.

The participants in STEMulate are students who identify as Latina/o, come from low-income households, and live in the surrounding area of the university. The students are recruited from three local high schools—two public schools and one private school. At the time the data were collected, the college readiness rates of the two public high schools were 7% and 19%, which were both substantially lower than the Illinois state average of 46% (Illinois State Board of Education, 2015). Students are considered college ready if they score 21 or greater on the ACT. In order to be eligible for STEMulate, students were required to have a 3.0 grade point average and be at least a sophomore in high school. The program was presented to students in their high school science classes, and interested students were given applications. The STEMulate staff reviewed applications, and students whose applications passed the first screening were then invited to an interview with at least one parent or guardian. After the interviews, the staff decided which students would be offered admission into the program, and then accepted students began STEMulate in the summer following their sophomore year of high school. Typically, about four students are accepted each year.

Participants

All people who were involved or previously involved with STEMulate at the time of data collection were invited to participate in the current study. Members of the research team conducted recruitment presentations at orientation sessions in the beginning of the summer of 2015 to inform participants about the study, and recruitment emails were sent to every potential participant. Of the 57 people who were involved, or had formerly been involved with STEMulate, 39 (68%) chose to participate. Participants fell into one of four groups: STEMulate students, STEMulate staff members, graduate student mentors, and faculty advisors. One staff member was also a faculty advisor. For the purposes of the present study, this individual was considered a faculty advisor because he discussed his role as a faculty advisor and his interactions with both his mentees and the other STEMulate students extensively during his interview. There were 20 students who had ever participated in the STEMulate program. There were four active students who chose not to participate, and there were five former STEMulate students who dropped out of the STEMulate program and did not participate in the study. Although we worked with program staff to contact these five individuals, we were unable to get in touch with them. Therefore, former STEMulate students who discontinued their participation in the program are not represented in the current study.

STEMulate students. There were 11 STEMulate students who participated in the current study. The STEMulate students were 55% male (*n* = 6) and 45% female (*n* = 5). All students (*n* = 11) identified as Latina/o. In terms of ethnicity, 82% (*n* = 9) of the students identified as Mexican/Mexican-American, one (9%) identified as Puerto Rican, one (9%) identified as Belizean, and one (9%) identified as Salvadorean. Students were able to report more than one ethnicity. The mean age of students was 18.00 years old (*SD* = 1.84) and the ages ranged from 16 to 21 years. All students were enrolled in STEMulate during data collection, and the mean number of years students had been involved in the program was 2.55 years (*SD* = 1.44; *range* = 1 to 5).

STEMulate staff members. There were 3 STEMulate staff members who participated in the current study. The STEMulate staff members were 100% female (*n* = 3). In terms of ethnicity, one staff member (33%) identified as White and Native American, one (33%) identified as White, and one (33%) identified as Mexican/Mexican-American. One staff member declined to provide her age, but the mean age of the other two staff members was 38.50 years old (*SD* = 2.12). The mean number of years that the staff members had been involved in the program was 3.67 years (*SD* = 1.15; *range* = 3 to 5).

Graduate student mentors. There were 12 graduate student mentors who participated in the current study. The graduate students were 58% male (*n* = 7) and 42% female (*n* = 5). Most of the graduate students (75%; *n* = 9) identified as White, two (17%) students identified as Asian/Pacific Islander (one of these students specified that s/he was Taiwanese and one student did not specify his/her ethnicity), one student (8%) identified as Mexican/Mexican American, and one (8%) student identified as “Other,” but did not specify a particular ethnicity. Graduate students were able to report more than one ethnicity. The mean age of the graduate student mentors was 28.92 years old (*SD* = 3.06; *range* = 25 to 35), and the mean number of years that graduate student mentors had been involved in the program was 2.67 years (*SD* = 1.50; *range* = 1 to 5).

Faculty advisors. There were thirteen faculty advisors who participated in the current study. The faculty advisors were 69% male (*n* = 9) and 31% female (*n* = 4). The majority of faculty advisors (77%; *n* = 10) identified as White, one (8%) faculty advisor identified as Korean American, one faculty advisor (8%) identified as Mexican/Mexican American, and one (8%) faculty advisor identified as African American/Black. Faculty advisors were able to report more than one ethnicity. The mean age of the faculty advisors was 51.92 years old (*SD* = 8.96; *range* = 37 to 64), and the mean number of years that the faculty advisors had been involved in the program was 3.00 years (*SD* = 1.54; *range* = 1 to 5).

Procedure

Once participants indicated that they were interested in taking part in the study someone from the research team scheduled an interview with them. Members of the research team who were trained to conduct one-on-one, in-depth interviews (including myself) conducted the interviews. All interviews took place at the medical university in private offices or conference rooms. Informed consent was conducted with each participant. Participants were informed of their rights as research participants, and they were told that their participation was voluntary, the information that they shared would remain confidential, and that there would be no negative consequences if they chose to discontinue their participation in the study. Participants completed the informed consent process by signing a consent form that stated they agreed to participate in the study. Participants who were younger than 18 years old signed an assent form, and they were also required to have their parent or guardian sign a parent/guardian permission form.

All interviews were completed during the summer of 2015. Participants completed one-on-one, in-depth qualitative interviews that ranged from 30 minutes to 150 minutes. All interviews were conducted in English and were audio-recorded. After participants completed the interview, they completed a brief survey about their demographic information, and then they were given a $25 gift card to Target for completing the interview. Interviews were transcribed verbatim by a professional transcription company and then sent back to the research team in a Microsoft Word document. All transcripts were kept in a private folder on a computer that could only be accessed by the research team. Transcripts were de-identified and labeled with a randomly assigned ID number. A separate document that linked participants and ID numbers was password protected and stored in private folder that could only be accessed by the research team.

Interview Protocol

A semi-structured interview protocol (see Appendix A) was developed for the larger study that inquired about several aspects of the participants' experiences in STEMulate. The interview protocol began with a series of initial open-ended questions. Then after establishing rapport with the participant we moved into more specific intermediate questions, and then we followed with reflective ending questions. The interviewers avoided asking closed-ended questions and tried to ensure that the participant did most of the talking. Although the interview protocol guided each interview, the interviewer asked follow-up or probing questions that were not part of the protocol when necessary.

The various sections of the protocol inquired about participants' perceptions of the skills that students gained from participating in the program, the relationships that participants had with their respective mentors or mentees, and participants' perceptions of the roles of gender and race/ethnicity in science. Student participants were also asked about their educational and career aspirations. Finally, participants were asked to share any suggestions they had for improving STEMulate. The focus of the current study is on the section of the interview protocol that directly assessed the skills and benefits that students gained from participating in the program. Specific questions asked about the technical and "soft" (e.g., communication, leadership) skills that students developed, students' attitudes toward science and school, students' confidence and science self-efficacy, and students' interest in science. Although we did not directly ask about skills and benefits in other sections of the protocol, many participants discussed the skills that students developed and ways in which students benefited in other sections as well.

Data Analysis

The data analysis in this study was guided by a two-phase, modified grounded theory approach described by Charmaz (2006). In Charmaz's (2006) approach there is an emphasis on diverse worldviews, multiple realities, and the influence of the researcher in steering the coding process rather than an emphasis on the adherence to strict coding methods. In this flexible approach to grounded theory coding, there are two steps: initial coding and focused coding. In her description of the coding process, Charmaz (2006) explains that she sometimes finishes the coding process with a modified version of Strauss and Corbin's (1990) axial coding, which results in a framework that demonstrates links between categories and subcategories. Charmaz's (2006) process of initial coding, focused coding, and modified axial coding was ideal to sufficiently explore the two research questions in the current study.

Dedoose, a web-based qualitative coding software, was used to complete the initial coding, the focused coding, and the modified axial coding phases. In the initial coding phase, a trained research assistant and I closely analyzed each line of text in the transcripts and coded any text that had to do with the benefits of participation in the program and the activities related to those benefits using the Comments tool in Microsoft Word. Although certain sections of the interview transcript focused on the benefits of participating in the program, the research assistant and I read each transcript in its entirety to identify all relevant data. The research assistant and I met weekly to discuss the coding process and resolve any coding disagreements that may have arisen. In the initial coding phase, we created detailed, descriptive codes that reflected the particular benefit or activity that was described to ensure that we remained open to all possible theoretical directions that might have emerged as we read the transcripts (Charmaz, 2006). This coding strategy we used is compatible with an inductive approach because it allowed for the creation of descriptive and detailed codes that were necessary in the initial phase of coding. During the initial coding phase, I shared the emerging results with a STEMulate faculty mentor and asked him for suggestions regarding the categorization of the emerging activities because many of the activities were highly technical and specific to biomedical research.

After the initial phase of coding was complete, I began the focused coding phase. The initial coding phase had given me a sense of the themes and subthemes that emerged. The next step was to sift through the descriptive codes produced during the initial coding phase, identify the themes and subthemes that were present in these codes, and organize them in a framework that was used to guide the focused coding phase. The result was a detailed and lengthy coding framework. During the focused coding phase, I reviewed each of the transcripts and revised the codes and framework as necessary. I identified larger themes in the data and combined some of the more detailed themes, which resulted in a more parsimonious coding framework. Themes were included in the final coding framework if they 1) represented benefits of program participation and/or activities related to the benefits, and 2) reflected common experiences shared by multiple participants. The focused coding phase helped me to ensure that the themes and subthemes that emerged in the initial coding phase accurately reflected the data.

After the initial and focused coding phases were complete, I conducted the modified axial coding to link the benefits and activities. Specifically, I conducted a qualitative “code x code” analysis in Dedoose, which resulted in a series of charts that revealed the frequencies with which each activity co-occurred with each benefit. These frequencies, along with memos that I had written throughout the initial and focused coding processes, guided the development of the links that identified the activities that were related to each benefit. Given the nature of the grounded theory approach, all coding was inductive, which means that the themes and subthemes that emerged were rooted in the data rather than from a preconceived framework.

Establishing credibility of research findings. An important step in qualitative research is establishing the credibility of the research findings that emerge (Lincoln & Guba, 1986). Because the researcher is an active participant in the interpretation of the data, it is important that the conclusions made by the researcher are reflective of the participants’ experiences (Charmaz, 2006). In the present study, several steps were taken to establish the credibility of the research findings. First, we conducted a series of member checks (Lincoln & Guba, 1986) after the initial coding phase was complete. Member checking is the process of testing the emerging results by sharing them with participants and assessing their reactions. We conducted four feedback sessions, one with each group of participants, during which we shared the emerging benefits and activities that were identified in the initial coding phase and asked them for their feedback. We asked for general reactions and questions, and we specifically asked if the findings were reflective of their experiences in the program. In each of the feedback sessions participants tended to validate the emerging findings and confirm that they were indeed reflective of their experiences. Although participants asked some clarification questions, there were no instances in which participants disagreed with the benefits and activities that had emerged.

Another way in which I worked to establish the credibility of the research findings was by engaging in peer debriefing (Lincoln & Guba, 1986), a process in which I discussed the emerging results with “disinterested professional peers” who are not directly involved in the research process (e.g., graduate students, undergraduate students, and psychology faculty members outside the community psychology program). Although not a strategy explicitly recommended by Lincoln and Guba (1986), I also discussed the findings as they emerged with those who were involved in the research process (e.g., dissertation chair, lab members). Discussing the results as they emerged with a variety of people, some of whom were involved in the research and others who were not, helped to counter researcher bias and helped me think critically about my results.

I also regularly engaged in negative case analysis (Lincoln & Guba, 1986) to establish the credibility of the results. Negative case analysis is a strategy in which the researcher actively searches for examples in the data that contradict the conclusions or results. The researcher uses these contradictions to think critically about the results and revise them if necessary. In the present study, I noted instances in which interviewees suggested that students did not experience certain benefits. I also conducted negative case analysis in the modified axial phase of coding while analyzing the links between activities and benefits.

Finally, I took notes (i.e., memos) throughout the coding process that described coding decisions or framework revisions that I made, as well as recurrent and co-occurring themes. I also saved every iteration of each coding framework to keep track of its evolution. I periodically reviewed these notes and previous iterations of the coding frameworks to reflect on the data analysis process.

Results

The purpose of the present study was to identify the ways in which students benefited from participating in a science support program, as well as to identify the activities that were associated with those benefits. The perspectives of each group of participants (staff, students, graduate student mentors, and faculty mentors) are represented in this section. First, the activities that were associated with beneficial outcomes for students are described, and then, the benefits students experienced are described. The relations among the activities and the benefits are discussed throughout this section. A list of the activities and benefits that emerged can be found in Table 1, and the links between the activities and benefits are presented in Figures 2, 3, and 4. To maintain confidentiality, pseudonyms are used for each participant throughout this section.

Activities

The STEMulate program engaged students in various activities during each eight-week summer session. Students took part in several program activities, and they worked in science research labs while receiving mentorship from graduate students and faculty members. Described in this section are six activities that were related to the benefits of participating in STEMulate: 1) math and science coursework, 2) oral presentations, 3) college visits and field trips, 4) presentations by professionals, 5) lab activities, and 6) mentoring.

Math and science coursework. A core component of the STEMulate curriculum is the math and science courses that take place every day for one hour in the afternoon. Graduate student mentors teach these courses, and they are largely responsible for choosing the topics and developing the lesson plans. The primary purpose of these courses is to provide students with lessons about foundational concepts in math and science that students need to grasp in order to be successful in their high school and college math and science courses. As one staff member, Mia, explained,

> "The students have daily classes in math and science and the graduate-student mentor creates the curriculum and its lessons based on things that they'll encounter in the labs and things that they will encounter in higher-level math and science classes that they'll hopefully be taking in college. They do it and they try to do it in a way that's a little more fun than you would maybe find in your typical classrooms. Discussing current events or articles and things on the topic."

For some students (typically first-year students), the information presented in these courses is brand new. The students who have already been introduced to these concepts benefit from these lessons as well, however, because they serve as a helpful review and reinforce these core concepts. The secondary purpose of these courses is to introduce students to new and exciting topics in science. For example, one graduate student mentor decided to teach students about core concepts in genetics by discussing research related to the cloning of thoroughbred racehorses.

Oral presentations. Students are expected to give at least one oral presentation each summer. All students give a research presentation at the end of each summer, and returning students give an additional presentation at Journal Club. These presentations are described in the following paragraphs.

End-of-the-year research presentation. At the end of each summer, students are expected to prepare and give an oral presentation. First-year students prepare and give a PowerPoint presentation about their summer research activities, while more advanced students give an abstract presentation, a 15-minute talk designed to mimic a conference presentation in which students summarize their summer research activities, data, and results. Students present to a group of their peers, graduate student and faculty mentors, STEMulate staff members, and other members of the university community who choose to attend. Although most students agreed that giving their end-of-the-year research presentation was a nerve-wracking experience that pushed them outside of their comfort zone, it was also described as having an impactful and positive effect on their development.

Journal Club. Each summer, all returning STEMulate students give a presentation at Journal Club. All students and graduate student mentors meet on Mondays during lunch for Journal Club. At each Journal Club meeting, a student gives a presentation about an empirical journal article that they read. Students choose the empirical journal article that they would like to present, and graduate student mentors often assist the students in selecting and analyzing the article and preparing their presentation.

College visits and field trips. Because STEMulate only meets Monday through Thursday, students have Fridays off. On some Fridays, however, the STEMulate staff members organize field trips to local colleges and universities or science research labs. The college visits were particularly helpful for the younger high school students because some of the college visits that were planned by their high schools were cancelled due to a strike. For some students, the college visits organized by STEMulate staff were the only opportunity they had to visit a college or university. Students also had the opportunity to visit science research labs, including a national science research lab where Nobel Award winning science research had been conducted. During these visits, students met professional scientists and learned more about their research and careers.

Presentations by professionals. Through their participation in STEMulate, students are exposed to professionals who are invited to come and present on a variety of topics. These presentations take place on Wednesday afternoons, and the topics are typically focused on career exploration and skill development. Professionals from the medical and science research fields came and talked to students about their careers and the paths they took to achieve their career. STEMulate staff members also arranged for professionals to come and lead workshops aimed at helping students learn specific skills, such as emergency response and first aid skills (e.g., CPR, the use of an AED, and stroke response), chemical safety training, and human ethics training. Finally, a STEMulate faculty mentor led a workshop about presentation skills.

Lab activities. A foundational component of STEMulate is the laboratory research experience. Each summer, students are assigned to work in a science research lab alongside a faculty member, and oftentimes, alongside other researchers, including graduate students, postdoctoral students, undergraduate student interns, and/or laboratory technicians. Some students return to the same lab year after year, while others join a different lab each year. Students are in their labs Monday through Thursday for approximately five hours each day (with the exception of Wednesday when they spend three hours in the lab). While in the lab, students' experiences vary. Some students (especially first-year students) spend the majority of the time learning through observation, while other students (typically more advanced students) are responsible for conducting their own independent science research project. Most students are assigned to basic science research labs, but a few students who express interest in medical careers work in applied clinical labs where they also interact with patients. The lab activities that were beneficial to students fell into two categories: hands-on experience and immersion in a science research lab.

Hands-on experience. The types of hands-on experiences students had during their laboratory research experiences depended on whether they were in a clinical research lab or a basic research lab. Students who were assigned to a clinical research lab had opportunities to practice clinical skills while interacting with patients. For example, these students were able to bandage the foot of a patient who had recently received a skin graft, irrigate a wound during a surgery, conduct back-to-school physicals for high school students, and work side-by-side with medical students on cadavers in the anatomy lab. The majority of students worked in basic science research labs, and in these labs they engaged in a wide variety of activities including data analysis using specialized computer programs, working with animal models (e.g., mice and sea slugs), using laboratory equipment (e.g., pipettes and microscopes), conducting specialized science techniques (e.g., Western Blotting, Real-Time Polymerase Chain Reactions, and preparing standard curves, solutions, and buffers), and reading empirical journal articles. The common theme across these clinical and basic laboratory research assignments was that the STEMulate student was actually *doing* science as opposed to observing or learning about science.

Immersion in a science research lab. Often when participants talked about their research experience, they simply referred to the overall experience of being immersed in a science research lab rather than referring to a particular activity that they did while working in the lab. For all students, STEMulate provided them with their first exposure to a science research lab, and as a result, they became familiar with the day-to-day activities, goals, culture, and people of a professional science research lab. The immersion in this unique culture often led to positive outcomes for students.

Mentoring. Faculty members and graduate students serve as formal mentors for the students during their time in STEMulate. Each summer, students are assigned to work in a faculty member's research lab, and that faculty member serves as the student's faculty mentor. Students are also assigned to a graduate student mentor. Sometimes the students work in the same lab as their graduate student mentor, but that is not always the case. Sometimes students end up being informally mentored by graduate students, postdoctoral researchers, or lab technicians who work in the lab to which the student is assigned, but who are not formally involved with STEMulate. If students do not work in the same lab as their graduate student mentor, the graduate student mentor and the STEMulate student are encouraged to spend time together outside of the student's lab time, such as at "Lunch with Mentors" on Wednesday afternoons. Mentors are critical to the success of STEMulate. Interviewees often described the mentors as being helpful and supportive. Specifically, mentors a) provided informational and emotional support, b) taught students, c) engaged in "bridging" behaviors, and/or d) served as role models. Each of these is described in greater detail below.

Informational and emotional support. Interviewees described various ways in which mentors provided the STEMulate students with informational and emotional support. The most common way in which mentors provided students with informational and emotional support was by having one-on-one conversations with them. These conversations varied greatly in content, but the common theme was that mentors engaged in face-to-face, one-on-one conversations with the students, thereby communicating that they cared about them and were interested in their thoughts and opinions. Students talked to their mentors about science, personal problems or concerns, major life decisions (e.g., choosing a college), and their interests. In return, mentors provided information, listened to students, shared personal experiences, gave advice, and encouraged and reassured them. Some interviewees shared that there were instances in which these one-on-one conversations helped mentors and students to bond with one another. When asked if there was a moment when he felt like he was making a difference for his mentee, Evan, a graduate student mentor explained:

> "We were talking and she was saying that she wasn't sure if she wanted to go to college or if she wanted to go to college right away. She wasn't sure if she wanted to take a year off and work and earn some money. I really encouraged her that I felt like she should go to college and I felt like she should go to college right away. I told her that I felt she was very academically gifted. I also told her—I shared my experiences where I'm one of the few from my community that went to college and basically I told her I didn't wanna scare her. It was very easy if you just stay in your hometown and don't go to college. It's very very easy to fall into just survival mode. Just getting an easy job and working and all of a sudden you turn around and […] ten years later they've got two kids and they're working a minimum wage job or two or three jobs. I mean we had a really long conversation about that […] She and I were talking the first day that she got back. She was saying how she was very excited that this year we've got college visits set up and that she's really excited about learning more about colleges and starting to get into applying for scholarships and looking at applying to colleges and stuff."

Evan's mentee, who was academically gifted and would be the first person in her family to go to college, was facing a major life decision in considering whether or not she will go to college. Evan engaged in a one-on-one conversation with her, listened to her reservations, shared his personal experience, gave her advice, and provided her with lots of encouragement and support as she considered her options.

Teaching. Mentors spent a great deal of time teaching students. Mentors taught students science concepts and skills by giving in-depth explanations and demonstrations, by questioning students and asking the students to explain concepts back to them, and by working side-by-side with students in the lab. Mentors taught students several things, including clinical and laboratory research skills, oral presentation skills, math and science knowledge, and professional development.

Bridging. Mentors also supported STEMulate students by engaging in "bridging" behaviors to increase students' access to resources and expand their social networks. Bridging behaviors referred to connecting students to people, resources (e.g., books, journal articles), and/or opportunities for development that students may not have been able to access without the intervention of the mentor. Examples of these opportunities included invitations to present at conferences, opportunities to publish, job offers, and summer research opportunities. Dr. Butler, a faculty mentor, made it a priority to expand her student mentee's social network and provide her with various professional development opportunities. In her interview, Dr. Butler explained:

> "One of the things that I did with Victoria was I hooked her up with a nurse anesthetist. All day long, she was side-by-side in scrubs in the operating room with this nurse anesthetist. They did a couple of total joint cases. She wound up presenting on the total joint case. There is no doubt she got exposure to what the profession, at least nurse anesthesia, looks like. In the anatomy lab at her table, where her cadaver was, there were five other students. Those five students came from physical therapy, from the physician assistant, the pathologist assistant, and the nurse anesthesia program. She got exposure to all of them."

Victoria, a STEMulate student, had aspirations to become a nurse, and Dr. Butler helped her to learn more about the nursing profession by connecting her to nursing professionals and graduate students. She also gave her with opportunities to work alongside graduate students.

Role modeling. Many STEMulate students looked up to their mentors and considered them to be role models. In forming relationships with them, students realized that their mentors were real people, or as Dr. Greene stated, "We're not gods up on pedestals or anything like that." With time, most students found that they and their mentors shared common interests or had experienced similar struggles, and as a result, they were able to better relate to their mentors. In their interviews, some students conveyed an, "if they can do it, I can do it" attitude when discussing their mentors. Working alongside their mentors for eight weeks, relating to their mentors, and ultimately looking up to their mentors as role models often benefited the STEMulate students.

Program activities not associated with benefits. There were three program activities, writing reflections, Lunch with Mentors, and interactions with STEMulate peers, that a few participants mentioned in their interviews, but these activities were discussed infrequently and did not seem to be consistently related to any of the benefits of participating in STEMulate. Writing reflections took place for 15 minutes at the end of each day, and students were encouraged to reflect on their day and write about their experiences. A graduate student mentor said in her interview that she believes the reflection writing activity helped one of her mentees to vastly improve his reading and writing abilities.

Another program activity, Lunch with Mentors, took place on Wednesdays, and it was designed as an opportunity for the STEMulate students and their mentors to eat lunch together and engage in informal conversation. While Lunch with Mentors was not necessarily beneficial in and of itself, the interactions that took place between the students and mentors allowed them to develop rapport and perhaps build a foundation for some of the mentoring activities (e.g., informational and emotional support, teaching) described earlier.

Finally, while in STEMulate, students interacted with their peers in the program. STEMulate staff admit cohorts of three to four students each year, and the program serves a group of between 15 to 20 active students at any given time. As a result of this cohort model, STEMulate students are surrounded by peers who share a common interest in science. The interactions with STEMulate peers were mentioned by a few participants as a factor that was generally beneficial for students, but they did not talk about any particular benefits.

Benefits of Participating in STEMulate

The STEMulate students benefitted in a variety of ways from their participation in the STEMulate program. The activities previously described contributed to the following 12 benefits: 1) access and exposure, 2) mastering science knowledge and skills, 3) academic outcomes, 4) broadened worldview, 5) confidence, 6) exploration opportunities, 7) higher order thinking, 8) professional development, 9) science interest, 10) science self-efficacy, 11) science is achievable, and 12) technical skills.

Access and exposure. Based on the interview data, STEMulate provided students with increased access and exposure to supportive people and resources. Interviewees discussed access and exposure as both a benefit and a theme that led to other benefits. When describing access and exposure as a benefit, interviewees specifically referred to the increased access and exposure to science research, science professionals, research settings, technical equipment, resources, and information that students did not have access or exposure to before joining the program. Oftentimes interviewees perceived this increased access to be beneficial, but they did not specify why. Data analysis revealed that many interviewees often identified this increased access and exposure as a theme that was related to several other benefits. For example, Laila, a STEMulate student, explained, “The thing is that I honestly wouldn’t be in college if it wasn’t for [the program]. I didn’t have the money. I didn’t have the resources. I didn’t even know where to begin.” For Laila, the increased access and exposure offered by the program generally was a critical component in her ability to attend college because it provided her with the resources, guidance, and support to further her education that she otherwise would not have had.

Mastering science knowledge and skills. In many interviews, STEMulate students referred to instances in which they realized they understood complicated science concepts when someone else was talking about them, or they surprised themselves by being able to successfully explain a highly technical science concept or procedure to someone else. In these instances, students demonstrated mastery of science knowledge and/or science skills, and this comprehension and the associated positive feelings was identified as both a benefit and a theme that led to other benefits, specifically, confidence and science self-efficacy (described later).

Making and correcting mistakes**.** Inevitably, students made mistakes while working in the lab. The process of making and correcting a mistake was a process through which students developed mastery of a science procedure. The experience of making a mistake was often an uncomfortable situation for many students, and initially, most students felt nervous to admit to their mentors that they made a mistake. When describing instances in which students made mistakes while working in the lab, most interviewees explained that the mentor helped the student to remedy the situation and sometimes taught them how to fix the problem on their own. Roberto, a STEMulate student, explained:

> “I guess I would say how they [mentors] changed, not just how I think, but how I work because I guess when I started working here I was really stiff. I read the protocol, I memorized the whole thing but even then I was afraid to make a single error, to make a single mistake, but now I feel like I won't make a mistake, no matter what I do, at least not try to. If I do, I feel confident that I can ask them what's wrong and then they'll help me fix it, and then next time I do it myself I can get it completely right.”

The process of making a mistake and correcting it without punishment helped students like Roberto to feel more comfortable with their mentors and working in a research lab. Consequently, they were more likely to speak up if they made another mistake in the future because they learned that their mentor would help them fix the situation rather than admonish them for their mistake. The ability to admit and/or correct one’s mistake is an important skill that can help students to be successful in future endeavors. It also emerged as a factor that contributed to the development of other benefits, namely confidence, critical thinking, and science self-efficacy.

Academic outcomes. Results from interviews with STEMulate students, staff members, and graduate student and faculty mentors revealed that participation in STEMulate positively influenced several academic outcomes for students. While in STEMulate, students gained information and experiences that helped them succeed in an academic context and/or advance their education. The specific ways in which students benefited academically are described below.

Educational attainment and academic performance. Interviewees discussed how participating in STEMulate increased students' educational attainment and academic performance. Specifically, students met their educational attainment goals, such as graduating from high school and applying to and enrolling in college, they were better prepared for and improved their performance in their high school and college courses, they performed better on standardized tests, and they demonstrated improvement in their writing abilities. The math and science courses and the lab activities were most frequently discussed as resulting in increased educational attainment and improved academic performance. Hands-on experience doing lab procedures was cited more frequently than immersion in a research lab. Yesenia, a STEMulate student, explained how the hands-on research experiences she had in STEMulate helped her in her high school anatomy class:

> "Yeah, because when I went into the cadavers and I went back to my senior year, when we did dissections, everything was familiar. Even though a human and a cat are not the same, it's like the same parts, in a way. Everything that [teacher] was explaining and all the parts I already knew. That was a good feeling; that you already know something. You enjoy it more, because you're not like a struggler, tryin' to figure out what he's talking about. You're already comfortable with that situation."

The act of carrying out scientific research in a laboratory setting provided students with a context for science application, which resulted in increased comprehension of science concepts and techniques that students were able to take with them back to the classroom.

Similarly, learning new information and reviewing core concepts in the math and science courses helped students to feel more prepared in their high school and college math and science courses because this information was familiar to them when it was taught in school. This familiarity permitted students to focus their efforts on performing well in their courses and prevented them from feeling overwhelmed or nervous about learning new information.

STEMulate also helped students to improve their standardized test performance. Later in her interview, Yesenia added that STEMulate helped her with her performance on the ACT, a college admissions exam, saying, “When I went back to school after my first year, I took the ACTs. I went up three scores.” Laura, a STEMulate staff member, revealed that Yesenia’s experience was not unique—“One of the things we teach is test taking techniques. Our students, on average, 100 percent of them will increase their ACT when they sit for a second time by two points on average.” In a report about students who took the ACT in 2015, Harmston and Crouse (2016) state that 57% of students who took the ACT a second time improved their composite score, while 22% of students received a lower score on their second ACT attempt. Compared to these national averages, it is notable that all STEMulate students improved their ACT score when they retook the exam.

Increased educational aspirations. STEMulate students aspired to attain higher levels of education than before entering STEMulate. Before STEMulate, all students aspired to graduate from high school, and most students had aspirations to go to college and attain a Bachelor’s degree, but not all. Raquel was one of the students who was not sure if she wanted to go to college, and STEMulate had a major influence on her educational aspirations.

> “You're gonna think this is funny, but at first, I didn't really wanna go to college. I thought it was just a waste of time. Then I don't know, I guess probably this program is what got me to liking college. It makes me actually want to go to college. Hearing about all the students that go into graduate school after college makes me want to do that, too. Because I don't know, I just feel like it's a experience that no one in my family has been through. I want to be the first one to try it.”

The role modeling of mentors was the activity most often cited by interviewees when discussing students' increased educational aspirations, followed by the access and exposure to science offered by STEMulate. Students developed relationships with their mentors and began to see them as role models. As a result of spending time with their graduate student mentors, students gained an understanding of how one goes about working toward a graduate degree in science, and by spending time with their faculty mentors, students gained a better idea of what a science research career entailed. Students alluded to an, "if they can do it, I can do it," attitude when talking about pursuing higher education in their interviews. Laura, a STEMulate staff member explained, "I've heard time and time again that what they say about their mentors is that, 'I can see somebody who has done it, and I now know that I can do it."

Other participants suggested that the increased access and exposure to an environment in which science professionals were conducting science research was responsible for the increase in students' educational aspirations. By becoming aware of the possibilities that result from a graduate degree, students aspired to earn a higher level of education than they had before joining STEMulate.

Increased motivation/perseverance. Students demonstrated increased motivation and perseverance in their education. STEMulate motivated students to improve their grades, challenge themselves academically, and deepen their commitment to furthering their education. The STEMulate mentors were influential in increasing students' motivation and perseverance by serving as role models to the STEMulate students, as was the increased access and exposure to science offered to students by the program. When asked how the program had influenced his attitudes towards school, Javier, a STEMulate student, explained:

> "The program, it shows me how these mentors, how they struggled also. So not everything is gonna be easy. It just gives me a boost of energy to my education that, 'Oh yeah, I could still do it. I could still do it. They did it, so I could do it.' They have faith in me so they know I could accomplish [attaining a graduate degree]. It's just something that's in me that, 'You have to do it. There's a lot of motivation, lots of motivation."

For Javier, the fact that his mentor had encountered hardships in his journey to become a scientist, but continued to persist increased Javier's resolve to attain a graduate degree.

STEMulate students' sustained interaction with their mentors and the increased access and exposure to a science research environment encouraged students to become more serious about school. It was not fully clear from the interviews why the mentors and increased access and exposure increased students' motivation and persistence. It is plausible, however, that students' increased motivation and persistence was fueled by students' increased educational aspirations and desires to emulate their mentors' educational and career trajectories.

Information about post-secondary education. During their time in STEMulate, students acquire a great deal of information about college and graduate school. Students learn important information about the steps one must take to apply to college, financial aid and scholarships, and factors that should be considered when choosing a college, such as college location, size, and programs offered by the college. Mentors were the primary source for information about college, followed by college visits arranged by the STEMulate program staff. Raquel explained how both her graduate student mentor and her faculty mentor helped her to learn more about college:

> "She's [graduate student mentor], always, when I talk to her about college, because I'm not sure which college I want to go to, she's like, "Well, do you want to go to a big school? Small school?" Then she tells me how she didn't really—she told me that she wanted to go to a small school and how she wanted to move from home instead of staying at home for college for her first years. That makes me think about if I wanna stay at home or leave home … [Faculty mentor], she has helped me with colleges, too. I ask her questions, and she got me to talk to this girl who works in the same building […]. She told me that I should talk to her about the college that she goes to. That it's a smaller college. That I should talk to

> her about it. Because of her, I learned about the other school. That really interested me."

Many mentors, like Raquel's mentors, had one-on-one conversations with their STEMulate student mentees in which they talked with them about college, shared their personal experiences, offered advice, and provided them with important information.

The college visits arranged by the STEMulate staff were also helpful in providing students with information about college. During these college visits, students got to walk around various college campuses, meet campus representatives, and get a feel for whether it was somewhere they would like to apply. For some students, these campus visits were the only opportunity they had to visit colleges or universities before applying to them.

Mentors played a key role in helping the STEMulate students to gain a better understanding of graduate school. Many STEMulate students had no knowledge of graduate programs in STEM fields before entering STEMulate. When asked if he knew about the various graduate programs in STEM that one could pursue after college, Antonio, a STEMulate student, said, "I did not. I did not. Again, college seemed like the biggest thing, do-all, end-all." STEMulate students gained most of their information about graduate school by working alongside their graduate student mentors, observing their daily activities, and by asking them questions and having conversations with them. When asked what the most beneficial, or influential part of the program was for students, Dr. Carter, a faculty mentor, replied:

> "I think that having the exposure to research and doing medical research, spending time in the lab, and also being around students, graduate students and post docs that have decided to pursue a career in the sciences, and understanding what that entails, and the possibilities that are out there for them."

It is likely that the sustained daily interactions the STEMulate students had with their mentors was an activity that greatly contributed to students' increased knowledge of college and graduate school because they got to experience a part of graduate school by working alongside them in the lab and observing their daily tasks and interactions with others as opposed to just hearing someone talk about postsecondary education.

Normalize higher education. Normalizing higher education was another way in which students benefitted academically from participating in STEMulate. The program takes place at a medical university, and because most, if not all, of the STEMulate students had never spent time on a university campus, it can understandably be an uncomfortable and intimidating experience for some students when they begin the program. Working alongside mentors in a research lab was a key activity that helped to normalize higher education for the STEMulate students. Evan, a graduate student mentor, explains:

> "I feel like what we're really trying to do is, like I said, normalize higher education for these kids. I feel like just making them less intimidated around professors. I mean they're working everyday with Ph.D.'s and professors. It's very, very clear the first-year students are intimidated by their advisors."

Over time, students develop relationships with faculty members and graduate students, and they become more comfortable being in an academic environment.

Broadened worldview. Interviewees explained that STEMulate helped to broaden students' worldviews by introducing them to new environments, people, ideas, and ways of thinking. A few students discussed how their experiences in STEMulate caused them to think differently about their experiences in high school. Javier attended an under-resourced high school in a low-income area, but he did not realize the shortcomings of his high school education until after he had spent time in STEMulate. Javier believed that his high school did not teach him how to learn or think critically, and when asked if students attending his former high school are aware of the shortcomings in their education, Javier replied, "They would be blind. They wouldn't see. If they came to this program, they would definitely be like, 'You guys [the high school] are doin' the whole system wrong. This system is just really wrong." After spending time in STEMulate and being exposed to a wealth of resources and support for learning, Javier became frustrated and dissatisfied with his high school education because he realized he and his peers were not being given those same resources and forms of support.

Another common way in which students' worldviews were broadened was through their expanded understanding of science. Before STEMulate, students' understanding of science was largely limited to biology, chemistry, and physics—the science courses that are typically included in a high school science curriculum. By working in a science research lab, students were exposed to many areas of science beyond biology, chemistry, and physics (e.g., neurology, pathology, and psychology), and they realized that science was much more expansive than they had previously believed. Interviewees gave examples of how mentors helped students to become aware of possibilities that they had never considered by having one-on-one conversations with them and telling the students about their personal experiences. In addition to the informational and emotional support given by mentors, the increased access and exposure offered in the program and the immersion experience in a research lab also helped to broaden students' worldviews.

Confidence. Students became more confident from participating in STEMulate. They felt more confident in their high school and college courses, in their ability to understand and carry out science research, in their public speaking ability, and in their ability to talk with science professionals. There were several activities that played a role in this increased confidence. Hands-on research experience with working in a research lab, the process of mastering science knowledge and skills (often by identifying and correcting their mistakes), and in-depth explanations or demonstrations from mentors all contributed to increases in students' confidence.

For Esme, a STEMulate student, gaining a thorough understanding of complicated science concepts made her feel confident in her ability to understand the science that she would learn in her upcoming high school science courses. She explained:

> "Yeah, I mean I'm still—it takes me a little bit to get into math. Like I said, it's not my forte. I'm really good at reading, and I've become very good at applied science, but it's definitely made me—it made me feel confident in the way that—just like I said, if I can understand LMTK2 and CFTR in eight weeks and not even every day, four days a week, I think I can understand school work in a year. If they're giving me a year to learn this, I should be able to get that. That really like—I don't know. That makes me confident in myself in the way that if I could understand a graduate student level science, I should be able to understand high school science."

Esme's confidence came from her understanding of complicated science concepts, and this mastery was a result of her hands-on experience carrying out science research in her lab, as well as from in-depth explanations of scientific concepts and demonstrations of laboratory techniques from her mentors.

Exploration opportunities. STEMulate provided students with ample opportunities to explore their interests, careers in STEM fields, and their own identities. These three areas are described in the following sections.

Interest exploration. Students were provided with opportunities to explore different areas of science and determine the areas that interested them and those that did not. Being immersed in a science research lab was the primary experience that allowed students to explore their interests in science. Most students became more interested in basic science research, but there were a few students who realized they were more interested in other fields (e.g., computer science, sociology). Even though these students chose to pursue careers outside of basic science research, their time in the program was valuable because it helped them to figure out the field that most interested them.

During their time in STEMulate, most students work in at least two different labs, and some students were assigned to work in a new lab each summer when they return to the program. Lucia, a graduate student mentor, explained how the lab experience helps students to explore different areas of science:

> "We see it as our job in STEMulate to continually offer options to them, different options, the same options, over and over, year after year because what they may be interested in one year will change. That's why we also change the labs. One student was like, "You know what? I really want to be a doctor." We put her in a certain lab. Then after that, we said—she said, "I'm really interested in forensics." We said, "Okay. What about this?" We put her in a lab that was molecular, and then it turns out she's interested in psychological forensics. Then we put her in a Ph.D. psych research group. Year after year, they build upon it, but we do our best to align them with a lab they want. We always give them the same options every year, and as well as new options at—like a dentist we offer at our school, but that is still an option because in school that year, they may have learned something that relates to their interests, and now they have a new career interest and want to pursue that, and then that might lead them to something else."

The access and exposure offered by these lab experiences were critical in helping students assess their science interests because they sometimes realized that they were interested in an area that they had not previously known about before STEMulate. The opportunity to assess their interests influenced students' course selections in high school and college, helped them to choose a major in college, and shaped their career aspirations.

Career exploration. While students assessed their interests in science, they also learned about various careers in STEM and began to consider which careers interested them and which did not. The career presentations given by STEM professionals were the primary way in which students learned about careers in STEM, followed by one-on-one conversations with their mentors. Yesenia, a STEMulate student, found the career presentations very helpful because she was a student who was interested in science, but unsure of the kinds of careers that she could pursue with a science degree. Yesenia explained:

> "Yeah, and it was really helpful. They had every Wednesday a speaker in different areas. They came and talked about their job and how they got there, the school, money-wise, everything. It makes you, "Oh, I could see myself in that career or this career." Just open your mind to things that you really didn't expect that there could be or you will be interested in."

During the career presentations, STEM professionals talked to students about their careers. The presenters discussed their job responsibilities, salary, work/life balance, and the trajectories they followed to attain their careers. Through these presentations, students learned about a wider variety of possible STEM careers they could pursue, and they learned important details about each of these careers.

One-on-one conversations with the mentors also helped students to learn more about different careers in science. Mentors provided students with a real life example of a science professional and helped to deconstruct preconceived ideas of scientists based on stereotypes that students may have had before joining the program. Like many of the STEMulate students, Raquel knew very little about the career opportunities in STEM that one could pursue after college. Raquel's faculty mentor, Dr. Carter, explained how she helped Raquel to become aware of the various education and career opportunities in STEM that she could pursue:

> "She's really deciding at this point on college. She was really interested actually in my pathway to get where I got. I didn't know that she had a—I think she was very interested in how you could go on to graduate school and beyond that, a post doc. I got the sense that she might not have been really familiar with an academic pathway and the different outcomes or professions that you can pursue. I went through and told her how I got where I am basically, and also where at different points along my career I could have chosen a different path as a lot of my colleagues have done, whether it be going in an industry, or going to teach at a four-year college versus having a research career, and so sort of trying to give her an overview of all the different options once you pursue a scientific career or any type of career."

Dr. Carter played an important role in Raquel's career exploration by telling her not only about her own job as a science researcher, but also about other STEM career paths that her colleagues had pursued so Raquel was more aware of the various paths she could follow. By spending time with their mentors, students also gained a better understanding of the roles and day-to-day responsibilities associated with their mentor's career. These interactions and experiences helped students to assess their science career interests.

Identity exploration. Through participating in STEMulate, students engaged in identity exploration by thinking more deeply about their possible selves. Students began to envision themselves in science careers that they may have not known about before joining the program. Further, they began to believe that studying science and attaining careers in STEM fields was a realistic possibility for them. One-on-one conversations with their mentors were the primary way in which students engaged in identity exploration. Antonio, a STEMulate student, credited his mentor in nurturing his interest in science and helping him to recognize the reality that he could be successful in science. Antonio explained:

> "Dr. Sun would encourage me to continue asking questions and being curious about things and how things worked. I was very—I was very scared of the unknown, when I first came here. I wasn't sure how I'd fit in in this type of environment. Dr. Sun reassured me that I have potential, which was very encouraging. He allowed me to process that I have this talent and this knack for science that I didn't realize, and that's something that has helped me look towards the future and think about pursuing this later on in life. It's something that I'm very interested in."

Without the influence and encouragement of Dr. Sun, it is possible that Antonio would have shied away from science given his initial discomfort and nervousness in a science research environment.

Other participants explained that simply being exposed to scientists in a science research environment prompted them to think about their possible selves. Joshua, a STEMulate student, explained how STEMulate influenced how he thought about his future, "When I was younger, I used to see myself working at a grocery store. Like just at the checkout. Now, I know I can definitely get my degree. Some way or another, I will do it." For Joshua, simply being exposed to scientists and working in a science research environment was enough to radically expand the range of possibilities for his future self.

Higher order thinking. Interviewees discussed ways in which STEMulate helped to benefit students' cognitive development. Students were taught and challenged to think critically, and they learned a great deal of science and math knowledge. These themes are described in the following sections.

Critical thinking. STEMulate students were taught how to think critically, and they demonstrated critical thinking in their lab work. Two activities that played significant roles in students' critical thinking were mentors' willingness to teach the STEMulate students and provide them with in-depth explanations and demonstrations, as well as students' time working in and having hands-on research experiences in a science research lab. Mentors taught students to think critically when working in the lab by teaching them how to investigate research questions using the scientific method, and they also taught students about research design and explained why particular research designs were more appropriate than others for answering various research questions.

Several STEMulate mentors reported that students demonstrated critical thinking by asking questions about the research and technical scientific concepts and procedures, by identifying and correcting their own mistakes, and when interpreting data and thinking about the implications of the results. Mentors challenged students to think about why they were doing what they were doing in the lab as opposed to allowing them to simply going through the motions without having a thorough understanding of what was happening and why they were doing what they were doing. Mentors played a key role in developing their students' critical thinking abilities, and interviewees discussed the in-depth explanations and demonstrations the mentors gave as contributing to students' increases in critical thinking. Dr. Schmidt, a faculty mentor explained how she helped her STEMulate student mentee to understand a complicated science concept:

> "There's one time when I was explaining something to him and you could see the light bulb go off. That was really good because it was a biological process that the graduate student was explaining to him, but I think she didn't realize how much more she needed to break it down—'cuz again, you just forget. He presents himself as such like a mature well-spoken person. You forget you're talking to a high school student. I kind of saw the look of the deer-in-the-headlights in his face, which I recognized, but she didn't. I went back and I explained it all over again and then, again, I could see the light go off, 'Oh, I got it.' Then he explained it back to me in the language, in the terminology and the semantics that were appropriate for his level. I'm like, 'Yes, you completely got it.' That was really cool. You could see him go from just sort of being frustrated and lost to this little spark of, 'I'm not stupid, it connected.' That was really cool."

Dr. Schmidt used two techniques that were particularly effective in supporting students' critical thinking. First, she provided the student with an in-depth explanation of the biological process, and second, to make sure he truly understood the process, she asked him to explain it back to her. When he was able to successfully do so, Dr. Schmidt was confident that the student understood the concept. Other mentors reported doing this as well, particularly when challenging students to identify their own mistakes. When students approached mentors with a problem, some mentors engaged in the Socratic method by asking the student a series of questions to see if they could identify the problem and solution on their own rather than the mentor pointing out the student's mistake and telling them how to fix it. This type of exchange between the mentor and the student helped the student to think critically.

Increased science and math knowledge. Students learned a great deal of science and math knowledge while in STEMulate. They were introduced to new science concepts, and they were provided with opportunities to review core science and math concepts, which helped to solidify their understanding of these concepts. The increases in students' science and math knowledge were the result of mentors teaching them, immersion in a science research lab, and the math and science courses taught by graduate student mentors. In her interview, Laila, a STEMulate student, credited her laboratory research experiences and the math and science courses in increasing her science knowledge:

> "Yeah, it helped a lot. In college, it's made me—the books are huge. When we read them, most of the students are like, "I have no idea what this protein does or what is carbohydrates or what is calcium or glycogen or this?" I'm like, "You know it's sugar, phosphate, and all of this." It's helped me be able to interpret what they are."

The interviewer asked Laila what parts of the program contributed to this science knowledge, and she replied:

> "The experiments. The experiments themselves because in order for—well, when I was doing the experiments, in order for me to be able to do experiments, I had to know what the experiment was, and why we were doing it, and why was it important. Then, we have classes in the afternoons. They go over what is biology; what is a protein; what is a DNA structure; what is the double helix, which is the DNA structure; what is RNA, MRNA; so that helps a lot."

Laila demonstrated increased science knowledge, and she was able to use this knowledge in college science courses. Her experience was not unique; all students demonstrated increases in science knowledge, and most students cited mentoring, the lab experiences, and/or the math and science courses as activities that increased their science and math knowledge.

Professional development. Interviewees explained that STEMulate helps students to develop professional maturity that will help them succeed in future educational and professional endeavors. After spending time in STEMulate, students begin to ask more questions and speak up without being spoken to first, and they become more comfortable talking to and working with science professionals. When the students first begin the program, they are typically very quiet because they are nervous about being in a science research environment, and they are intimidated by their mentors. Over time, students become more comfortable in their surroundings, and most students become more comfortable talking to and working with their mentors. They realize that their mentors are real people just like them, and they typically are able to find something they have in common.

Students demonstrate increased responsibility inside and outside of the research lab. They communicate via email with their mentors, they show up where they are expected to be on time, and they inform their mentors and staff members of any schedule changes. Although STEMulate students were not expected to work on Fridays, one student chose to work in the lab on a Friday to make up for a day earlier in the week that she had missed, although no one pressured her to do so. Students also demonstrated improved time management, increased conscientiousness, and leadership skills. A student credited STEMulate with his increased involvement in leadership roles at his high school. Interviewees discussed students' immersion in a research lab and one-on-one conversations with mentors as activities that increased students' professional development. Lucia, a graduate student mentor, shared her expectations for her students:

> "Part of that is I do expect them to be on time. I expect them to always be honest. I expect them to turn in work to me on time. I also expect them to do their best work. I don't want to see sloppy mistakes. Those are the type of skills that when I expect it of them, then they take it in later, and because they've already been honest, they've been on time, those are things that really help them in the long run. I push them to be adults, but then within that, obviously, we have fun and I try to cheerlead them on, but I do expect them to grow up and take on this responsibility."

Lucia had high expectations for the STEMulate students, and the combined impact of mentors' high expectations, conversations with mentors, and immersion in a research lab contributed to students' increased professional development.

***Professional accomplishments*.** A specific way in which students developed professionally was through their professional accomplishments. Students acquired certifications, trainings, internships and jobs, conference presentations, and publications while in STEMulate. Students added these accomplishments to their resumes, and they help to make students more competitive candidates when they apply to college, graduate school, internships, and jobs. One student was offered a job working in a research lab, and another student coauthored a conference presentation and an empirical journal article. Students who interacted with patients in clinical research settings completed HIPAA training, and students working with animal models completed animal research and ethics trainings. Finally, some students were required to complete chemical safety training if they were working with potentially hazardous substances, and all students left the program with a First Aid certification in CPR and AED.

Javier, a STEMulate student, explained that he received an internship offer while in STEMulate:

> "Yeah, because there was this lady from AIV, she was like the high director of some department. She was like, 'When you come outta college, and you're still engineer, come talk to me because I'll give you an internship.' So that just made me like, 'What? I already have an internship right after college?—I'm not even looking that hard.' I'm like, 'Wow, this program is really helpful."

Javier received this offer during a career presentation when he met the presenter who came to talk to the STEMulate students about her career at a global science and engineering equipment distributor. Javier said that he never would have met that woman and gotten that opportunity if he had not been involved in the program.

The activities that were most commonly discussed by interviewees as being related to students' professional accomplishments were the students' experiences working in the research labs, bridging by mentors, and the career presentations. Not all students attained all of these professional accomplishments, however. Many were opportunities that were unique to particular labs or faculty mentors, and thus were only made available to the student(s) who happened to work in a particular lab or who were mentored by a particular faculty mentor.

Science interest. Most STEMulate students' interest in science grew during their time in STEMulate. A few students realized they were more interested in other fields, and although they chose to pursue higher education in those fields (e.g., computer science; sociology), they still said that their interest in science had grown during their time in STEMulate. Interviewees discussed mentoring and hands-on experiences conducting research in a science research lab as increasing students' science interest. Students and their mentors had conversations about science topics that they both found interesting, and mentors provided students with resources (e.g., books, empirical journal articles, TED Talks, and documentaries) about topics that interested the student. Antonio, a STEMulate student, explained how his faculty mentor, Dr. Sun, inspired his interest in science:

> "I have had a rather interesting experience in STEMulate, especially last year. Last year I was with Dr. Sun in the neuroscience department. We focused on the Aplysia Californica, which is a sea slug that has very simple systems. Its brain is visible, and we can detect where its neurons are. That was extremely fascinating. I talked to Dr. Sun about so many different aspects of science. We just sat down and discussed many different things, which grew my interest in the field of neuroscience."

Dr. Sun positively impacted Antonio's science interest in two ways. First, he worked side-by-side with Antonio conducting hands-on science research with animal models in the research lab, and second, he had one-on-one conversations with him about different topics in science in which he provided information about the topics. Together, these activities increased Antonio's interest in science.

Science is achievable/attainable. Interviewees explained that before entering STEMulate, science research seemed inaccessible and intangible to many of the STEMulate students. The only science research that the students had been exposed to before STEMulate was mostly limited to the science experiments they conducted in high school. Many students did not have a clear understanding of the day-to-day realities of science research. As a result, a career in science did not seem particularly attainable for most of these students. Through their participation in STEMulate, the students became intimately familiar with science research culture, and they began to see themselves as science professionals in training because they were carrying out science research in the same ways as their mentors. Further, most students did not know anyone personally who had a career as a scientist before entering STEMulate. By forming relationships with their faculty and graduate mentors, their social networks suddenly included professionals in STEM fields. The fact that the students knew people who were STEM professionals and had an understanding of what their job entailed made a future career as a STEM professional a realistic possibility. For Evangelina, a STEMulate student, being surrounded by other women scientists in her research lab made a career in science achievable:

> "Mainly because they're all female, it really has inspired me to continue what I'm doing, and that it actually is achievable. I really like the fact that my lab is all women. I was actually talking to them the other day about it. I was like, 'It's surprising because, when I think of science, I don't think of this many women in a lab. I just think of guys.' She's like, 'Yeah, we probably have all the women in that department.' Just being surrounded by that, it really makes it seem like something I can do, and that it's possible."

For Evangelina and many other students, the access and exposure to STEM professionals granted by STEMulate and the relationships the students developed with STEM professionals who they considered role models helped to make the prospect of a career in science a reality.

Science self-efficacy. The majority of the STEMulate students enter STEMulate with little or no experience conducting science research, and they underestimate their abilities to carry out the type of research that they see their mentors doing in the lab. As students experience success completing research related tasks in the lab, they begin to realize that they are capable of successfully conducting science research. Making, identifying, and successfully correcting mistakes while doing hands-on research in the lab is an experience that contributed to students' science self-efficacy. Roberto, a STEMulate student, felt more self-efficacious in his science research abilities after making a messy mistake in his lab. He explained:

> "Yeah, so my first mistake was not checking if there was a leak or not. I mean I was taught how to check for a leak, but I think I forgot because it was my first time making it alone, but after I made it and I removed the extra liquid that wasn't needed there for the job, I realized that the plate is supposed to be three fourths full, and then when I removed the excess it was two fourths because some of it had poured out. It solidified on the bench so I had to ask them how to remove it, which we saw today, meant changing the whole bottom out of the bench … So the first time I was like, oh man, what do I do? I don't wanna report this but it's a gel and it's made out of things that are biohazard, so I better go report it, so I reported it and they told me you just have to switch it, and just try not to do it again and I was like, yeah I got it and now I don't make that mistake…I always check for a leak… now I can, I was one of the few that managed to stop the leak, so I can stop the leak…If I do spill something, I don't have to worry about them telling me, oh, you have to switch that and here, I'll teach you how, because I already know."

Roberto's mentors showed him how to fix his mistake, and Roberto felt confident that he could fix a similar mistake on his own if it were to happen again in the future. For many other students, in-depth explanations and demonstrations from their mentors helped to increase their science self-efficacy. The combination of in-depth explanations and demonstrations was more effective than didactic instruction in increasing students' science self-efficacy.

Technical skills. During their time in STEMulate, students learned technical skills relevant to a career in science, and they were given opportunities to practice and refine these skills while working in research labs and during various STEMulate program activities. These skills are described in the following sections.

Clinical and laboratory research skills. Unsurprisingly given the science research emphasis of STEMulate, participants agreed that students learned a wealth of clinical and laboratory research skills by engaging in hands-on research experiences while working in a science research lab. Mentors taught the STEMulate students how to correctly carry out these research skills by giving the students in-depth explanations and demonstrating the skills. Sam, a graduate student mentor, explained how she taught her STEMulate student mentee, Raquel, an important laboratory research skill:

> "When she first came in, I showed her how to basically take care of them and how to passage them, meaning when a plate gets full, we need to move a small population of that onto a new plate and continue that growing. That's called a passage or splitting. Raquel has been able to take care of her own set of cells that I've given her. She's been able to just passage them for a couple weeks right now. The biggest challenge to this is contamination. When I first started working in cell culture, which is what this technique is called, I was contaminating everything. I got bacteria. I got fungus. I got yeast. I got everything. She's been phenomenal so far. I haven't seen any problems. There hasn't been any contamination at all. Her cells look healthy and happy."

Although passaging cells can be tricky due to the ease with which the cells can become contaminated, Sam effectively taught Raquel how to carry out the procedure, and Raquel was able to successfully passage cells on her own.

Oral presentation skills. Another way in which students benefited was through the development of public speaking and oral presentation skills. Each summer, all students gave at least one presentation, and returning students gave two. During the last week of the program, students gave their end-of-the-year research presentations, for which they either prepared a PowerPoint presentation or an abstract presentation about the research they conducted that summer. Returning students gave an additional presentation at Journal Club, which entailed reading an empirical journal article and then preparing and giving an oral presentation that provided audience members with an overview of the article. Participants often cited these two presentation opportunities as key events that helped students develop their presentation skills. Another program activity that was associated with the development of presentation skills was the presentation skills workshop, which was prepared and presented by a faculty mentor who had a special interest in presenting.

Mentors also played an important role in helping students to develop their presentation skills. The end-of-the-year research and journal club presentations are nerve-wracking experiences for students, and they typically cause students anxiety in the weeks leading up to their presentations. Mentors helped students to feel more prepared by teaching them presentation skills and providing them with informational and emotional support. Specifically, mentors helped students to develop their presentation, gave constructive feedback, and provided them with reassurance and encouragement. Esme, a STEMulate student, explained how her mentor, Riaz, helped her when she was preparing for her end-of-the-year research presentation:

> "Riaz really, for my PowerPoint, he really wanted me to have a certain outline of how to word things cuz he says that science is all about wording. I can't just—cuz it's especially like in research, you can't say that this is like—oh, LMTK2 normalizes CFTR. Well, no, it doesn't; it's a hypothesis. You have to say we believe that it normalizes; it can't be statement. Everything has to be worded a certain way. He really, really, help with that cuz he—I didn't know this. I thought I could just go up and say, 'Oh, this is what we got, blah, blah, blah,' and it's cuz I was like oh, we—our data wasn't good enough or it wasn't competent. He was like, 'Don't say that. You never want to say that your data is incompetent. Anybody can be incompetent, but no, you want to say you want to verify your data.' It's all about wording and how it presents science stuff. They're very nitpicky about that. They want me to make sure I get it right."

While helping Esme to prepare for her presentation, Riaz gave her detailed feedback about the content of her presentation, and he explained to her why she should discuss her findings in a particular way. The support he provided was a key factor in helping Esme to improve her presentation skills, and it paid off—several participants agreed that Esme's presentation was impressive.

Discussion

The current study provides evidence that science support programs positively affect youth development. The aims of the current study were 1) to identify the ways in which low-income, Latina/o students benefited from participating in a science support program, and 2) to identify the activities that were related to those benefits. Previous research on the role of STEM programs in youth development has revealed that STEM programs tend to positively affect youth in three areas: science interest and attitudes toward science (Bystydzienski et al., 2015; Christensen et al., 2015; Duran et al., 2014; Murray et al., 2009; Sahin et al., 2013; Sorge et al., 2000; Tyler-Wood et al., 2012), science knowledge and skills (Bluestein et al., 2013; Duran et al., 2014), and academic performance (Bystydzienski et al., 2015; Murray et al., 2009; Olsen et al., 2007; Tyler-Wood et al., 2012; Winkleby, 2007). While the majority of the research on STEM programs has focused on identifying the benefits of STEM programs, far fewer studies have explored the specific activities that lead to these benefits. The results of this study corroborated findings from previous research, provided new information about additional ways in which students benefit from participating in a science support program, and identified the activities that contribute to the benefits.

The present study findings supported previous research on STEM programs in that the STEMulate students' science interest increased and they demonstrated favorable attitudes toward science, they increased their science knowledge and research skills, and they improved academically. The results also revealed that students benefited in two areas not typically discussed in previous research on STEM program participation. Specifically, STEMulate helped to broaden students' worldviews, and contributed to students' identity exploration and development. The activities related to these five groups of benefits are shown in Figure 5. It is noteworthy that STEMulate contributed to students' identity exploration and development because a lack of a STEM identity is often a reason that youth do not pursue education or careers in STEM fields (Krishnamurthi, Ballard, & Noam, 2014). Youth may have positive attitudes toward STEM and they may be interested in STEM, but they still may not consider the prospect of attaining a STEM career to be a realistic possibility. For example, results from a recent study of students in London revealed that although most students held high career aspirations, reported liking science, had positive views of science and scientists, and performed well in their school science courses, only 15% of students aspired to become scientists (see Krishnamurthi et al., 2014). The authors explained that students' conceptualizations of scientists were based on stereotypes (i.e., white, middle-class, male, and "brainy"), and students who did not identify with these identities had a difficult time envisioning themselves as scientists. STEMulate addressed this disconnect by immersing students in research labs where they conducted hands-on science research alongside science professionals and began to envision themselves as scientists. These experiences helped to make the prospect of a career in science more achievable for students because they were doing some of the same work as their mentors who were scientists, they understood what a career as a scientist entailed, and they gained better understanding of the trajectory they would need to follow to become a scientist.

The overarching goal of most STEM programs is to prepare youth for careers in STEM fields. Social cognitive career theory (SCCT) provides a framework for understanding career development, and it acknowledges the influence of person factors (e.g., race/ethnicity, gender, socioeconomic status) that also shape career development. Given the acknowledgement of demographic characteristics and contextual affordances that influence career development trajectories, SCCT is a particularly helpful model to consider when investigating the career development of low-income, Latina/o youth. All of the students in STEMulate identified as

Latina/o, came from low-income backgrounds, and attended underperforming schools. Without STEMulate, their opportunities for STEM career development would have likely been more limited because they would not have had access to the critical learning experiences offered by STEMulate that help launch youth toward careers in STEM. For example, the students would have likely not had the opportunities to experience personal successes conducting hands-on science research in a science research lab or master science knowledge and skills, both of which are examples of critical learning experiences that foster science career development.

SCCT offers a model (see Figure 1, pg. 9) that outlines several factors necessary for career development (i.e., learning experiences, self-efficacy, outcome expectations, interest, choice intentions and goals, and choice actions; Lent et al., 1994). In terms of STEM career development, SCCT would posit that the process begins with formative learning experiences related to STEM, which lead to the formation of STEM self-efficacy and outcome expectations about a career in STEM, which then increase or quell STEM interest. If increased, STEM interest leads to the development of goals and intentions to pursue a STEM career and then to actions aimed at attaining a STEM career. The results of the current study revealed that STEMulate provided students with learning experiences that contributed to the development of students' science self-efficacy, the belief that a career in science is achievable (i.e., an outcome expectation), science interest, goals and intentions to pursue a career in science (i.e., educational aspirations), and choice actions (i.e., taking advanced science classes, enrolling in college, and choosing a science major).

In the context of STEM programs, the program activities in which students participate are examples of learning experiences. Lent and colleagues (1994) proposed four types of learning experiences based on social cognitive theory (Bandura, 1986) that they hypothesized to be the foundation of career development: personal success experiences, vicarious learning, social persuasion, and physiological reactions. Several of the activities that were identified in the current study align closely with these four learning experiences.

The first learning experience is personal success. In this study, conducting hands-on research in a science research lab, giving oral presentations, and mastering science knowledge and skills emerged as activities that contributed to many of the program outcomes (see Figures 2 & 3). Next is vicarious learning, in which youth observe similar others (people to whom the individual perceives him/herself as being similar, such as graduate student mentors) succeed or fail at a given activity. Role modeling by mentors is an example of a vicarious learning experience, and it was an activity that was related to many benefits in the current study (see Figure 4).

Social persuasion is another learning activity that refers to the influence of people and settings on attitudes and behaviors. In this study, students' immersion in a science research lab was an example of social persuasion, as was the increased access and exposure they had to science research settings, science professionals, technical equipment, and resources that they did not have access or exposure to before joining STEMulate. For eight weeks, students spent several hours each day immersed in a science-positive environment surrounded by professionals who had chosen to pursue careers in science. Naturally, students were influenced by their experiences, and the social persuasion that resulted from this sustained immersion helped to improve students' attitudes toward science, along with several other benefits (see Figures 2 & 3).

Physiological states is the fourth learning experience proposed by Lent and colleagues (1994), and it refers to the feelings that one experiences while engaged in a given activity. For example, negative feelings (e.g., anxiety, fatigue, or depression) during task performance may diminish self-efficacy, while positive feelings (e.g., composure, stamina, and exhilaration) may increase self-efficacy. Several interviewees mentioned in their interviews that students typically feel nervous and intimidated upon entering STEMulate, but those feelings lessen as students progress in the program. Interviewees' personal successes, such as mastering science knowledge and skills, helped students to feel more confident and more self-efficacious, which then helped them to feel more comfortable in the program. These data suggest that personal successes (the first type of learning experience proposed by Lent et al., 1994) influenced students' psychological states (the fourth type of learning experience). Although relationships among the learning experiences are not addressed by the SCCT model, this relationship between the first and fourth learning experiences provides a specific example of how the link between learning experiences and self-efficacy is formed, which is not specified in the SCCT model.

Lent and colleagues (1994) state that empirical research is needed to test the relations among the variables proposed in their model, and they specifically suggested that research be conducted on the learning experiences that shape self-efficacy and outcome expectations, particularly among underrepresented racial/ethnic minority groups. The current study provides an in-depth investigation of the learning experiences that contribute to the career development of low-income Latina/o youth in STEM fields. Many activities identified in this investigation aligned well with the four types of learning experiences proposed by Lent and colleagues (1994), but there were other important activities that did not. These activities were the math and science classes, college visits and field trips, presentations by professionals, and informational and emotional support, teaching, and bridging from mentors. These activities (as opposed to the activities that fit neatly into the four learning experiences as defined by Lent and colleagues [1994]) are characterized by the explicit provision of information to the students by others.

Therefore, it is plausible that this fifth type of learning experience, the explicit provision of information by others, is a critical component of the STEM career development of low-income Latina/o youth.

The SCCT model suggests that STEM-related learning experiences influence the development of science self-efficacy and outcome expectations for a career in science, which then lead to the development of science interest. The relations among the activities and benefits in the current study did not always follow that path, however. In the current study, there were instances in which interviewees described learning experiences that influenced science interest, without mentioning science self-efficacy and outcome expectations. Therefore, it is unclear whether the relations between the learning experiences and science interest were explained by science self-efficacy and/or outcome expectations, as suggested by SCCT, or if there was a direct relation between learning experiences and science interest. If there were a direct relation between learning experiences and science interest, it is possible that it is a product of the STEMulate students' intrinsic science interest. All of the students chose to apply to STEMulate, which suggests that they had a preexisting interest in science before entering the program, and it is unclear whether these same patterns would be observed in a different sample of youth who do not demonstrate intrinsic STEM interest.

Mentoring emerged as an activity that positively impacted students' development and contributed to 10 of the benefits identified in the current study (see Figure 4). Rhodes' (2005) model of youth mentoring proposes that mentors positively affect youth in three areas of development: in their social-emotional development, cognitive development, and identity development. Rhodes, Spencer, Keller, Liang, and Noam (2006) explain that while there is a growing body of research that provides evidence for the protective qualities of mentoring relationships for youth, few researchers have explored the processes by which mentors influence developmental outcomes. Rhodes and colleagues (2006) reviewed the limited research on mentoring processes and concluded by saying that much greater attention needs to be paid to understanding mentoring processes in order to increase the effectiveness of mentoring programs in improving the lives of the youth they serve. They specifically point out the need for qualitative studies to develop more nuanced understandings of how particular mentoring processes promote youth outcomes from the perspectives of youth and their mentors (Rhodes et al., 2006).

In their review of the literature on mentoring processes, Rhodes and colleagues (2006) summarize the processes that have been identified as mediators of the relationship between mentoring and positive outcomes. For example, mentors helped to improve youths' social-emotional development (i.e., youths' relationships with their parents) by helping them to develop effective strategies and techniques to regulate their affect (Spencer, 2002). In the same study, mentors positively affected youths' cognitive development by working with them to complete a task or achieve a goal (Spencer, 2002). Youths' identity development is the most understudied area of development in the mentoring literature (Rhodes et al., 2006), and consequently, little is known about the processes that mediate the relationship between mentoring and identity development.

Rhodes (2002; 2005) has proposed that mentoring affects youths' social-emotional development by enhancing their social relationships and emotional wellbeing, their cognitive development through instruction and conversation, and their identity development through serving as role models and advocates. In the current study, mentors' provision of informational and emotional support, teaching, bridging, and role modeling were identified as the specific mentoring activities, or processes, that contributed to the benefits students experienced. Although the benefits in the current study are not categorized as social-emotional development, cognitive development, and/or identity development, these four mentoring activities provide additional insight into the mentoring processes that positively affect youth development and provide a foundation for future inquiry on this topic.

Strengths and Limitations

The current study has several notable strengths. First, it is the first in-depth, qualitative investigation of the ways in which students benefit from participating in a science support program. Previous research on STEM programs has focused on a limited range of outcomes (interest, attitudes, skills, and academic performance). The current study used an inductive approach to explore a wide range of ways in which students benefit from participating in a science support program. Second, the proposed study focused exclusively on the experiences of low-income Latina/o students, which is uncommon in the research literature.

All of the previous research on the role of STEM programs in youth development has assessed student development from the youths' perspectives, and no studies explored youth development associated with participation in a STEM program from multiple perspectives (e.g., student, instructor, staff). In the present investigation, the perspectives of STEMulate students, STEMulate staff members, graduate student mentors, and faculty mentors were accounted for in understanding how students benefit from participating in a science support program.

Finally, an important strength of this study is that I explored the activities and/or experiences that led to particular benefits, as reported by participants. The identification of these explanatory mechanisms, or "active ingredients," provides a more nuanced understanding of how participation in a science support program benefits youth. These findings help to extend the literature on STEM programs for youth, and they provide examples of program activities and experiences that are particularly beneficial for youth that practitioners can refer to when developing and refining science support programs for youth.

Despite its strengths, this study also has its limitations. An important limitation of the current research is selection bias. The students who participate in STEMulate are in the program because they demonstrated an interest in science and went through the effort to apply to the program. We were unable to interview the five students who discontinued participation in the program, so the perspectives of these students who might not have benefited from the program, or did not benefit in the same ways as the current students, are absent from this study. One student was asked to leave the program because of repeated non-compliance, two students decided to leave the program in order to work full time during the summer, one student left due to pregnancy, and one student decided to pursue a different area of study (a STEM field) and pursued summer internships related to that particular industry. Because these students did not participate in the current study, it is difficult to determine whether or not they experienced the benefits suggested by the results. Perhaps these students dropped out of the program because they were not experiencing the benefits that were reported in this investigation. It is also possible, however, that the students did experience these benefits and discontinued their participation for other reasons.

Another limitation of the current study is that the students in this study may be more motivated, or inclined to succeed compared to their peers. There was no comparison group in the current study, so it remains unclear if STEMulate would be as effective in eliciting positive outcomes among students who do not demonstrate interest in science or who do not self-select into the program. Further, STEMulate has rigorous admittance criteria including a minimum GPA of 3.0. This suggests that the students in this program have demonstrated a certain level of academic aptitude and may be more academically talented than their peers. Finally, STEMulate is a paid, intensive, full-time, multi-year program, which sets it apart from most other STEM programs. The majority of STEM programs are shorter in duration and do not serve the same students year after year. Therefore, it is unclear how the results of this study will translate to other STEM or science support programs.

Recommendations for Future Research

The current study contributed to the literature on STEM programs by identifying the benefits of a science support program and the activities in a science support program that contribute to these benefits. The results of this study help to further both SCCT (Lent et al., 1994) and mentoring theory (Rhodes et al., 2006) by providing information about the processes that contribute to both career development and youth development. Quantitative studies aimed at testing the activities identified in this study as mediators of STEM program participation and career and developmental outcomes would help to expand the literature on STEM programs for youth and refine SCCT as it relates to STEM career development. Further, a quantitative study in which the four mentoring processes identified in the current study (informational and emotional support, teaching, bridging, and role modeling) are tested as mediators of social-emotional, cognitive, and identity development would help to expand the mentoring literature. Finally, the results of these studies would have important implications for STEM programs and mentoring programs because they would provide evidence of the types of activities that are associated with desired outcomes.

Given the uniqueness of the STEMulate program (i.e., it is intensive, paid, has a duration of several years, and has rigorous admittance criteria), more qualitative research studies of other STEM programs that are different from STEMulate (i.e., STEM programs that serve other racial/ethnic groups that are underrepresented in STEM fields, such as African American youth, or STEM programs that do not have a minimum GPA requirement) should be conducted to see if the results associated with STEMulate are found in other programs as well. Studies such as these would have important implications for STEM program development and refinement, and they would help to expand the literature on STEM programs.

A longitudinal investigation of students' participation in science support programs is also needed to better understand the nature of students' interactions with science support programs over time. A longitudinal study would help researchers and practitioners to better understand how the program affects students over time, how students' needs change over time, and it would provide important information about the ideal length of time students should spend in the program. For example, a longitudinal study could answer the question of whether there is a point of diminishing return when students would be better served by engaging in different activities (e.g. internships). Finally, future research should examine the role of gender to explore whether male and female students experience these benefits in similar ways.

Conclusion

The results of this study support the idea that students benefit in several ways from participating in a science support program. Students' increased their science knowledge and developed science skills, they engaged in identity exploration and development, their worldviews were broadened, their science interest increased and they demonstrated favorable attitudes toward science, and finally, students' academic performance was positively affected. The results of this investigation identified program activities and experiences that were associated with these benefits, which have important implications for expanding the research on STEM programs and for the development and refinement of STEM programs for youth. Future research aimed at testing the program activities identified in the current study as mediators of program participation and youth outcomes is needed, as is an exploration of the impact of science support programs on youth over time. The results of the current study provide evidence for the importance of science support programs in positive youth development, and they should continue to be implemented to increase the participation of underrepresented groups in STEM fields.

References

Afterschool Alliance (2011). *STEM learning in afterschool: An analysis of impact and outcomes.* Afterschool STEM Hub. Washington, DC. Retrieved from http://www.afterschoolalliance.org/STEM-Afterschool-Outcomes.pdf

Anderson, D., & Anderson, E. (2006). *Increasing the success of minority students in science and technology.* American Council on Education, Washington, DC. Retrieved from https://www.acenet.edu/news-room/Documents/Increasing-the-Success-of-Minority-Students-in-Science-and-Technology-2006.pdf

Benson, P. L., Scales, P. C., Hamilton, S. F., & Sesma, A., Jr., (2006a). Positive youth development: Theory, research, and applications. In W. Damon & R. Lerner (Eds.), *Handbook of Child Psychology* (pp. 894-941). Hoboken, NJ: Wiley.

Benson, P. L., Scales, P. C., Hamilton, S. F., Sesma, A., Jr., Hong, K. L., & Roehlkepartain, E. C. (2006). *Positive youth development so far: Hypotheses and their implications for policy and practice.* Search Institute Insights and Evidence, Volume 3, Minneapolis, MN. Retrieved from http://www.isbe.net/learningsupports/climate/pdfs/positive-youth-dev.pdf

Blustein, D. L., Barnett, M., Mark, S., Depot, M., Lovering, M., Lee, Y., Hu, Q., Kim, J., Backus, F., Dillon-Lieberman, K., & DeBay, D. (2013). Examining urban students' constructions of a STEM/career development intervention over time. *Journal of Career Development, 40*(1), 40-67. doi:10.1177/0894845312441680

Bystydzienski, J. M., Eisenhart, M., & Bruning, M. (2015). High school is not too late: Developing girls' interest and engagement in engineering careers. *The Career Development Quarterly, 63*(1), 88-95. doi:10.1002/j.2161-0045.2015.00097.x

Charmaz, K. (2006). *Constructing grounded theory. A practical guide through qualitative* *analysis.* Thousand Oaks, CA. Sage.

Chen, X., & Weko, T. (2009). *Students who study science, technology, engineering, and Mathematics (STEM) in postsecondary education.* National Center for Education Statistics, NCES 2009-161, U.S. Department of Education, Washington, DC. Retrieved from http://nces.ed.gov/pubs2009/2009161.pdf

Christensen, R., Knezek, G., & Tyler-Wood, T. (2015). Alignment of hands-on STEM engagement activities with positive STEM dispositions in secondary school students. *Journal of Science Education and Technology*, *24*(6), 898-909. doi:10.1007/s10956-015-9572-6

Claridge, T. (2004). Definitions of social capital. Retrieved from http://www.socialcapitalresearch.com/literature/definition.html

Colby, S. L., & Ortman, J. M. (2014). *Projections of the size and composition of the U.S. population: 2014 to 2060.* Current Population Reports, P25-1143, U.S. Census Bureau, Washington, DC. Retrieved from https://www.census.gov/content/dam/Census/library/publications/2015/demo/p25-1143.pdf

Creswell, J. W. (2007). *Qualitative inquiry and research design. Choosing among five approaches.* Thousand Oaks, California. Sage.

Crisp, G., & Nora, A. (2012). *Overview of Hispanics in science, mathematics, engineering, and technology (STEM): K-16 representation, preparation, and participation*. Educational Leadership and Policy Studies. San Antonio, TX. Retrieved from http://www.hacu.net/images/hacu/OPAI/H3ERC/2012_papers/Crisp%20nora%20-%20hispanics%20in%20stem%20-%20updated%202012.pdf

Duran, M., Hoft, M., Lawson, D. B., Medjahed, B., & Orady, E. A. (2014). Urban high school students' IT/STEM learning: Findings from a collaborative inquiry- and design-based afterschool program. *Journal of Science Education and Technology, 23*(1), 116-137. doi:10.1007/s10956-013-9457-5

Illinois State Board of Education. (2015). Retrieved from https://www.illinoisreportcard.com/Default.aspx

Krishnamurthi, A., Ballard, M., & Noam, G. G. (2014). *Examining the impact of afterschool STEM programs*. Retrieved from http://www.afterschoolalliance.org/ExaminingtheImpactofAfterschoolSTEMPrograms.pdf

Krogstad, J. M. (2014). *11 facts for national Hispanic heritage month.* Washington, DC: Pew Research Center. Retrieved from http://www.pewresearch.org/fact-tank/2014/09/16/11-facts-for-national-hispanic-heritage-month/

Kuenzi, J. J. (2008). *Science, technology, engineering, and mathematics (STEM) education: Background, federal policy, and legislative action.* Congressional Research Service Reports. Paper 35. Retrieved from http://digitalcommons.unl.edu/crsdocs/35/

Landivar, L. C. (2013). *Disparities in STEM employment by sex, race, and Hispanic origin.* American Community Survey Reports, ACS-24. Washington, DC: US Census Bureau.

Larson, R. W. (2000). Toward a psychology of positive youth development. *American Psychologist*, *55*, 170–183. doi:10.1037/0003066X.55.1.170

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive career theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior, 45*, 79-122. doi:10.1006/jvbe.1994.1027

Lincoln, Y., & Guba, E. (1986). But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *New Directions for Program Evaluation, 20*, 15-25. doi:10.1002/ev.1427

Mahoney, J., Vandell, D. L., Simpkins, S., & Zarrett, N. (2009). Adolescent out-of-school activities. In R. M. Lerner & L. Steinberg (Eds.), Handbook of adolescent psychology (3rd ed., pp. 228–269). New York: Wiley.

Mathematica Policy Research (2011). *Science, technology, engineering, and mathematics (STEM).*

Murray, N. G., Opuni, K. A., Reininger, B., Sessions, N., Mowry, M. M., & Hobbs, M. (2009). A multimedia educational program that increases science achievement among inner-city non-Asian minority middle-school students. *Academic Medicine, 84*(6), 803-811. doi:10.1097/ACM.0b013e3181a425e7

National Poverty Center. (2010). *Poverty in the United States.* Retrieved from http://www.npc.umich.edu/poverty/

National Science Foundation. (2010). Division of Science Resources Statistics, special tabulations of U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, 2000–2008. Retrieved from https://surveys.nces.ed.gov/ipeds/

Olsen, R., Seftor, N., Silva, T., Myers, D., DesRoches, D., & Young, J. (2007). *Upward bound math-science: Program description and interim impact estimates.* Mathematica Policy Research. Prepared for U.S. Department of Education: Office of Planning, Evaluation, and Policy Development. Washington, DC.

President's Council of Advisors on Science and Technology. (2012). *Engage to* *excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics*. Washington, DC. Retrieved from http://www.whitehouse.gov/sites/default/files/microsites/ostp/fact_sheet_final.pdf

Rhodes, J. E. (2002). Stand by me: The risks and rewards of mentoring today's youth. Cambridge, MA: Harvard University Press.

Rhodes, J. E. (2005). A model of youth mentoring. In D.L. DuBois and M.J. Karcher (Eds.), Handbook of Youth Mentoring (pp. 30-43). Thousand Oaks, CA: Sage.

Rhodes, J. E., Spencer, R., Keller, T. E., Liang, B., & Noam, G. (2006). A model for the influence of mentoring relationships on youth development. *Journal of Community Psychology*, *34* (6), 691-707. doi:10.1002jcop.20124

Roth, J., Brooks-Gunn, J., Murray, L., & Foster, W. (1998). Promoting healthy adolescents: Synthesis of youth development program evaluations. *Journal of Research on Adolescence*, *8*(4), 423–459. doi: 10.1207/s15327795jra0804_2

Sahin, A., Ayar, M. C., Adiguzel, T. (2013). STEM related after-school program activities and associated outcomes on student learning. *Educational Sciences: Theory and Practice, 14*(1), 309-322. doi:10.12738/estp.2014.1.1876

Seeman, T. (2008). Support & Social Conflict: Section One - Social Support. *MacArthur Research Network on SES and Health.* Retrieved from http://www.macses.ucsf.edu/research/psychosocial/socsupp.php

Sorge, C., Newsom, H. E., & Hagerty, J. J. (2000) Fun is not enough: Attitudes of Hispanic middle school students toward science and scientists. *Hispanic Journal of Behavioral Sciences, 22*(3), 332-345. doi:10.1177/0739986300223004

Strauss, A., & Corbin, J. (1990). Basics of qualitative research: Grounded theory procedures and techniques. Newbury Park, CA: Sage.

Tenenbaum, H. R., & Ruck, M. D. (2007). Are teachers' expectations different for racial minority than for European American students? A meta-analysis. *Journal of Educational Psychology*, *99*(2), 253-273. doi:10.1037/0022-0663.99.2.253

Tyler-Wood, T., Ellison, A., Lim, O., & Periathiruvadi, S. (2012). Bringing up girls in science (BUGS): The effectiveness of an afterschool environmental science program for increasing female students' interest in science careers. *Journal of Science Education and Technology*, *21*(1), 46-55. doi:10.1007/s10956-011-9279-2

U.S. Department of Education (2015). Retrieved from http://www.ed.gov/stem.

Vilorio, D. (2014). *Stem 101: Intro to tomorrow's jobs.* U.S. Bureau of Labor Statistics. Washington, DC. Retrieved from http://www.bls.gov/careeroutlook/2014/spring/art01.pdf

Weinstein, R. S. (2002). *Reaching higher. The power of expectations in schooling.* Cambridge, MA: Harvard.

Winkleby, M. (2007). The Stanford medical youth science program: 18 years of a biomedical program for low-income high school students. *Academic Medicine, 82*(2), 139-145. doi:10.1097/ACM.0b013e31802d8de6

Zeldin, S. (2000). Integrating research and practice to understand and strengthen communities for adolescent development: An introduction to the special issue and current issues. *Applied Developmental Science*, *4* (1), 2–10. doi:10.1207/S1532480XADS04Suppl_1

Table 1

List of Activities and Benefits

Activities	Benefits

• Math and science courses
• Oral presentations
• College visits and field trips
• Presentations by professionals
• Lab activities
  ○ Hands-on experience
  ○ Immersion in a science research lab
• Mentoring
  ○ Informational and emotional support
  ○ Teaching
  ○ Bridging
  ○ Role modeling
	• Access and exposure
	• Mastering science knowledge and skills
	• Academic outcomes
	  ○ Educational attainment and academic performance
	  ○ Increased educational aspirations
	  ○ Increased motivation/perseverance
	  ○ Information about postsecondary education
	  ○ Normalize higher education
	• Broadened worldview
	• Confidence
	• Exploration opportunities
	  ○ Interest exploration
	  ○ Career exploration
	  ○ Identity exploration
	• Higher order thinking
	  ○ Critical thinking
	  ○ Increased math and science knowledge
	• Professional development
	  ○ Professional accomplishments
	• Science interest
	• Science self-efficacy
	• Science is achievable
	• Technical skills
	  ○ Clinical and laboratory research skills
	  ○ Oral presentation skills

Figure 2. Links between the activities and benefits of participating in STEMulate

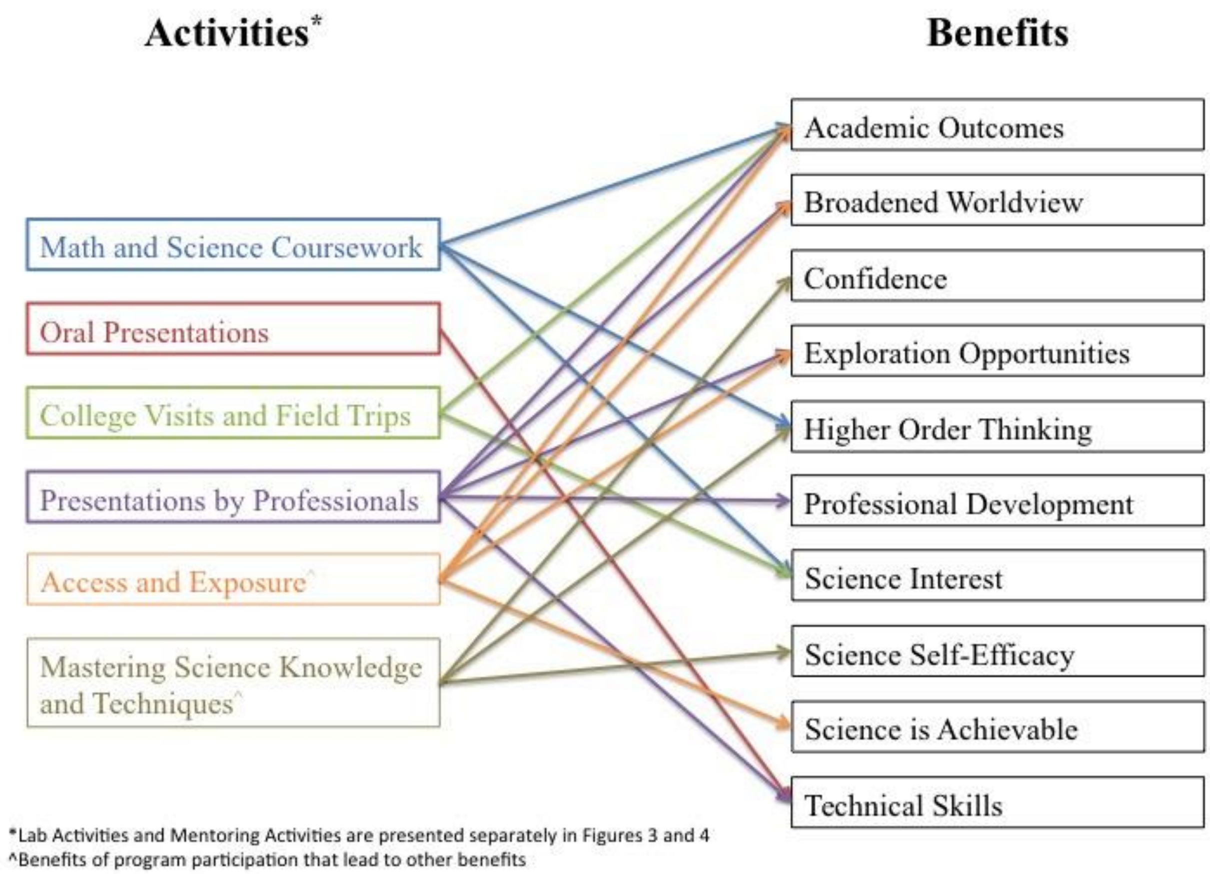


Figure 3. Links between the lab activities and benefits of participating in STEMulate

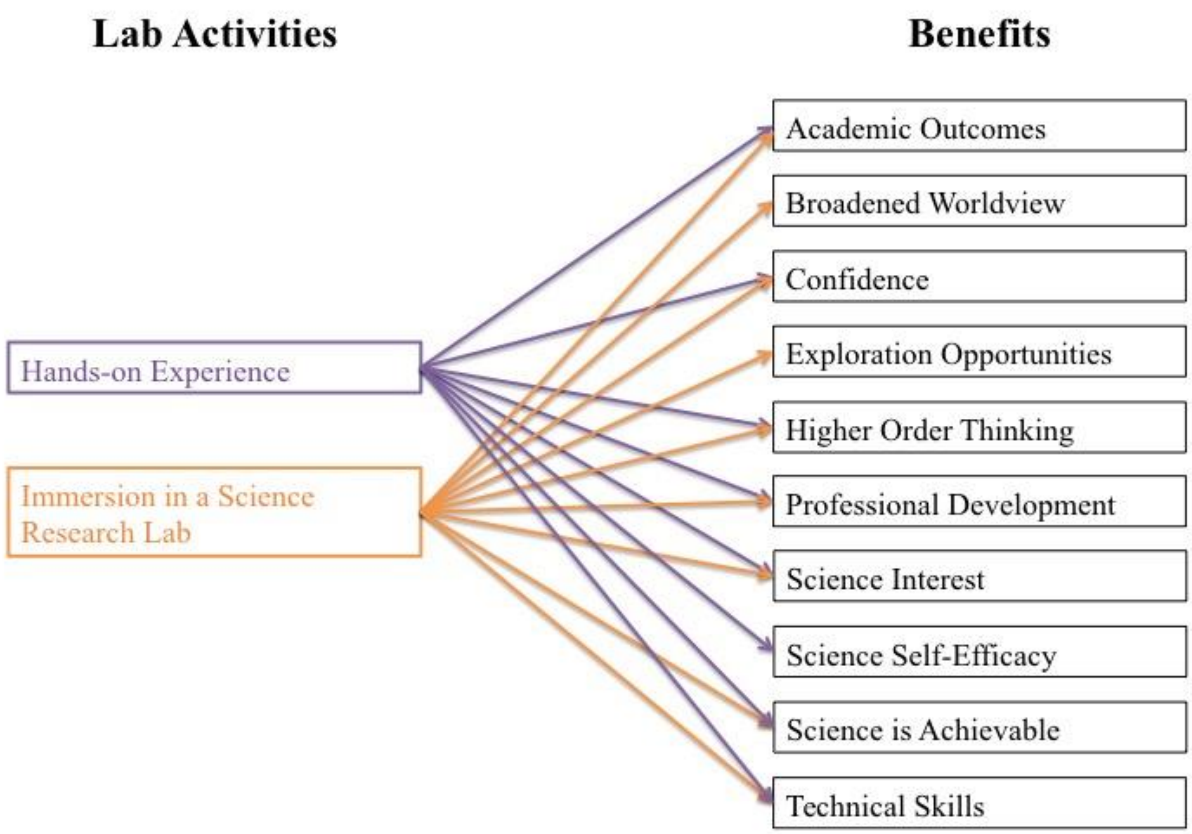


Figure 4. Links between the mentoring activities and benefits of participating in STEMulate

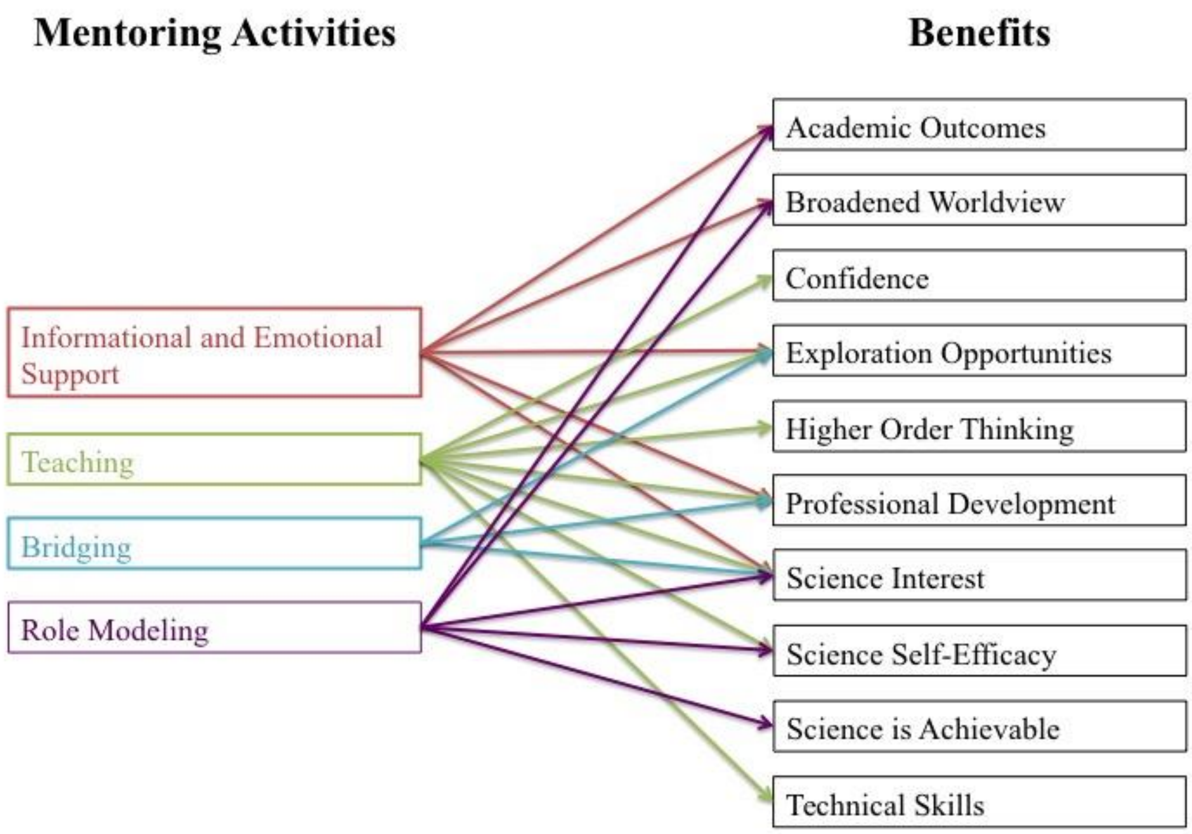
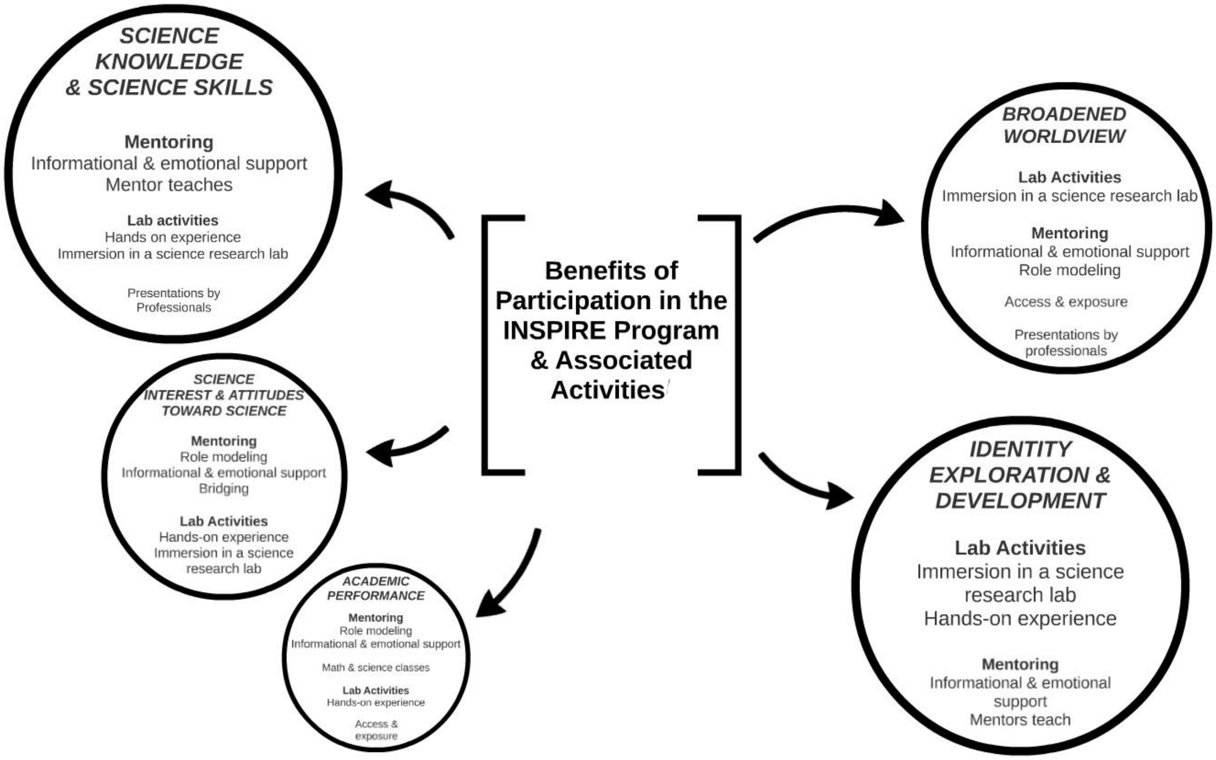


Figure 5. Benefits of participating in STEMulate and related activities



Appendix A: Interview Protocol

Note: The highlighted section in the interview protocol below identifies the section that explicitly inquired about the skills students developed and ways in which they benefited as a result of participating in the INSPIRE program. However, participants were able to discuss the skills and benefits in any section of the protocol, and many chose to do so.

INSPIRE STUDENT
Interview Protocol

Date: ____________ Time interview began: _____________ Time interview ended:_________

Before beginning interview state, "Participant __(ID)___; DATE." Then researcher will request participant's permission to record the interview by saying, "This conversation is being recorded for research purposes. Please let me know now if you do not agree to being recorded. [WAIT FOR PARTICIPANT'S RESPONSE]. [AFTER OBTAINING PERMISSION] You may request that the recording stop at any time."

Section I. I would like to start off by learning about your experience generally in the INSPIRE program.

1. To start, could you please tell me when you first joined the program?
2. How did you get involved in the INSPIRE program? What influenced you to join the program?
3. Let's say there is a Latino student at your high school who heard about the INSPIRE program and is interested in applying, but isn't familiar with the program. How would you describe the INSPIRE program to that student?
4. Tell me now about your specific experience in the program. Describe your own personal experience in the program.
    a. *Probe the student to talk about the various projects s/he has worked on in the INSPIRE program (specific research project and specific lab activities).*
    b. *Probe for further clarification about the various activities if necessary (e.g., types of assignments, research lab activities, mentoring).*
5. What do you think have been the most beneficial or influential parts of the program?
    a. *Ask participant to elaborate and provide specific examples if he/she does not do so automatically.*
6. What parts of the INSPIRE program could be improved, if any? What changes to the program do you think should be made, if any?
    a. *Ask participant to elaborate and provide specific examples if he/she does not do so automatically.*

Section2: Thanks for telling me about your experiences in the INSPIRE program. Now I'd like to talk about what you've gotten out of participating in the program, specifically the skills that you've gained and your career interests and aspirations.

1. What skills do you think you have gained from participating in the INSPIRE program?
    a. *Ask them to specify which activities helped them gain specific skills with examples.*
    b. *Probe for science and research performance and skills.*
2. How has the INSPIRE program influenced your attitudes toward school, if at all?
3. How has the INSPIRE program influenced your confidence in your science abilities, if at all?
    a. What specific parts of the INSPIRE program influenced your confidence in your science abilities?
        i. *Probe for influence of assignments, mentoring, or research lab*
        ii. *Probe for aspects that have been particularly helpful in developing students confidence*
4. How has participating in the INSPIRE program influenced your interest in the sciences, if at all?
    a. What specific activities or parts of the INSPIRE program influenced your interest in science?
        i. *Probe for influence of assignments, mentoring, or research lab*
5. Tell me about your educational goals. E.g., kind of college, major, degree?
        i. *If already in college, ask if they have chosen a major, and if so, what major(s) they have chosen.*
    b. How has participating in the INSPIRE program influenced your educational goals?
    c. *Outcome expectations:* What do you think will happen as a result of choosing a major in the sciences?
        i. *Probe for positive and negative expected outcomes/rewards*
        ii. Why do you want to choose [*state major*] as your major?
            1. *Probe about physical outcomes—status, prestige, difficulty, money*
        iii. How do important people in your life feel about you studying science?
            1. *Probe for family and friends.*
        iv. How do you think studying science [*OR state major if not science related*] affects how you see yourself?
6. You discussed your level of confidence in your science abilities. You discussed the possible rewards of pursuing a science major. And you talked about the possible negatives of choosing a science major. Which of these three factors do you think is most important in determining whether you'll choose a science major?
    a. *Make sure the participant elaborates why that factor is so influential.*
7. Tell me about your career goals today. E.g., kind of job/career that you would like, professions that interest you.

a. How has participating in the INSPIRE program influenced your career goals?
b. How has it influenced your expectations for a career in science [*or other field if participant is not interested in a science career]*?
c. *Outcome expectations:* What do you think will result from choosing a career in [*state career*]?
    i. *Probe for positive and negative expected outcomes/rewards*
    ii. Why do you want to choose [*state career*] as your career?
        1. *Probe about physical outcomes—status, prestige, difficulty, money*
    iii. How will the important people in your life feel about you choosing [*state career*] as your career?
        1. *Probe for family and friends.*
    iv. How do you think being a [*state career*] will affect how you see yourself?

8. You mentioned that you're interested in [*state major or* career]. Let's imagine 10 years from now. How old will you be? When you are [*state age*] years old, how do you think being in the INSPIRE program would have helped you in your education and/or in your career?
    a. What do you see yourself doing at this age?
    b. Describe how you got to this point. *Make sure the participant describes his/her education and career path.*

Section 3. Race/ Ethnicity & Gender

1. Would you mind telling me how you identify in terms of gender and race/ethnicity? [*If participant agrees, ask them to state gender/race/ethnicity*].
2. How do you think being a Latina woman/Latino man has influenced your experience as a science student?
    a. Probe to see how much of it is due to gender/how much is due to race. Make sure participant discusses both gender and race/ethnicity.
    b. Add contextual probes about their schools if relevant.
3. What barriers, if any, are there for [*men/women*] in pursuing a major or career in science? [*this question gets at gender barriers*]
4. What barriers, if any, are there for Latina/os in pursuing a major or career in science? [*this question gets at race/ethnicity*]
5. Have you experienced explicit harassment or discrimination as a Latina/Latino*?*
    a. If yes, how did you handle the situation?
    b. Probe to see how much of it is due to gender/how much is due to race.
6. What advice would you give to other Latino/a high school students about pursuing the sciences*?*
7. How do expectations of you as a Latina young woman (*or Latino young* man) align with a career in the sciences?
    a. *Probe for personal expectations and expectations from others e.g., family, friends/peers, instructors/professors, classmates.*
    b. Were there any ways in which a science career does not fit those expectations?

i. *Probe for personal expectations and expectations from others e.g., family, friends/peers, instructors/professors, classmates.*

Section 4. Now I would like to learn about your experiences with your graduate student mentor and faculty advisor in the program.

1. Who has been the most influential person in the INSPIRE program?
    a. What is it about this person that makes them so influential?
        i. *Probe the participant to explain why this person has been so influential.*
2. Who is your graduate student mentor and faculty advisor in the program?
    a. *Clarify if students have had the same mentor or different mentors if student has participated in the program 2+ years.*
3. Describe your relationship with each of these individuals.
    a. *Allow student to say whatever comes to mind about relationship(s) with mentor(s) and advisor(s).*
    b. *Probe for additional information about the relationships based on participant answers if necessary.*
4. What has been most important about your relationships with your grad student mentor and faculty advisor?
    a. *Distinguish what was important about grad student mentor vs. faculty advisor.*
5. Is there an experience/moment in your relationship with your mentor/advisor that you felt like they were really making a difference for you as a science student? Please elaborate.
    a. *Make sure participant describes the situation.*
    b. What made you feel like this person was making a difference?
    c. How did you know that this person made a difference?
    d. How did you change as a result of this experience?
6. What have these individuals done that you think are helpful?
    a. How do they support you?
    b. *Probe to understand how/why participant thinks these things are helpful*.
7. How has your relationship with your grad student mentor and faculty advisor influenced you in any ways?
    a. *Areas to probe:*
        i. With school overall?
        ii. Performance in science and in research?
        iii. With your interests in science?
        iv. With your confidence in your science abilities?
        v. With your expectations about pursuing an education/career in science?
        vi. With your educational and career goals?
8. Tell me about a time in a mentoring relationship when you and your mentor or faculty advisor were struggling with an issue in the relationship.
    a. How did you respond to this difficulty?
    b. How did your mentor or faculty advisor respond to this difficulty?
9. Are there any things your graduate student mentor(s) and/or faculty advisor does that are not helpful, or that you find frustrating?

    a. *Probe to understand how/why participant thinks these things are not helpful, or frustrating.*

10. Is/are there anything(s) about your graduate student mentor and/or faculty advisor that you would change?
    a. *Probe to understand things about mentor/faculty advisor that participant would like changed.*
11. What about the older peers in the program? How have they been helpful to you in the program, if at all?
12. Now I'd like to think about people outside of the program who may have been helpful or supportive to you about pursuing your interest in the sciences.
    a. Who are the people in your life outside of this program who have been most supportive about you pursuing the sciences?
        i. What do these individuals do/say? How have they been supportive to you?

Section 5. Final Thoughts: Now we are at the end of the interview.

1. Do you have any final thoughts about the INSPIRE program and the effect it has had on you?
    b. *Probe if necessary to gather more information.*

Thank you so much for doing this interview. All the information you provided was really helpful. This is the end of the interview and we are going to do the survey now.