The Socialization and Retention of Low-Income College Students: The Impact of a Wrap-Around Intervention

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Abstract

The Strategic Undergraduate STEM Talent Acceleration INitiative (SUSTAIN) provided a coherent ecosystem of academic, social, and career support services designed for a diverse cohort of high-achieving, low-income STEM students during their first year of undergraduate study. Findings are discussed in terms of the efficacy of the program interventions to enhance students' socialization and retention within the STEM community. Results indicate that participants perceived the interventions to have helped them adjust to college life and develop skills in understanding science and the scientific process. Which, in turn, participants reported, helped them to succeed in their STEM courses and visualize themselves as part of the larger STEM community. The participants rated STEM faculty mentoring, research experience, and community building as more helpful than other interventions. Our findings will aid researchers to better understand how SUSTAIN interventions influence students' socialization into the STEM community and provide valuable insight to guide policymakers in shaping future programs that are successful in retaining diverse students in STEM fields.

Keywords: STEM education, higher education, social development, socialization

1. Introduction

Over 21 million students are currently enrolled in colleges and universities in the United States (National Science Board (NSB), Science and Engineering Indicators, 2018). Low-income and first-generation students constitute approximately 30% of this population (NSB, 2018). Drawing from Tinto's student integration model (1993), Engle and Tinto (2008) reported that first-generation and low-income students are four times more likely to drop out of college when compared to their non-first-generation, non-low-income peers. Furthermore, research indicates that "underrepresented students often have less exposure to STEM career options" (as cited in Hernandez et al., 2013, p. 21). Broadening early engagement with STEM-related experiences could be particularly helpful for the recruitment and retention of low-income and underrepresented students (females, African Americans, Hispanic Americans, Native Americans, persons with disabilities, first-generation college students, and Veterans) into STEM (Hernandez et al., 2013).

Colleges and universities in the U.S. are struggling on two fronts in their efforts to develop STEM talent (Chen, 2015). The first hurdle to overcome is the difficulty associated with attracting a diverse pool of undergraduates to pursue a STEM major; a task that has proven particularly daunting given the limited number of underrepresented minorities, women, and low-income students from disadvantaged backgrounds who opt to pursue STEM majors in college (Chen, 2015; Castellanos, 2018; Seidman, 2004). A greater challenge still is how to retain these students in the STEM pipeline during their undergraduate programs. Numerous reports and studies have cited critical factors that contribute to the exodus of undergraduates out of STEM majors including inadequate pre-college academic preparation for the rigors of undergraduate STEM coursework, unsupportive social environments within undergraduate STEM departments, and dissatisfaction with outdated instructional methods commonly used in introductory STEM courses which fail to capture the excitement of scientific inquiry (Chen 2015; PCAST, 2012;

Morganson, Major, Streets, Litano, & Myers, 2015; Provencher & Kassel, 2017). The National Academy of Sciences (2011) has identified key focus areas that must be addressed in order to reduce the STEM attrition rates among low-income undergraduates including students' preparedness, access, and motivation to learn, and the academic and social supports necessary to persist in the STEM pipeline (Kates, 2011). Specifically, academic socialization has been found to be a predictor of students' retention and persistence in STEM fields (Hunter, Laursen, & Seymour, 2007).

In order to respond to these challenges through a purposeful and coordinated approach, we have developed the Strategic Undergraduate STEM Talent Acceleration INitiative (SUSTAIN) project. The SUSTAIN project is a three-year National Science Foundation-sponsored project at a large, private, research-intensive university in the northeastern United States that provided a robust, multi-faceted series of curricular and co-curricular learning experiences, and professional services for a diverse cohort of high-achieving, low-income STEM students during their first and second years of undergraduate study (Tillotson et al., Under Review). As part of the SUSTAIN project, the purpose of this study is to investigate how the specific evidence-based wrap-around support and mentoring system interventions contributed to the students' perceived socialization within the university STEM community and retention in STEM fields.

The SUSTAIN project specifically focused on the disciplines of biology and chemistry, and the related majors of biochemistry, neuroscience, and forensic science, because they represent the largest undergraduate STEM programs within the College of Arts and Sciences. As well, these disciplines serve as important gateway majors for a wide range of STEM career professions. The SUSTAIN project seeks to develop our institutional capacity to retain a higher percentage of biology and chemistry majors during their pivotal first and second years on campus and equip them with the tools they will need to continue on the path toward earning a STEM degree. As part of the SUSTAIN project, we investigated the following research questions in this study:

How do the purposeful and inclusive sequencing of the academic, social, and professional support interventions provided to high-achieving, low-income undergraduate STEM students from diverse backgrounds influence

- their perceived socialization into the STEM community?
- their persistence in the STEM pipeline?

2. Theoretical and Conceptual Framework

Higher Education retention literature is rooted at the beginning of the twentieth century (Seidman, 2005). Recently, Tinto (2012) proposed that student retention research should shift from a model of student departure to a model of institutional action. Student background characteristics such as gender, race, as well as external factors such as family, culture, and peers may influence student persistence (e.g., Tinto, 1993; 2006; Astin, 1993). Therefore, Tinto (2012) suggested focusing on institutional actions and conditions that will positively influence the likelihood of student success. With this goal, Tinto (2012) listed four conditions that institutions can control that will positively influence the likelihood of student success: maintaining high expectations, academic, social and financial support, frequent feedback, and educational and social programs. As the SUSTAIN project aims to provide academic, social, and professional support interventions for the persistence of low-income STEM undergraduate students, Tinto's model of institutional action (2012) was utilized as the theoretical framework for the SUSTAIN project. As suggested in Tinto's model (2012), we focused on student expectations and provided various support interventions that aimed at encouraging student engagement and success (Cromley, Perez, & Kaplan, 2016; Kuh, 2008; Tinto, 2012).

We particularly focused on student engagement, which was defined as "…both the time and energy students invest in educationally purposeful activities and the effort institutions devote to using effective educational practices" (Kuh et al., 2008, p. 542). Two familiar models related to student involvement and academic socialization provided the foundation for this study; Austin's theory of involvement and Weidman's model of undergraduate socialization. Astin's theory of involvement (1984) has served as the theoretical framework for several studies related to college student involvement and retention (e.g., Garibay, 2015; Kim & Lundberg, 2016; Johnson & Stage, 2018). Elaborating on previous models, Astin's Input-Environment-Output (IEO) model (1993) focuses on describing the changes students encounter during their college experiences, intending to predict the outcomes and relationships between students' background characteristics and environment. Input factors are comprised of the variables that make up students' prior experience, what they bring when they enter college; such as gender, race, socio-economic status (Astin, 1993). The environment in the theoretical model refers to the students' academic and social experiences during their college years (Astin, 1993).

Astin and Antonio (2012) emphasized the importance of environmental factors because institutions can deploy resources and use effective educational practices to enhance student engagement and promote success-oriented outcomes. Environmental factors consist of interactions with faculty, peer relationships, and institutional policies and programs (Astin, 1993). The environment in this study refers to the SUSTAIN project interventions. We hypothesize that exposure to SUSTAIN project interventions will have a positive impact on students' involvement in STEM and influence their career choices during their college years. Outcomes in the model indicate that benefits students experience after exposure to environmental factors (Astin, 1993). The relationship between experience and exposure to environmental factors is further described as "the extent to which students are able to develop their talents in college is a direct function of the amount of time and effort they devote to activities designed to produce these gains" (Astin, 1984, p. 36).

Socialization is broadly defined as "the way in which individuals are assisted in becoming members of one or more social groups" (Grusec & Hastings, 2007, p.15). It has been shown to play an integral part in determining persistence; it is directly related to degree completion and the pursuit of STEM career pathways (Gardner & Barnes, 2007). Weidman's model of undergraduate socialization (1989) is utilized to provide an explanation of student socialization in college. The model states that students' experiences in college can be described by "organizational variables, academic environment, and extracurricular environment," which consist of interactions with faculty and peers as well as time and energy devoted to purposeful educational and social activities (Weidman, 1989, p. 292). Weidman's model (1989) also uses students' background characteristics as a frame to explore the socialization of college students. This study was designed to incorporate Astin's theory of involvement and Weidman's model of undergraduate socialization to explain and understand how students interact with the STEM campus environment, their overall experiences, and the efficacy of the SUSTAIN project interventions on students' socialization (see Figure 1 for the adapted model).

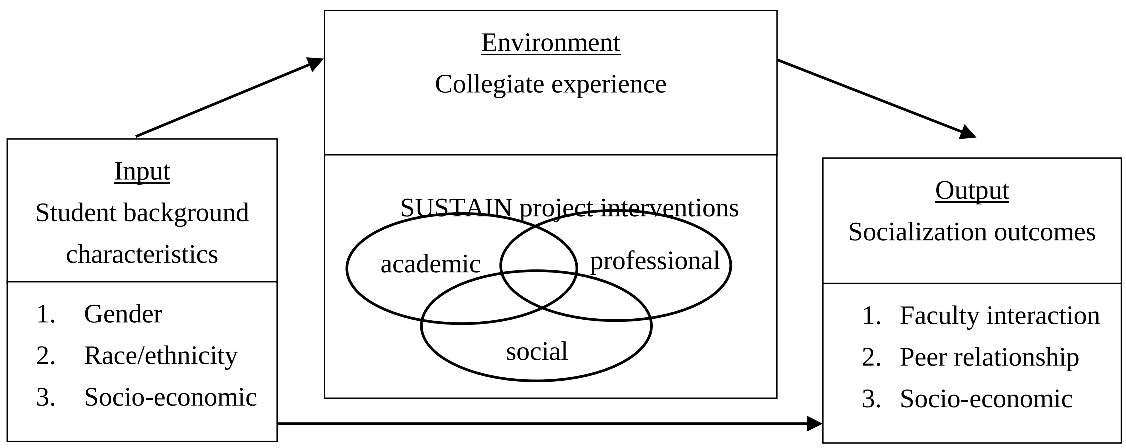

Figure 1. Astin's (1993) model and Weidman's (1989) model adapted for this study

3. Method

3.1 Context and Participants

The study was conducted at a large research-intensive private university in the northeastern United States. All data in this study were gathered as part of a larger NSF-funded project to examine the impact a coherent ecosystem of academic, social, and career support services have on a diverse cohort of high-achieving, low-income STEM students during their first year of undergraduate study (Authors, in review). Researchers recruited students through two main application and selection processes. Researchers first launched a national recruitment campaign targeting high-achieving, low-income students, including underrepresented minorities, women, and students from high-need urban and rural schools from across the United States. Then, researchers targeted matriculated applicants from the pool of intended STEM majors at the university who had declared their interest in either biology, chemistry, biochemistry, neuroscience, or forensic science. From a database consisting of eligible students, twenty-eight students were selected to participate in the project. The participants were predominantly female (71%), first-generation college students (86%), and ethnically diverse (14% Asian, 11% Black, 7% Hispanic, 18% mixed race/ethnicity, 50% White). The majority of the participants were declared biology majors (42%), followed by biochemistry (22%), forensic science (14%), chemistry (11%), and neuroscience (11%). Data were collected in the

2017-2018 academic year, during the freshman year of the participants.

The SUSTAIN Project (The Strategic Undergraduate STEM Talent Acceleration Initiative)

The SUSTAIN project is a three-year NSF-funded project that responds to the contemporary challenges of STEM education through a purposeful and coordinated approach. SUSTAIN provided a coherent ecosystem of academic, social, and career support services strategically designed for a diverse cohort of high-achieving, low-income STEM students during their first and second years of undergraduate study. Specifically, this three-year project awarded a total of twenty-eight scholarships to a single cohort of entering first-year undergraduate students and provided them with $10,000 of financial support annually for both their freshman and sophomore years. These NSF scholarships served as a mechanism for attracting a large pool of highly accomplished, low-income and underrepresented students (females, African Americans, Hispanic Americans, Native Americans, persons with disabilities, first-generation college students, and Veterans) who are interested in pursuing biology and chemistry majors at a private university in the northeastern United States.

The SUSTAIN project further provided the participants with a robust, multi-faceted series of curricular and co-curricular learning experiences and professional services that are designed to: a) foster their sense of preparedness for collegiate STEM work; b) enhance their access and motivation to pursue STEM pathways; and c) provide the academic and social supports necessary to ensure their persistence in the STEM pipeline throughout the challenging first and second years of undergraduate study [National Academies of Science (NAS), 2011]. The SUSTAIN participants engaged with key programming elements, which were 1) STEM faculty mentoring and early-immersion pre-research program, 2) community-building activities, 3) STEM career awareness activities, 4) Peer-Led Team Learning, 5) professional living-learning community experience, and 6) nature of science and inquiry themed first-year forum course (see Table 1).

Table 1. Descriptions of SUSTAIN interventions

SUSTAIN interventions	*Descriptions*
STEM faculty mentoring and early-immersion pre-research program	Each participant in the project has been matched with an experienced STEM faculty mentor from the biology or chemistry departments to observe and participate in the activities of the faculty mentor's research lab during the spring of their freshman year.
Community-building activities	We have hosted four informal community-building activities throughout the year to provide a sense of connectedness and support early in their undergraduate experiences.
Career awareness activities	The participants had the opportunity to participate in two career awareness activities to observe as many different STEM career profiles as possible during the first year on campus to raise their awareness of different STEM pathways they may wish to pursue.
Peer-Led Team Learning	This program involves collaboration between the faculty member teaching the course, a PLTL learning specialist (currently a research faculty member with advanced training and experience in PLTL), peer leaders, and students. The participants engaged in Peer-Led Team Learning as students in either or both chemistry and biology to support first-year biology students' conceptual learning and engagement (Snyder et al., 2016).
Professional living-learning community experience	Most of the participants received a special housing assignment to further strengthen their STEM ties with other students and ensure the continuation of academic and social supports.
Nature of science and inquiry themed first-year forum course	The participants participated in a specially-themed section of the First-Year Forum (CAS 101) course. This specially designed section of the required course included advising, reading and discussing STEM-specific topics on the nature of science, and other special activities designed to enthuse students about STEM and their place within in STEM disciplines.

3.2 Research Design and Measures

This study was designed to explore the retention and perceived socialization of the participants as first-year undergraduate students into the STEM community. The research team collected comprehensive qualitative and quantitative data through 1) initial surveys focused on the participants' pre-college STEM learning experiences and expectations, 2) follow up interviews at the end of their first year on campus examining the participants' undergraduate STEM experiences (Ceglie & Settlege, 2016), 3) focus group discussions clarifying the major themes generated from the individual in-depth interviews, 4) formative assessment surveys focusing on project monitoring, making judgments about the activities, developing best practices within the institution and a model (or aspects of a model) of practice that is deemed impactful (Patton, 1987).

This paper focuses on the institutional data for the participants' retention and cumulative grade point average, as well as the results from interviews with the participants about their socialization experiences. The methods of data collection and analysis of the study regarding the academic socialization of the participants were qualitative, based on in-depth, semi-structured interviews with participants. The interview protocols were developed regarding the socialization literature, as well as project objectives and interventions. During the interview process, participants were asked to explain whether curricular and co-curricular learning and professional services provided as part of SUSTAIN project interventions facilitated their socialization into the STEM community. Open-ended, semi-structured individual interviews sought to examine interactions and social processes that are relatively understudied. During the semi-structured interviews, spontaneous follow-up comments were established, as well as specific themes identified in the interview questions. Individual, in-person interviews lasting 25-45 minutes were recorded and transcribed. After data collection, a conceptual analysis was conducted to organize the data into categories based on the literature and theoretical framework that guide this study. Based on the conceptual analysis, data were coded and recoded inductively and deductively to interpret the observations and emergent themes through the constructs utilized by Astin's theory of involvement (1993) and Weidman's model of undergraduate socialization (1989). Two researchers read, reread, and coded the data independently and then compared the coding results. Any discrepancies in coding were discussed until consensus was reached.

4. Results

4.1 Retention Rates

The SUSTAIN project recruited a single cohort of twenty-eight students who were matriculated as anticipated biology, chemistry, biochemistry, neuroscience, or forensic science majors, and provided them with a series of deliberate curricular and co-curricular intervention supports designed to facilitate their continued success and retention in the STEM pipeline. The SUSTAIN project purposefully developed interventions to facilitate and increase the academic success of the participants. The mean score of the participants' cumulative GPA was M = 3.4, SD = 0.58 in the Fall 2017 semester. The minimum GPA score was 2.09, with only five participants earning a GPA lower than 3.00, 16 participants had a GPA score above 3.5, and six participants had a GPA of 4.00. The mean score of the participants' cumulative GPA was M = 3.3, SD = 0.58 in the Spring 2018 semester. Although STEM coursework was more rigorous in the second semester, only eight participants had a cumulative GPA lower than 3.00, and 15 participants still had a GPA score above 3.5 (see Table 2).

Table 2. Cumulative GPA of the SUSTAIN project participants in their freshman year

Semester	*Mean*	*Std Dev.*	*Median*	*Min*	*Max*
Fall 2017	3.4	.58	3.55	2.09	4.00
Spring 2018	3.3	.58	3.52	2.19	4.00

Overall, 26 out of 28 participants (93%) were retained as intended or declared STEM majors following their first year of participation in the SUSTAIN project. One of the participants who left the SUSTAIN project is pursuing her academic career in the STEM pipeline at another university, and according to her self-reported insights, she transferred to another university primarily to be closer to home. She explicitly stated, "SUSTAIN has been a really rich and exciting experience, and I am grateful for your support this past year." The other participant indicated she left the university due to personal reasons, explaining that this university was not a good "fit" for her given her rural background and the urban environment in which the college campus is located.

4.2 The Socialization of the SUSTAIN Project Participants

According to the analyses for each SUSTAIN project intervention, the majority of the participants stated that SUSTAIN activities helped them overcome some of the challenges throughout their first year as a freshman (88%), and SUSTAIN activities helped them adjust to college life as a STEM student (85%). By following the Astin's theory of involvement (1993) and Weidman's model of undergraduate socialization (1989) constructs, interview codes were grouped under the categories of faculty interaction, peer relationships, personal and professional gains. The detailed analysis of the interviews revealed the self-reported influences of the SUSTAIN interventions on participants' socialization into the STEM community during their first year of undergraduate study (see Table 3).

Table 3. Categories and subcategories for the participants' self-reported influences of the interventions

Categories	*Subcategories*	*Coded references*	
		n = 26	*%*
Faculty Interaction	Learn about science and the scientific process	19	73
	Help shape career choices	16	62
	Learn the interactions and relationships in the laboratory	10	39
Peer Relationships	Helped be successful	19	73
	Build relationships	18	69
	Talk about common freshman challenges	14	54
Personal and professional gain	Learn the options and the challenges in STEM	21	81
	Form a community	15	58
	Immerse into the campus and the program	8	31
	Helped building confidence in being a woman in STEM	8	31

Note. All percentages displayed represent each category's percentage of the total number of participants' interviews (n = 26). Coded responses above 30% were only displayed.

Faculty interaction

One of the main goals of the project was improving participants' professional socialization in the STEM community. Undergraduate research is a crucial context in faculty-student interaction (Thiry & Laursen, 2011). Participants' comments on the faculty interaction were given in Table 4.

Table 4. Faculty interaction subcategories and examples of participants' statements

Subcategories	*Sample participant statements*
Learn about science and the scientific process	I got to learn the data analysis process, which was something that always kind of terrified me. But once I knew it, I could apply it to different things, like specifically, the map that we were doing for the data that I had. But it was just kind of cool to say, "This terrified me before, but now I know how to do it," and to analyze a graph and know what it says. I thought that was the coolest thing. Whereas in class, they'll be, "Oh, you have to look at these figures and analyze them and see what they say," and I'm just like, "How do I do that?" But then in the actual research process, you're like, "Oh, I get it. This is great."
Help shape career choices	In the middle of the semester, I had some uncertainties when declaring my major that the lab does not fit in to what I want to do in the future. I found that when talking to Dr. P. (my mentor), she comforted me and helped me make a decision on what to do next semester.
Learn the interactions and relationships in the laboratory	I guess just the importance of forming relations with both faculty members or other students, especially in the research lab because I think there are two undergraduate students that are working together. And they have individual projects but they're kind of connected. So that was very helpful to me because it's kind of like you have your own thing going on but you can also get help from another student that's in the lab.

At the end of the Fall 2017 semester, the participants were provided with a list of the various STEM faculty members who had agreed to serve as undergraduate research mentors. The participants were asked to rank their top five choices after reviewing the research profiles of the STEM faculty mentors on their department website. When the matching process was completed, eighteen of the twenty-eight participants were matched with their first choice, two were matched with their second choice, and the other eight were matched with either their third, fourth, or fifth choice. Participants spent approximately 3-5 hours per week during the Spring 2018 semester observing and participating in mentor-facilitated lab activities. The majority of the participants stated that STEM faculty mentoring and the early-immersion pre-research program helped them learn about science and scientific process (73%) and shape their career choices (62%).

The participants pointed out the importance of learning skills like conducting research, forming social and professional relationships between laboratory members, and connecting laboratory work and content knowledge. Specifically, some of the participants expressed how important the research aspect of the project was for them in helping form social and professional relationships with the faculty to learn how scientists work on real-world problems, as exemplified by this participant's response:

> *My mentor is phenomenal, and she is very helpful, especially in the research part and also helping me choose what classes to take. She also impacted my choices after graduation because I was always planning on going to med school, but now I am also interested in the MD/Ph.D. program. And I was planning on doing the Ph.D. in neuroscience just because of this research with her.*

This quote reflects the importance of faculty interactions with participants. Faculty mentors help the participants to develop skills and confidence academically as well as influence their persistence in STEM through course selection and enlighten students to different career pathways in STEM. The outcomes of faculty mentoring influenced participants' career choices in STEM.

Peer relationships

SUSTAIN Project aimed at building a community within participants to promote their socialization into the STEM community through purposeful activities such as PLTL, professional living-learning community, community-building activities. Participants' comments on peer relationships grouped in three subcategories (see Table 5).

Table 5. Peer relationships subcategories and examples of participants' statements

Subcategories	*Sample participant statements*
Helped be successful	It was really good to be part of the learning community because it was easier to study for things together because we were all in the same area. So forming study groups and doing better on exams was just a bonus all living together. And we're really close to the center of campus, so it was just a benefit for living in the community.
Build relationships	I said it (professional living-learning community) was very helpful because a lot of my close friends, or my really best friends, now at college are in SUSTAIN and we all live in the same area. We basically have the same core friend group and the same core beliefs of what we want to do in the future. So I think that was really helpful putting us together in one spot. You just initially gives you someone to talk or someone that you can go for for help if you do not understand something that was explained in lecture today or something.
Talk about common freshman challenges	I guess just being a freshman, my first time, I am not used to certain things. And then getting into classes, what classes to take. Figuring out my schedule on my own, that was a little difficult. It is a lot of hard work but people in SUSTAIN has helped me with that. It helped me reinforce all of my decisions so I am glad I am a part of it.

Participants also commented on how PLTL helped them develop peer relationships and helped them be successful in their STEM courses. The PLTL program involved collaboration between the lead faculty member teaching the introductory biology and chemistry courses, a PLTL learning specialist, peer leaders, and undergraduate students. The learning specialist worked with the instructors of the courses to select and/or develop materials for PLTL workshops which matched the STEM course curriculum. In their first year of the SUSTAIN project, the participants engaged in PLTL as students in either chemistry, biology, or both. Out of twenty-eight SUSTAIN participants, twenty of them participated in the PLTL program in introductory biology, and twenty-three of them participated in the PLTL program in introductory chemistry. The participants mentioned that the PLTL program helped them overcome challenges through interactions with other STEM students (73%). For example, one of the participants expressed the impact of PLTL by stating, “Just being around people who are doing the same thing as you and the same responsibilities that are asked of them are asked of you. So I guess that is encouraging.” Another participant elaborated on this sentiment by commenting on the impact of SUSTAIN more broadly:

I definitely think SUSTAIN did help. Partially just because it is obvious you get socialized with a huge group of people all at one time, and they are all kind of in the same position as you, but I also think it is very important to have friends that are in the same major as you. I mean I have friends obviously that are outside of STEM, and that is wonderful, but at the same time I think it is very important that you have people who are kind of going through the same thing as you and I think that is the whole point of SUSTAIN is trying to support each other and being able to help each other.

The participants expressed that the benefits of the PLTL program and forming peer relationships are rooted in gaining a support network of like-minded individuals. Through the PLTL program, participants’ perceived socialization is improved by providing a space where academic challenges can be shared and experienced together, helping them to overcome difficulties and persist in their studies. The support network participants formed through PLTL was positive in helping students succeed academically as well as emotionally.

We hosted four informal community-building events throughout the participants’ freshman year to develop and nurture their sense of awareness and belonging within the STEM community on the campus. For the community-building activities, a majority of the participants commented on its helpfulness on building relationships with other STEM students (69%) and having a break from the courses and the coursework (54%). The participants emphasized the importance of the SUSTAIN project community-building activities in helping build ties with other STEM students from diverse backgrounds that would support them in overcoming the stress and fears associated with moving away from home and starting a new phase in their academic lives. A participant further described this sentiment:

I would not have made friends I made without it (SUSTAIN). I mean, I am sure I would have eventually, but it was just easier to know people before you even got here. Through the summer event, I knew people before even coming here, so that definitely helped.

Community building activities for participants served many functions, first as an initial introduction to one another, as in the case of the summer event hosted before the start of their first year, and then as a way to continue to build on and develop relationships to ultimately form their own STEM community within a larger STEM community. The SUSTAIN project was purposefully designed to aid in alleviating some of the stress and anxiety associated with transitioning from high school to college, and continuing community-building activities for participants was critical in achieving this perceived outcome.

Considering the importance of understanding the nature of science (Erduran & Dagher, 2014), we developed the nature of science and inquiry themed one-credit course. During Fall 2017, all of the SUSTAIN participants were assigned to take this course. The course consisted of seven 80- minute class sessions, four of which were devoted to readings, activities, and discussions on the nature of science in STEM-specific topics. The additional session discussions focused on adjusting to college life, the rigor of college STEM courses, and overcoming college adjustment and transition issues. Half of the participants reported that the nature of science and inquiry themed first-year forum course was helpful in that talking about challenges that affected them as a freshman and hearing others’ perspectives on those challenges was beneficial in overcoming them (54%). One of the participants stated that “it is interesting to see different people's perspectives in the STEM community” and “it is productive and eye-opening about science and the science community.” The nature of science and inquiry themed first-year forum course allowed participants to discuss science ideas from multiple perspectives, share personal struggles in their own STEM courses, and hear from community members who are in the STEM field.

Personal and professional gain

One of the project goals was to expand the participants’ awareness of diverse STEM career pathways. With this goal in mind, we organized a workshop speaker series from various STEM fields to discuss and inform our participants about different career tracks. We also aimed that the professional living-learning community, STEM faculty mentoring and early-immersion pre-research program, and the community-building activities would contribute to the personal and professional gains of the participants. Participants' comments on personal and professional gain were presented in Table 6.

Table 6. Personal and Professional gain subcategories and examples of participants' statements

Subcategories	*Sample participant statements*
Learn the options and the challenges in STEM	I think for me personally when I came in to (the college) I know I wanted to be a biochem major but I was still a little bit nervous about whether or not it would be something for me. Obviously there is the rumor that college students you change your major all the time and once you go into one thing a lot of times you have completely changed subjects even. So I was worried that I would not have the accessibility to be able to realize my potential and realize if I was actually going to fit in. And I definitely think one of the main things was working in the lab. I just did not realize how big of an experience that would be and obviously I could not have gone out and done it myself... Also it (career-awareness activities) made me realize the STEM career awareness, it made me realize all of the STEM jobs that there are. I really did not realize all the options that I did have. I am planning on going to med school but the same time it gives me peace of mind to know that if I decide later down the road that maybe med school is not for me I know that there are other options and I am aware of that fact. So I think that is another reason that it helped me realize that my major is a good one and I do not need to switch. I love it and just because I might not go to med school there are other options and it is not like I am not going to not have the ability to get a different job if I am not going to med school.
Form a community	It is definitely beneficial as a community especially in SUSTAIN that we get together and we do fun things not only just focusing on school. If it is just living in Shaw being all STEM majors, it can be overwhelming a little bit. So I think being able to sit back and have something that is fun but still connected and science-y in a way and that you can still learn at the same time, like a new experience, I think it is really important.
Immerse into the campus and the program	I feel like that (research experience) was the most inclusive thing, the thing that immersed me the most. The other things were more like, I am sitting here and you give me information. The research was I am in there and I have to do something. I can not just sit around. Our faculty mentor already expects that from us. She is not just letting us watch. The second day she was teaching us, she let us do an entire RNA extraction by ourselves.
Helped building confidence in being a woman in STEM	95% of the people in my lab are women, which I think is really cool because a lot of labs that I have walked by are mostly guys. So that was really cool because I feel like we are underrepresented in the STEM, which is not cool but all these people here really are into it, really care about what they are doing. And they are super smart, and they deserve to be there so it is really nice to be somewhere like where I feel like, okay, we are not underrepresented here.

The largest coded reference for the career awareness activities was its usefulness in learning the benefits and challenges of being a STEM student (81%). One of the participants stated that they feel "it is important to meet with people outside of the sphere of the university" and "lucky to hear other people's perspectives who actually exist in STEM fields." Participants' expectation for career awareness was primarily centered around engaging with STEM professionals within academia and the business industry. In order to better address this expectation, the SUSTAIN project team felt it necessary to provide more opportunities for participants to form connections in STEM business and industry within the local community. Participants further indicated how they developed their science identity in terms of personal and professional gains by stating:

I think just STEM, it has a certain stigma of being more difficult or being more time-consuming and challenging. And SUSTAIN, just the activities and the mindset of everybody in it made the transition a lot easier and made it less intimidating.

Just being able to sit down and actually helping other people when they did not understand something and being *able to not only know the information but being able to explain my viewpoints on that specific information that I was talking about made me just more confident in myself.*

Regarding the participants' expressions, they described increased confidence to continue in STEM because of the perspectives they gained through interacting within their STEM community and the opportunity to engage in discourse as part of that community by not only receiving support but also providing support. These interactions helped participants further visualize themselves as part of the broader STEM community at the university and understand the various options available to them in the future.

As part of the SUSTAIN project interventions, we wanted to help ensure the participants' integration into the STEM culture on campus. Therefore, all of the participants were offered a special housing assignment arranged by the Office of Residence Life. The vast majority of the participants (21 of 28) were placed in the professional living-learning community with the exceptions being those students that were selected for the Honors Program or who participated in athletics and had designated assigned housing in other residence halls. The purpose of living at the STEM Residential College was to give students access to intentional academic support (advising, tutoring, study groups) as well as meaningful and dynamic opportunities for students to connect with each other and STEM faculty and staff outside of class time. Participants indicated that the professional living-learning community experience helped them build relationships with other STEM students (58%). Some of the participants stated that it was beneficial to access academic support, and have fun social opportunities to connect with other project participants, faculty, and graduate students within the STEM disciplines on campus. A participant remarked on the specific benefits of the professional living-learning community:

I guess people around me doing it, it shows you that you can do it, too. And I feel like if I did not have SUSTAIN, I would have more questioning of whether this was the right path for me or if I truly enjoyed it. But I feel so grounded, especially with this program. And people around me are getting by and doing what they can and helping each other.

The professional living-learning community experience extended the participants' socialization network to include both professional and personal opportunities in a physical space always available to students. In effect, participants were surrounded by support systems in this space to connect and solidify their STEM experiences. This allowed participants to understand their decisions, to consider if STEM is the right path for them, and to access the resources to help them pursue their path.

5. Discussion

The purpose of this study was to investigate how the academic, social, and professional support interventions influenced a diverse group of undergraduate STEM students' persistence and perceived academic socialization into the STEM community during their first year of undergraduate study. The analyses of the SUSTAIN participants' self-reported data revealed the positive influences of the SUSTAIN interventions on their perceived socialization experiences. The participants specifically indicated that SUSTAIN interventions helped them to remain in STEM fields. Previous studies show that a high percentage of students who declare STEM majors at the beginning of college dropout (Chen, 2015) and more than half of STEM students ultimately graduate with a non-STEM baccalaureate degree (National Science Board, 2012; Soldner et al., 2012). The findings of this study revealed that the SUSTAIN project interventions have contributed to the SUSTAIN participants' socialization experiences and their persistence in STEM disciplines.

In light of Astin's theory of involvement and Weidman's model of undergraduate socialization, results showed that the participants rated STEM faculty mentoring, the early-immersion pre-research program, and community-building activities as more helpful than other interventions. Supporting the assertions of Astin's theory of involvement (1993), the majority of the participants stated that SUSTAIN interventions provided a robust learning environment and helped them overcome some of the challenges and adjust to college life as a STEM student. Specifically, the participants described STEM faculty mentoring and early-immersion pre-research program as a crucial opportunity to learn about science, scientists, and scientific process and helped them be successful in their STEM courses. This finding is similar to recent research, which suggests the inherent value of early pre-research experiences for STEM undergraduates as a tool for enhancing student success, especially for first and second-year students (Craney et al., 2011; Schneider et al., 2016). Our findings suggest that participation in an early research experience helped participants learn interactions and relationships in the laboratory and/or academic world, as well as to feel connected to the professional world by learning the skills to conduct research and in experiencing how things work in the laboratory. Our findings align with the literature; in that, early-immersion experiences serve to develop students' knowledge, socialization, and confidence to achieve success in STEM research by affording them an opportunity to learn basic research skills and etiquette, learn about the research dissemination process, and better understand the ethical considerations associated with STEM research (Aikens et al., 2016; 2017; Schneider, et al., 2016).

The findings on community-building and career-awareness activities, in addition to the professional living-learning community experience, are other noteworthy results of the study regarding aspects of socialization within the university STEM community. During interviews regarding their experiences as first-year STEM students and the impact of the SUSTAIN interventions on their socialization experiences, the participants revealed their expectations for career awareness activities. The participants expressed a desire to meet with professionals from various STEM fields not only in academia but also from the industry to discuss and learn more about different experiences and opportunities. The SUSTAIN project team is currently working closely with representatives from the STEM community to make connections with local business and industry partners in the region to better incorporate the participants' feedback.

This study is significant because it explores the impact of the purposeful sequencing of academic, social, and professional interventions on undergraduate STEM students from diverse backgrounds. However, it has important limitations as well. Our study was conducted at a large private research-intensive university in the northeastern United States with a small sample of high-achieving low-income STEM undergraduate students completing their freshman year. This may limit generalizations to ethnically, culturally, and academically diverse student populations. We also did not analyze the retention rates or socialization experiences of the participants with a comparable control group of high-achieving, low-income STEM students, thus limiting our ability to make definitive claims about the efficacy of the project interventions. It is also worth to note that the SUSTAIN support interventions such as community-building, career-awareness, and PLTL have been tried and put to use in many institutions with various student groups for many years. Even though these efforts are not new to the field, our findings will likely help researchers better understand how these interventions influence the students' socialization into the STEM community during their first year of undergraduate study. The findings of this study are in line with and contribute to the existing literature on the subject and can provide valuable insights to help guide policymakers and leaders in shaping future programs that are successful in retaining diverse students in STEM fields.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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