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“In each class I went to, there were people that I was able to talk to”:
Sense of Belonging in STEM Linked-Learning Communities

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Abstract

Women, students of color, and students of low socioeconomic status are historically underrepresented in science, technology, engineering, and mathematics (STEM) programs (Apriceno, 2020). Interventions such as linked-learning communities have been introduced in STEM programs to improve student success and to combat underrepresentation; however, the research thus far is predominantly quantitative. While providing useful insight, quantitative data does not reflect unique individual experiences, so qualitative research will better allow for understanding of student experiences. This research examined the role of linked-learning communities among first-semester STEM students with varying social identities and backgrounds. During semi-structured interviews, participants \((N = 10)\) were asked open-ended questions regarding their experiences in the college, in their major, with peers and faculty, and their personal identities. Data were analyzed using thematic analysis to identify patterns (Braun & Clark, 2020). Students highlighted connections with peers and faculty that were supported through the linked-learning communities, demonstrating the overarching theme that sense of belonging was fostered through intertwining social and academic factors. The examination of student experiences increased our understanding of student success and belonging in STEM.

*Keywords: Linked-Learning Communities, STEM, Undergraduate Students, Sense of Belonging, Social Identities*
“In each class I went to, there were people that I was able to talk to”:

Sense of Belonging in STEM Linked-Learning Communities

A first-year STEM undergraduate student may start their day with a science lecture, in a packed classroom with no familiar faces and a professor they have never met before. Then, they may travel to a new building for a math course, with new peers and a professor who teaches differently from their last one. Their first week of classes follows the same pattern of new professors, new subject matter, and new forms of instruction for all their five courses. It is difficult to get to know their peers when they are constantly surrounded by new faces, which makes it hard to ask for help with homework questions. College is stressful, and they are embarking on their journey in a challenging field, filled with lectures, labs, and exams, in an unfamiliar environment with different social dynamics than they are used to.

In addition to the difficulty of college to begin with, this student may be a first-generation college student, without role models in their life to give advice or support about managing college. This student may be a woman, and when she looks around her science and math classes, her peers are mostly men. This student may be a student of color, and she may feel out of place surrounded by White classmates. These feelings have the potential of multiplying due to her dual minority status – as one of the only women and one of the only students of color. She may feel she does not belong and start to question if she has declared the right major. It may be difficult for her to form relationships with her peers if she does not feel she relates to them. Furthermore, there is the preexisting challenge of keeping track of so many different students across her numerous classes.

For individuals with minority status, particularly those who are Black and Latinx, not entering STEM fields or leaving them is a pattern happening across the United States and
Canada (Riegle-Crumb, 2019). Disparities in STEM are rooted in the historical composition of the field: middle- and upper-class White men. The historical basis of underrepresentation carries into the field today, and the effects can be harmful to individuals who do not fit into the mold. Initiatives such as mentoring programs, diversity programs, and linked-learning communities have been introduced by universities to increase representation in undergraduate level STEM programs (e.g., Apriceno, 2020; Burt, et al., 2020; Goldman, 2012). The goal of such initiatives is to foster community and sense of belonging among students, which in turn can help student success.

**STEM Representation**

Secondary education teachers may ask their students to “picture or draw a scientist” to reflect on the characteristics they believe make a scientist. Examinations of the activity reveal that students are likely to draw White men. Students who draw male scientists are also likely to include information about the scientist being middle-aged, working alone, having unkept hair and facial hair in their drawing (Karaçam, 2016). The findings reflect stereotypes surrounding the STEM field and who is likely to be a scientist: White, middle-aged men. Even in an age of social justice and equity, women, students of color, and students of low socioeconomic status are underrepresented in STEM fields. Women only make up 34% of STEM workers in the United States, despite being half of the population. Additionally, African Americans, Latinx individuals, and Alaska Natives make up 30% of the U.S. population, yet they only make up 23% of the STEM workforce (National Science Foundation, 2021). Further, individuals in STEM fields face lower rates of unemployment and greater salaries on average than non-STEM fields. With White men constituting much of the STEM field, it leaves them to reap the benefits of low
unemployment and high salaries, while also contributing to the cycle of underrepresentation in STEM.

Additionally, underrepresentation can compound when considering intersectional social identities. With few women and few students of color participating in STEM programs, the effects of underrepresentation are amplified for students with dual minority status (e.g., students who are Black and who identify as women). Dual minority status is correlated with lower academic confidence, and students with dual minority status will often face excessive pressure to prove themselves (MacPhee, 2013; Morton, 2017). Further, research has indicated that graduate STEM students with dual minority status are less likely to feel a sense of belonging in their program (Stachl & Baranger, 2020). Thus, it is important to consider intersectionality when looking at representation; the experience of a White woman in STEM will likely differ from the experience of a Black woman in STEM.

Underrepresentation in STEM is a problem for two major facets. The first is that underrepresentation is harmful for individuals within STEM. For example, Black students often feel that they do not fit into the STEM field, which acts as a motivation for them to pursue other fields (Brockman, 2021). Black and Latinx students are significantly more likely to switch from a STEM field to a non-STEM field than their White counterparts (Riegle-Crumb et. al, 2019).

Secondly, by pushing underrepresented students out of STEM fields, those voices are silenced. This limits the conversations, ideas, research questions, and the products being engineered by a broader population. This results in the field missing out on the contributions of people who have not always fit into the prototype of the STEM field. The goal of STEM is to solve problems, which means that the problems addressed are going to be driven by those in the field, which historically has been White, middle-class men.
Why Does Underrepresentation Exist?

Underrepresentation is a multifaceted problem, and it is difficult to identify its roots. We know that disparities in secondary education, stereotypes, and the cyclical nature of underrepresentation are large contributors. White female students are more likely to graduate with degrees in STEM fields if they had attended a high school with higher proportions of female math and science teachers (Stearns et al., 2016). When students see adults who look like them in a field, they are more likely to feel confident in pursuing that field, which demonstrates the importance of increasing diversity in STEM. Being mindful of factors that impact STEM success in secondary education is incredibly important when working to mitigate their effects.

Programs geared towards student success in STEM, such as gifted learning programs, also have disparities. Crabtree and colleagues (2019) revealed that Black students, Latinx students, and students in poverty are underrepresented in gifted learning programs. Participation in gifted education opportunities in secondary education is associated with enrollment in Advanced Placement courses, correlating to enrollment in college and participation in college-level STEM programs. If the programs that work to benefit students in STEM in secondary education are not equitable, then it becomes even more difficult for underrepresented students to succeed in postsecondary STEM education.

Stereotypes

Stereotypes are incredibly pervasive in STEM and perpetuate the idea that certain groups are better suited for STEM than others. Women in STEM are often the target of stereotypes and are perceived as less capable than their male counterparts, which can act as motivation for them to pursue non-STEM fields (Starr, 2018). A study on women in male-dominated majors in their
fourth year of study found that sexist events that occurred in their major or department were associated with lower levels of sense of belonging (Lawson & Kuchta, 2018).

Additional stereotypes, such as the Model Minority Myth, are also incredibly pervasive and harmful (McGee et al., 2017). This stereotype perpetuates the idea that Asian students should excel in math and science. It furthers the notion that an Asian student is participating in STEM solely because of their race and background, while also creating turmoil in Asian students who may struggle in math or science. The Model Minority Myth is detrimental for the mental health of Asian students while also having the capacity to act as an adaptive or maladaptive motivation (McGee et al., 2017). These forms of motivation can be helpful and motivate students to succeed in STEM; however, they can also result in excessive pressure and the need to prove oneself.

In addition to biases and stereotypes in STEM, stereotype threat can also create barriers for students. Stereotype threat refers to an individual feeling that they are at risk of conforming to stereotypes, and it plays a role in student success as well (Steele & Ambady 2006). Women may experience higher anxiety when working on a high-stakes project involving mathematics due to the fear that they may perform poorly due to their gender (Steele & Ambady 2006). Previous research has also found that women underperform significantly on mathematics-related tasks when told that the task has revealed stereotypical gender differences (Spencer et al., 1999). Learning in an environment where a student is the only student of their identity in the class may increase the saliency of their identity. This has the capability to activate and contribute to stereotypes about the performance of students of specific groups within STEM, while also interfering with the student's personal success by adding unnecessary anxiety.
Similarly, Taylor and Walton (2011) suggest that stereotype threat undermines learning and performance in underrepresented students, finding that Black students performed worse on a test than the warmup and further, those who learned in a threatening environment performed even worse. Research examining token individuals (underrepresented students who are the only person of a social category in a group), found that token students remember fewer of the opinions shared by themselves and others when compared to non-token students (Lord & Saenz, 1985). This demonstrates how feeling like an outsider can impact students. Further, observers remembered more of what token students said than non-token students, demonstrating the implications of stereotype threat and illustrates how an unrepresented student can become a spokesperson for their social category.

The Cyclical Nature of Underrepresentation

Underrepresentation can be considered cyclical due to the solo status problem. Solo status occurs when someone is the only person of a certain social identity within a larger group. When students do not see examples of people who look like them or who they feel they can relate to in certain fields, they may avoid entering that field for fear that they do not belong. Participating in an environment where a student is marginalized can result in feelings of isolation, as emphasized in a sample of Latina undergraduate students in STEM (Rodriguez & Blaney, 2020). Further, female students scored lower on a spatial ability test when they were under the assumption that they were being scored by a group made of all males afterward (Keller & Sekaquaptewa, 2008). When students are not surrounded by peers that look like them, they may be less likely to succeed academically and continue in their field. In effect, underrepresentation begets underrepresentation.
The ways in which underrepresented students make sense of their experiences can contribute to a sense of inferiority. Semi-structured interviews with Black STEM students found that it is common for Black students to compare their experiences with those of their peers in terms of gender and race (Brockman, 2021). Identifying inequities in these experiences resulted in feelings that they were not meant for STEM. Underrepresentation leads to harmful stereotypes about the type of people who belong in STEM (Starr, 2018) and manifests feelings of isolation for minority students (Rodriguez & Blaney, 2020). A deeper understanding of student experiences within STEM can allow for improvement and increased diversity in this ever-growing field.

**Sense of Belonging**

Sense of belonging is defined as feeling connected and included as a member of a group. Research has indicated that sense of belonging is an especially crucial factor to consider when examining the experiences of underrepresented students in STEM. Apriceno (2020) found that students who formed an engaged relationship with a mentor during their first year of an undergraduate program reported higher levels of belonging within their university and class. Feelings of belonging can continue through a student's time in college, which illustrates how pivotal the first year of a STEM student's college career is (Apriceno, 2020). Wurster et al. (2021) found that increases in students' levels of hope and sense of belonging were associated with an increase in academic self-efficacy. These findings further demonstrate the impact of sense of belonging for students in STEM. Sense of belonging is also positively associated with student engagement (i.e., socialization with peers; Gillen-O’Neel, 2021) which highlights the importance of considering this factor.
It is apparent that sense of belonging is an incredibly relevant and key factor to consider when examining the success of students in STEM; however, underrepresented students often experience sense of belonging differently than White men students. Walton and Cohen (2007) discovered that minority students were more likely to feel an increased level of uncertainty when considering their sense of belonging when compared to students in the majority. This demonstrates a gap between underrepresented students and their counterparts in STEM. Working to develop feelings of belonging in underrepresented students could help to boost their academic confidence and success, which in turn could increase their participation in college-level STEM programs. Villa and Hampton (2020) found that, subconsciously, Latina engineering students acknowledged that their ideas of not belonging were based on experiences of stigma. Increasing representation in STEM is easier said than done, and the next section highlights the interventions that have been used to target these issues.

**Interventions**

Investigating and reducing disparities in gifted education is proposed to broaden STEM participation for students from diverse backgrounds. One example of this is the Students Advancing through Involvement in Research Program (STAIRSTEP) which targets traditionally at-risk students in STEM (Doerschuk et al., 2016). At risk refers to students who are most likely to not complete their degree program. STAIRSTEP helps students to engage in professional development practices such as outreach activities, interactions with faculty mentors, research opportunities, and tutoring. The program has been successful in engaging and attracting underrepresented students, which in turn increases the chances of at-risk students furthering their education in STEM.
STEM programs at universities across the U.S. have introduced various interventions with the goal of increasing representation among minority students. Interventions such as mentoring programs (e.g., Apriceno, 2020), diversity programs (e.g., Burt et al., 2020), and linked-learning communities are common strategies in addressing underrepresentation. Typically, these interventions address factors such as academic achievement and performance and sense of belonging among students. Elevated levels of these factors can be important for a student's continuation in a STEM program, particularly if that student is a traditionally underrepresented student.

Other research indicated promising results from initiatives aimed at increasing STEM representation. Students participating in a diversity program were better able to develop their personal identities within STEM (Burt et al., 2020). Opportunities like this may be beneficial when targeting underrepresented students specifically to address gaps in achievement. The success of initiatives is important; however, little research has examined student experiences within an intervention through a qualitative framework.

**Linked-learning communities**

Linked-learning communities (also referred to as cohort learning models) refer to groupings of students who take several courses together to build community. Linked-learning communities vary in format, with residential communities where students live in a residence hall together or other forms where course content is linked to encourage interdisciplinary learning. Communities and cohort learning are expected to be beneficial for students because they encourage and promote community. Students in these communities interact regularly in their courses or in the living space, which works to foster relationships and sense of belonging. Previous research has demonstrated that first-year students who participate in linked-learning
communities report higher levels of satisfaction than those who do not participate (Goldman, 2012). Students also perform better academically, which benefits their motivation and continuation in STEM (Goldman, 2012).

Despite the success of linked-learning models in some studies, not all research has supported their effectiveness in STEM. Holt and Nielsen (2017) examined differences in performance and retention across students in linked-learning communities and students not in the communities. They did not find evidence of a distinct difference between the groups. The authors propose that other measures of academic success, besides performance and retention, could be helpful when considering the effectiveness of linked-learning communities (Holt & Nielsen, 2017). While this research did not find changes in academic performance in linked-learning communities, it raises the question of the other factors that linked-learning communities may foster. Considering factors such as sense of belonging may be important to gain an understanding of the impact linked-learning communities can have on students and understanding their benefit for students.

Linked-learning communities are promising for increasing representation by emphasizing a sense of community for students. Joshi and colleagues (2022) found that students in STEM perceived more individual and self-directed opportunities than they did community opportunities. The increased perception of individual opportunity was also more pronounced in majors where there are fewer collaborative opportunities. This indicates that when in a major where there are increased levels of collaboration between students, students experience increased community opportunities, which has also been found to be connected to motivation in the field. By utilizing linked-learning communities and allowing students to be surrounded by familiar
faces, the goal is that students' perception of collaborative opportunities will increase, and in turn so will perception of community.

The Present Study

This study aims to gain a deeper understanding of student experiences in linked-learning communities in STEM. The College of Science and Mathematics at a regional university in the northeast is currently conducting a randomized controlled trial of linked-learning communities, or cohort groups, of first-year students majoring in math or science. In the linked-learning communities, students take three classes together in their first semester so familiar faces in their classes will help build community and sense of belonging across students. As part of this larger study, the present research used a qualitative approach to gain a deeper understanding of how sense of belonging arises from participation in these linked-learning communities. Sense of belonging and student identity play large roles in how students experience their major, especially in a historically underrepresented field; therefore, understanding experience is key to developing interventions. Previous research has indicated the potential for success with initiatives geared toward increasing diversity within STEM; however, most of this research is quantitative, which limits the data and understanding of unique experiences. This study aims to examine student experiences of linked-learning communities within a qualitative and intersectional framework. Research was guided by the following question: What role do linked-learning communities play in a sense of belonging among STEM students with varying social identities and backgrounds?

Method

Participants

Ten first-year students were recruited to participate in this qualitative study. The students were all enrolled in linked-learning communities in the College of Science and Mathematics at a
state university in the Northeastern United States. The linked-learning communities were part of a larger randomized control trial that assigned participants to either a linked-learning community group or the control group. Students in the linked-learning communities took three courses together: a first-year seminar, a math class, and either an introduction to their major course or a public speaking course (based on their math placement scores). Participants for the present qualitative study were recruited in person, via email, and by requesting additional information on the final survey for the randomized control trial. Participants were compensated for their time with $25 sent to them via electronic payment.

Students needed to be first-year students in the linked-learning communities and over the age of 18 to participate in the qualitative study. There were 55 students who participated in the linked-learning communities and 10 students who opted to participate in the qualitative study ($N = 10$). Participants were assigned pseudonyms based on color names to ensure confidentiality. All participants were either 18 or 19 years of age. See Table 1 for a full breakdown of participants’ demographic information.

**Table 1**

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Gender</th>
<th>Race/Ethnicity</th>
<th>Major</th>
<th>Age</th>
<th>First-Gen.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amber</td>
<td>Woman</td>
<td>White</td>
<td>Biology</td>
<td>18</td>
<td>No</td>
</tr>
<tr>
<td>Auburn</td>
<td>Man</td>
<td>Black/African American</td>
<td>Biology</td>
<td>19</td>
<td>No</td>
</tr>
<tr>
<td>Cyan</td>
<td>Man</td>
<td>Black/African American</td>
<td>Computer Science</td>
<td>19</td>
<td>No</td>
</tr>
<tr>
<td>Gray</td>
<td>Man</td>
<td>White</td>
<td>Chemistry</td>
<td>18</td>
<td>Yes</td>
</tr>
<tr>
<td>Indigo</td>
<td>Woman</td>
<td>White</td>
<td>Biology</td>
<td>19</td>
<td>No</td>
</tr>
<tr>
<td>Jade</td>
<td>Woman</td>
<td>White</td>
<td>Computer Science</td>
<td>18</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### Positionality

Due to the subjective and complex nature of qualitative data, it is important to note my own identity as a White, cisgender, 21-year-old woman. I am also a native speaker of English. As this study seeks a deeper understanding of student experiences in STEM, particularly of those who are underrepresented, it is critical to acknowledge my privilege. I would also like to note my own personal experience as a student coming from a program where I am in the majority in terms of race and gender identity. It is necessary to recognize that while discrimination has not played a role in my experience, it could be prevalent in the experiences of the participants.

The research team involved in this project consists of eight psychology undergraduate students in the Psychology of Women Research Collaborative. Of the eight students, all identify as White. Additionally, six are women and two are men. Two of the students were only involved in the design of the study and the interview guide. The group is led by two psychology faculty members, who both identify as White, cisgender women. The team was involved in many components of the project, including designing the study, transcribing interviews, and analyzing the data.

### Interview and Procedure
Qualitative data was collected by researchers in the Psychology of Women Research Collaborative through semi-structured interviews with participants. Information about the study was shared by one or two members of the research team through in-person presentations in the three first-year seminar classes. The students were provided with general information about the study, how the interviews would be conducted, and whom to contact if they were interested. Participants were also recruited through emails sent to all first-year students in the linked-learning communities and through information shared at the end of the surveys for the larger study. If an individual agreed to participate in the study, an email was sent to them with interview scheduling information and a consent form. When an interview was scheduled, a Zoom link and a consent form was sent to the participant. Interviews began with an overview of the study and the consent form, with interviewers receiving verbal consent for participation and for the interview to be audio recorded.

To begin, participants were asked broadly about their semester, classes, and involvement on campus to establish a conversational approach to the interview. Next, participants were asked about their experiences during their first semester in the College of Science and Mathematics and their relationships with faculty members and peers. Then, they were asked about the experience of having the same students in multiple classes and their sense of belonging. Finally, students were asked about their social identities and if their background influenced their experiences in STEM. A full list of the questions can be found in the Appendix. Interviews lasted between 25 minutes and 55 minutes ($M = 34.0$, $SD = 9.51$). After the interviews were completed, the interviewer downloaded the audio recording and the Zoom transcript. Both were uploaded to a secure cloud account that can only be accessed by members of the research team.
Members of the Psychology of Women Research Collaborative transcribed the interviews. This process entailed listening to the audio recording of each interview and editing the autogenerated Zoom transcript for accuracy. Transcribing the interviews also allowed researchers to become familiar with the content discussed, in preparation for data analysis.

**Data Analysis**

Thematic analysis (Braun & Clarke, 2020) was used to analyze the data. This process included coding the interview documents and working on theme development. Coding began with multiple researchers reading the edited transcripts and noting points of importance or interest (i.e., open coding). Quotes from participants that touched on the research question “What role do linked-learning communities play in a sense of belonging among STEM students with varying social identities and backgrounds?” were also noted. From this inductive coding process, themes were developed and outlined, and quotes were collected to further support these themes.

Open coding began with coding several interviews together as a group and noting all items of interest. Then, members of the research team coded interviews individually. Each interview was coded by two or three people. Codes were combined before the process of creating and defining themes and subthemes began. Multiple iterations of defining and organizing the subthemes took place, led by myself with feedback from the collaborative. When the results section was written, quotes were cleaned up by removing repeating words and filler words to make reading easier, as recommended by Braun and Clarke (2020).

**Results and Discussion**

This qualitative study examined the experiences of first-year students in STEM (science, technology, engineering, mathematics) linked-learning communities. Participants shared connections they formed through the linked-learning communities, their personal sense of
belonging, and the ways their individual interests and identities have impacted their experiences. The overarching theme that emerged from the data set is **social and academic factors are intertwined to foster sense of belonging.**

**Social and academic factors are intertwined to foster sense of belonging**

The overarching theme examines sense of belonging and the influence that social and academic factors have on it. Participants explicitly define their sense of belonging in terms of their academic potential and achievement. They also explain it in terms of their relationships with peers and faculty. Academic and social factors are not simply co-occurring, but rather are co-dependent. For instance, a student may form connections with peers from their classes which indicates the formation of a social relationship; however, it also signifies the academic context through which the relationship was formed. It becomes impossible to separate where social factors end and academic factors begin. Thus, the themes developed operate on an understanding that these factors are intertwined.

Indigo, a White woman, talked about one of her classes stating, “Everybody in that class struggled a bit, so I didn't feel alone in the struggling area. But they all went really, really well. I passed them all, thankfully.” For her, the shared experiences between her and her peers in an academic setting helped her to avoid feelings of being alone. She was able to pass all her classes and succeed academically, but the social connections she formed through common experiences were incredibly beneficial for her. The intertwining of social and academic factors is especially apparent here; she forms connections through her classes, which grants her social support that assisted her in her classes.

While developing themes, the Ecological Systems Theory (Bronfenbrenner, 1979) was considered as a potential model for demonstrating the development of sense of belonging
through various domains. Bronfenbrenner theorized that development is impacted by everything in one’s environment, including intrapersonal influences, interpersonal influences, and societal influences. While not every domain outlined in Bronfenbrenner’s theory maps onto the content of the interviews, a similar framework was used to examine how social and academic factors interact within the different domains of a college student’s life. The systemic nature of Bronfenbrenner’s model fits this data because the individual relates to all the outer domains. This is demonstrated in the visual of the five concentric circles, with individual in the center, as ssen in Figure 1.

On an intrapersonal level, the theme *Individual Aspects* considers personal and internal experiences of participants. The second theme, *Family Influence*, examines the influence of participants’ family members, including siblings, parents, and extended family. *Connections Within the Linked-Learning Communities* examines the connections participants made directly within their linked-learning communities (e.g., a peer from several of their classes). *Connections Beyond the Linked-Learning Communities* examines connections beyond the scope of the linked-learning communities (e.g., a student joins chemistry club at their first-year seminar professors’ recommendation). The final theme, *Social Climate*, is defined as societal and cultural values. This subtheme examines topics that are considered social constructs, such as social identity. At all five levels, social and academic factors are present and play a role in the student's sense of belonging.
**Individual Aspects: “I’ve always liked the science field”**

This theme encapsulates personal experiences that directly shape participants’ journey within STEM. For many, this includes personal interests that may have prompted the pursuit of STEM. This theme is also intertwined with prior knowledge and high school experiences. For some students, selecting their major includes a process of deep reflection of their future goals, whereas others place more emphasis on considering their strengths and interests when making their decision.

Amber, a White woman, shared her reasoning for selecting biology as her major, stating “I sort of reflected a lot, and when I was younger, I really liked animals and wildlife and learning about that. So that's sort of the direction I'm trying to go right now.” Amber illustrates the pattern of selecting one’s major based on personal interest. A deep level of thought and reflection is apparent in her decision-making process. Selecting a major that one is personally interested in allows for investment in one’s classes, which for Amber connects to the level of work she puts into school.

When Amber was later asked if she feels that she belongs in the college, she said, “I do feel like I belong there. I feel like I produce good work, and I'm able to contribute well to my classes.” For her, there appears to be a link between personal interest and personal sense of belonging. She quantifies sense of belonging as producing good work and contributing to her classes without noting external factors (like social connections). For some students, sense of belonging may also be intertwined with a sense of achievement.

Similarly, Indigo, a White woman, shares that her career goal is what has guided her selection of a biology major by saying, “When I was younger, I wanted to be a vet. That’s changed now. Maybe human doctor at the moment. But I've always liked the science field and
bio is so diverse. You can be basically anything [chuckles.]” This reflects the large number of career options, and she enjoys the flexibility of it. Additionally, she feels comfortable within biology because she knows the major and STEM as a field offers opportunities to branch out and continue her career in many different facets (such as becoming a veterinarian or doctor). Her selection of biology has been guided by her personal interest and career goals. A pattern of personal interests guiding major choice is demonstrated through Indigo’s response.

In contrast, when asked about why she selected computer science as her major, Jade stated, “I spend a lot of time on computers, anyways. So, I play video games.” She demonstrates her personal interest and knowledge of computers through video games. Her preexisting interest in computers made computer science a natural choice for her. Her decision is guided by experiences that have fostered her interest in computer science. Alternatively, Indigo’s decisions seem to be more future-oriented.

Students demonstrate the importance of having a vested interest in STEM, specifically when discussing why they chose their major. Research has indicated that there are strong positive correlations between student interest, personal motivation, and curiosity (Pohan et al., 2020). This helps to explain why personal interest is so highlighted in the data. Students that are interested in their courses likely have curiosity and additional motivation to succeed. Motivation to succeed could prompt students to form connections and seek out opportunities that may contribute to their overall sense of belonging.

**Family Influence: “My dad is a computer science teacher, so it just kind of felt like the right way to go”**

For this subtheme, family influence refers to the occupations of participants’ family members and their expectations for their students. When participants cited their reasons for
selecting their major, some shared their parents’ jobs and how they played a role in their decision-making process. Having family in STEM can act as a further motivation for students and allow for deeper reflection as to why they are entering the field, or alternatively, entering STEM can seem to be the path of least resistance. As students face the selection of their college major, they also must navigate the expectations of their parents, including the expectation of a specific career, or simply the expectation to work hard and succeed.

For Sage, a White man, selecting computer science appears to be the path of least resistance. His father’s knowledge and experience played a role in his selection process, and his statement does not imply any deep-level thinking. He says, “My dad is a computer science teacher. So, it kind of just felt like the right way to go.” His decision could have resulted from his father’s expectations that he would follow in his footsteps, or it could have been a decision Sage made because he was exposed to computer science by his father.

Alternatively, others seem to have taken the knowledge they have gained from family and used it as anecdotal evidence to support their decision. Gray, a White man studying chemistry, states “I do have a lot of family members who are into STEM. You know, my cousin met his wife via both of them being in like um the lab together, and that kind of stuff. So, it's definitely been a part of my life before I was even like really into it.” Gray’s exposure to the STEM field helped to guide his decision. This connection to the field beyond academics can influence how students feel in the field overall. Previous research has examined the role that generation plays in academic success. First-generation college students are more likely to have varying levels of sense of belonging on a day-to-day basis. Sense of belonging is also associated with student engagement (i.e., socialization with peers; Gillen-O’Neel, 2021). This illustrates why family in the field of STEM may be such an important factor. Students may benefit from the guidance they
can provide which can lead to greater confidence in the field and additional resources when facing challenges.

While both Gray and Sage seem to have used their family experiences to help guide and shape their own decisions to enter STEM, other participants have parental expectations as their reasoning. Olive, a White man who is majoring in biology, shared:

Oh, so it's because my mom. She wants me to be a dentist. So, she went to [school name] and she became a dentist, and she did the same major. [...] If you take a bio major, it covers all the classes that is required for either medical school or dental school. So, I just did that, and it's going great so far [...] And also, I really like biology as well. It's a fun major.

For Olive, liking biology almost seems like an afterthought. It is a bonus that he also enjoys the field that he is in. His main reasoning for selecting biology is because his mother wants him to follow in her footsteps. Later, he shares that his mom can help him with his biology homework if she remembers it, further demonstrating the advantageous nature of having family in STEM.

Similarly, Amber, a White woman, touches on the expectations her father has for her. While her father did not seem to influence her decision to select biology over other majors, he prompted the development of a skill set. She said:

My dad's an immigrant. He came here from the Middle East. And he's always instilled work ethic in us and hard work and putting your mind towards things that are valuable and important.

The strong work ethic that Amber’s father instilled in her as an immigrant demonstrates the value that she and her family place in these qualities. She selected biology so she could work hard towards something she feels is valuable and important, and she went on
to explain how she would like to help and benefit the environment. Amber also touches on pursuing research with one of her professors, furthering her opportunities to excel in the program she has chosen. This reflects greatly on the expectations her father has for her to do well and succeed.

The participants demonstrated the role their family played in their decision to enter the STEM field and in the qualities that their families ingrained in them. Interestingly, no questions in the interview guide explicitly ask participants about family, so all references and examples of family members were introduced by participants themselves, which highlights the importance of their influence on participants and how family impacts college experiences.

**Connections Within the Linked-Learning Communities: “There was one peer that was in a lot of my classes”**

This subtheme explores connections formed within the structure of the linked-learning communities. Participants share the ways in which connections were formed with their peers and professors and the result of these connections. Exposure to familiar faces repeatedly across courses occurs in the linked-learning communities and is hoped to foster the development of connections within the communities.

When asked how it was for him to see familiar faces in his classes, Auburn, a Black man, shared, “After first-year seminar, a few of my classmates, we have calculus together, and it's in the same room. So, we kind of just stay there, and we kind of talk about what we’re gonna do in calculus.” This connection between himself and his peers in several classes was formed as a direct result of the linked-learning communities. The intention of the linked-learning communities was that familiar faces across classes would build connections and Auburn’s experience reinforces the effectiveness of the linked-learning communities.
Similarly, Indigo reported that familiar faces made the process of reaching out to peers much easier. She stated, “Especially the [peers] I had in multiple classes. It was very easy to just reach out to them, even if it wasn't for the class we were in at the moment, it was easy to reach out to them for a different class we shared.” This highlights the reason linked-learning communities were introduced into the College of Science and Mathematics to begin with. Seeing students from several of your classes regularly can make it easier to reach out to them with academic questions, but also as friends.

This is further demonstrated in her response to the question “Can you share an instance of when you felt like you belong?”

I'd say I belong. Everybody that I've met, everybody has very similar interests like I said before. So, it's very easy to find at least one person to connect to, and share ideas, or just simple interests with them. And then find out, maybe another teacher has an interest, or, oh this group has an interest, so it's very, very nice to find similar things people were interested in, then find that a lot of people had the same interests.

Indigo demonstrates the importance of shared interests in STEM and how her classes allowed her to find people that she can relate to and share ideas with. This connects back to ideas referenced in Individual Factors and the importance of selecting a major that you enjoy and are interested in. Individual factors reflect a sense of knowing oneself, and having shared interests connects that inner sense of self with a group, leading to sense of belonging in students.

Similarly, Cyan, a Black man studying computer science reflects on shared interests being a basis for relating to his professors. When asked if he felt that he could relate to his professors, he said, “I mean they enjoy math, I enjoy math. My teacher for MATH199, and my
teacher for COMP151, both have a background in programming so that's cool, so I can relate to them in that way.” Being able to relate to his professors over shared interest may allow students to feel more comfortable with their professors, which in turn contributes to their sense of belonging.

This is similar to Olive’s experience. When asked if he belongs in the STEM field, he shared:

I think that I do belong in the STEM area because I’m the same major as mostly everybody else in the place. Most of my classes are there. I have a lot of friends who are there at that area. And, when I go into the building, I like the area. It feels very nice. It's not a lot of people there, so it's great to go study. But I mainly do my studying in the library in the study rooms, or at home. But I do feel the connection there, that I belong there.

Relating to his peers is what allows Olive to feel that he belongs. Olive also emphasizes physical space as a factor that indicates a sense of belonging for him. This may be because the space, the science and math building, is where his classes, peers, and professors are, so it is a comfortable and familiar place for him. Mulrooney and Kelly (2021) found that physical sense of belonging is considered important and is related to sense of belonging for college students. This is likely because, in theory, campus communities have the capacity to bring people of varying backgrounds and experiences together in a common space (Andersson et al, 2012). Olive highlights this importance, and it explains why the science and math building plays a large role in his personal sense of belonging.
Other participants did not see much of a difference when faced with peers they recognized. When Sage was asked if his experience differed based on recognizing peers in his classes, he said, “You know I don't really think so. But maybe I guess if anything, it was better to see familiar faces. But if anything, slightly.” Even for students, like Sage, who did not feel much of a difference from being in a linked-learning community, it was an overall neutral or slightly positive experience.

**Connections Beyond the Linked-Learning Communities: “There’s some people in my computer science classes this semester that I recognize from the last one”**

This theme examines the outcomes of connections established within the linked-learning communities. For some students, their connections from their first semester carried into their second semester classes. For others, connections with faculty presented opportunities to join extracurriculars or to conduct undergraduate research. This theme demonstrates that the connections formed in the linked-learning communities beget other connections. Such connections beget community and contribute to the sense of belonging within the college. Many participants touched on connections with peers and faculty that have continued beyond their first semester of college.

Jade, a computer science major, formed a deep connection with her chemistry first-year seminar professor. When asked if she had connections with faculty in the college, she shared that she went back and visited this professor in the start of her second semester. Jade shared

Yeah. I actually went, my first-year seminar teacher, I like went and said “Hi” to her on the first day of school, and she asked me how my classes were, and we talked.
Jade demonstrates that a connection she formed in the fall semester carried into the spring. She knows that she has this professor to go to for support and for questions if needed, which corresponds to an overall sense of belonging. Research has indicated that supportive classroom environments predict higher levels of sense of belonging (Zumbrun et al., 2014). This is important because Jade’s connection with her first-year seminar professor may be contributing to her overall sense of belonging in the department.

Amber, a White woman majoring in biology shared her main takeaways from her first-year seminar. When asked if she felt motivated to continue in STEM based on these takeaways, she shared:

Yeah, I would say, I'm not sure if I would go on and like test water research things, but I am motivated in learning more, sort of seeing how these issues impact people. I know specifically with my professor, um she offered to me potentially doing research with her next semester.

The connection with her professor was formed through the linked-learning community and has contributed to her continuing success in the college. She now has the opportunity to do research as a first-year student with a faculty mentor. Becoming involved with research allows opportunities for students to form more connections. Amber’s initial connection with her professor has led to a research opportunity, which has the capacity to lead to even more connections and opportunities, further demonstrating that connections from the linked-learning communities beget additional connections.

For other students, connections established in their first semester led to additional connections. Gray, a White man, made the decision to join chemistry club at the recommendation of his first-year seminar professor.
So, I wasn't able to take anything for my major, my first semester. But I’m thankfully in the one chemistry class that they're having next semester. So, I was kinda nervous about it at the beginning, because I knew I was gonna be a bit behind, if that makes sense, when it comes to my major. But honestly, I got over it pretty quickly cause I was still doing a lot of stuff in the math and science building. So, okay, I'm still like in the building doing stuff. I’m part of the chemistry club as well. So even if I wasn't in the class for it technically, I was still actively participating in the building and a lot of the stuff that they have going on there.

He shares that he was unable to take introduction to chemistry his first semester because he did not receive a high enough score on his math placement test. However, by being actively involved in chemistry club, he shared that he still feels welcome and like he belongs in the major and in the College of Science and Mathematics.

For some students, they felt comfortable approaching their professors when they saw them outside of class. Jett, a White man, talks about how seeing one of his professors outside of class was very nice. He also felt comfortable asking his professor questions beyond the scope of their class. He shared:

I know it's nice to see my math and social dynamics professor in the hall. I wave and say “hi.” It was very convenient, because I remember it was after his class we were working on a final project for calculus, and he just so happened to walk into the room, and he knew basically everything about the program we needed to use. And he answered all my questions. It was really great.
His first-year seminar professor was helpful to him and his peers on an assignment for their calculus class. He demonstrates a few things in this quote. The first was that he could work on assignments for calculus with his peers before his first-year seminar class met. If not for the linked-learning communities, Jett likely would not have had several peers from his calculus class in his first-year seminar class. This allowed these students to collaborate for their calculus class outside of when it met. Secondly, this group of students felt comfortable approaching their professor and asking him a question about a different subject matter. This furthered the connection between professor and students, while also extending their conversation beyond the scope of the first-year seminar.

Indigo also references additional support in the college (tutors) as a place she can go to for help. This seems to speak to the broader environment supporting student success. She felt like she had people to turn to if she needed help. When students become comfortable asking peers in the linked-learning communities for help, students may also begin to feel comfortable asking for help from other supports, like tutors. Feelings of comfort and support surround the college in ways beyond the linked-learning communities, highlighting that connections and community beget more connections and more community.

As established in the previous theme, students were able to develop connections with peers and faculty within the linked-learning communities; however, participants formed additional connections as a result of the connections formed within the linked-learning communities. This emphasizes the importance of the linked-learning communities when examining their effectiveness in fostering community. Students are
allowed opportunities to form connections in academic and social settings that will help them achieve their personal, academic, and career goals.

**Social Climate: “Equaling out that balance and getting all sorts of people in STEM”**

Social climate refers to the broader social constructs in our world that contribute to individual experiences. For example, social identities are socially constructed and contribute to the formation of biases and stereotypes about groups of people. As previously outlined, stereotypes are prevalent in STEM and their implications can negatively impact students and further underrepresentation in STEM. Participants were asked about their social identities and the ways in which they impacted their experiences.

Roan, a Black man, shared that, for him, social identities do matter. As an English Language Learner and an immigrant, his experience has been impacted by his background.

I believe they can matter, because, for example, in my case, I'm a person that was not born here, or in any speaking English-speaking country. So, it can affect me because English is my second language. And there's some things in English that I cannot understand, and that may affect my way of learning something in STEM, so you can say that it can matter in that case.

For Roan, his academics may be impacted because he may not understand something in English. However, he does not touch on this impacting his experience socially, nor did he emphasize the role of race in his experiences in STEM. He explicitly shared that being an English Language Learner was “the only thing that affected [his] learning in STEM.”

While some participants share their own experiences as members of marginalized communities in STEM (for Roan, being an English Language Learner and immigrant), no
participants shared instances of discrimination or stereotyping in the interviews. It could be that participants were not comfortable sharing these experiences in the interviews or that there seems to be an understanding that social identities are important, but they should not matter when it comes to ability. Sage, a White man, voices this by saying:

I feel like at [school name] there really is no treating people differently because of something, like you’re all like learning together and there's no like “oh, this is different for you because of your gender, or because of your race.” We’re all treated the same, I feel. [...] But also, I could not know, because I don't really fit into like many of those categories. But I've never heard anyone talk about that really or seen that been an issue.

In Sage’s experience, he has not seen any of his peers be treated differently based on any of their social identities or backgrounds. He also has not heard his peers talking about issues surrounding social identities in the college. Here, Sage highlights his privilege; being a White man in a STEM program allows him the extraordinarily privileged position of not facing discrimination or microaggressions due to his gender or race. However, he also recognizes that as a White man he is not part of a marginalized community in STEM, which could affect his perceptions and ability to notice these issues. It is important for White students to recognize their privilege, particularly in historically underrepresented fields, such as STEM. Phillips and Lowery (2018) suggest that when privileged individuals protect their innocence by ignoring their privilege, this leads to the emergence of the invisibility of privilege on a societal level. It is necessary to acknowledge the advantageous nature of privilege in order to address inequities in our society.
One participant disclosed his identity as a transgender man in the interviews. When he was asked about if his social identity impacted his experience in STEM, he shared the following.

Definitely. I think it does in a lot of ways. It's been interesting for me cause I am a trans guy. So, it's been a very, not so much balancing act, but it's been very interesting, because you know, at some points I’m treated like a guy, and there’s other points where I’m treated like a girl. When it came to when I was first at like applying for scholarships, there's a lot of adults in my life being like “you should apply for women in STEM scholarships” and I was like “I don't really think I can.” I ended up not, because I was like, “this doesn't apply to me basically.” It's definitely been very interesting, because I've been meeting people, you know, who are in similar boats to me. And I've been meeting people who are very different from me when it comes to that kind of stuff.

This participant shares that there are times when he is treated like a man and others where he is treated like a woman. This highlights one of the difficulties that transgender people face. With gender differences and stereotypes being so prevalent in STEM, his identity as a man is nuanced. His social identity has greatly impacted his experience and he shares how he has worked to make sense of his identity and how he fits in, in a field where gender plays a big role. He also states

I know that I can't really have a cut and dry discussion about some things when it comes to gender and that kind of stuff, cause it's always very much people being like “Oh, it's very male dominated.” And I’m like, “yeah, I fully agree.” And

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1 Due to the small number of transgender men in this STEM program and the desire to support the anonymity of our participants, quotes from this participant will not be identified with his other demographic information or with the pseudonym used for his previous quotes. The participant consented to quotes about his trans identity to be used in this way.
sometimes people are surprised when they're like, “How do you agree?” And I’m like, “yeah, there's a lot of guys here, and I’m technically part of that quota.” But it's always this very interesting aspect, because it's an idea of like, “Oh, you're a guy,” and I’m like, “yeah, I am a guy.”

Here, he touches on what it is like for him to discuss STEM being male dominated. He recognizes that STEM is a male dominated field and that he is a member of this, which has caused this participant to be misgendered at times. Microaggressions, such as misgendering, can cause stress and embarrassment for trans individuals (Pitcher, 2017). This may cause trans STEM students to feel lesser and to feel decreased feelings of belonging, especially if they are made to feel as if they are not valid in their identity. When this participant was asked if his experience in the College of Science and Mathematics was positive, negative, or neutral, he stated the following.

Honestly, I’m gonna say it's been pretty neutral cause I've had negative experiences. I've had positive experiences. But I think that this comes with life in a lot of ways. But most of the people that I've met are cool, and we move on because it doesn't really affect them when it comes to certain things. So, it's always kind of just been a fun fact, I guess [laughs].

While there is scant research on transgender people in STEM, Hall and colleagues (2022) found that students who are nonbinary and transgender men are likely to have a decreased sense of belonging and a negative perception of the climate in STEM. This is likely due to bullying, stigma, and discrimination that individuals who are not cisgendered face. While this participant recognizes his negative experiences, he also recognizes his positive ones, which provides hope for the growth and diversity in STEM fields.
With identity playing a large role in STEM and in our broader society, it is important to consider why diversity is so important and what it brings to STEM. Our transgender participant emphasized this when discussing how his identity as a trans man has impacted his experience.

I think it's definitely, really important, because each person in their identity can bring different things to the table, especially when it comes to what they want to research in cause, you know, there's been a lot of studies about race and gender when it comes to certain aspects of, you know, like the workplace, and that kind of stuff and I don't think those studies would have happened if you know there weren't people like that that were thinking about that kind of stuff because it affects them personally. Being able to bring that to a wider audience is always really interesting, especially when it comes to stuff like this. So, it's always pretty interesting. Honestly.

Diversity in STEM is critical to combat the cyclical problem of underrepresentation. By broadening the voices in STEM, the questions asked, the research conducted, and the problems solved will better reflect the entire population.

Similarly, Amber, a White woman, said the following:

I feel like, from what I've gathered like today, there's more of like an emphasis in getting women in STEM, and sort of equaling out that balance, and getting all different sorts of people in STEM. Also, different races, or previous disparities between races, people, and trying to get more opportunities and more balance. I definitely think that social identities are important and valuable, it's important to get different experiences from different people and what they can each contribute.
I definitely think that's valuable and just optimizing what you do with STEM, like the positive impacts that you can have through different people, and their experiences ideas on where they come from, what they know. I think that's very important.

In her response, she acknowledges the disparities there are in STEM among women and non-white races. She highlights the importance of having all different sorts of people in the field and the value differing perspectives can bring. Amber also emphasizes the overarching theme of social and academic factors being intertwined here. She discusses the importance of diversity and people of all social identities and background in STEM, but also what this diversity can bring to the field in terms of contributions, both academic and career-wise.

Gray, a White man, touched on gender differences in STEM as well. He shared that he is happy to see more women in STEM because broadening a field is beneficial for everyone.

I know that the STEM field is very male dominated when it comes to presentation at least. So, you know, when I was watching all these types of things, and I would see women discussing that. So, it's like, “oh my God! Like, thank God, like there's more of you.” […] I've kind of paid attention to it, but I always get kind of happy when I see it, cause I’m like alright, it's nice, seeing the field pretty quickly get broader when it comes to the people that are in it, and I think that can only be helpful, especially for how we look at certain things and the types of documentation that we wanna do and the types of labs that we wanna do.

Gray acknowledges that the STEM field is very male dominated and that he is excited to see it grow in diversity. His anecdotal observation is backed by the literature, with
women holding far fewer STEM field careers than men (National Science Foundation, 2021). Recognizing the importance and value of diversity in STEM could be motivating to students from underrepresented groups. In turn, this contributes to sense of belonging; as the field broadens and students begin to see more people of similar social identities to them, they may feel an increase in sense of belonging. The opposite of this is also true; Brockman (2021) found that Black students who do not feel that they fit into the STEM field use their low sense of belonging as motivation to pursue non-STEM fields. This highlights the value of diversity, representation, and equity in STEM in order to maintain and increase diversity among historically underrepresented groups (such as women and people of color).

The United States is a capitalist country, where the economy is controlled by the people rather than the government. Participants were not asked about the economy; however, many indicated that their pursuit of a STEM major was in the hope of earning money. STEM workers earning high salaries is true – STEM workers earned an average salary of $55,000 in 2019 and non-STEM workers earned an average salary of $33,000 (National Science Foundation, 2021).

When participants were asked why they chose their major and are entering the STEM field, many expressed personal interests and career goals, as highlighted in the Individual Factors theme. For others, job security and a high paying job play a major role in this decision. Roan says, “I picked that because [...] know how to use computers a lot, and I know it's a major that can give you a lot of money.” This reflects the pressure society places on students to become a productive member of society and to get a well-paying job. This reflects on the broader societal context. Similarly, he shares, I would like to become a computer engineer. [...] And start working in a field that requires that and get paid very good for my job. That's what my goal is
coming to study this major.” Roan very explicitly shares that his goal in pursuing STEM is to get paid well. This reflects on the broader societal and economic systems in place in the United States.

Jade shared that computer science was her major and that she had a deep interest in cybersecurity. When asked why, she shared, “I just think the whole hacking thing is cool and it's a lot of money, too, is involved in it. It's a good career.” The emphasis that she has placed on a job that is considered “a good career” is evident here. While she doesn’t explicitly share where these ideas come from, it is understandable that getting a well-paying job and being successful is a social norm which is reflected in our society. Moreover, computer science and hacking are growing fields that greatly benefit our nation. Feeling that she is contributing to our society may play a role in Jade’s sense of belonging and her personal self-worth.

Auburn, a Black man, also demonstrates the idea of contributing to our society when discussing the purpose of STEM.

Another purpose of STEM, well, it improves the economy, like if you're a computer science major, you can do like a lot with that. You can go into software engineering, which is like you need people that do software engineering. And you need engineers in this world, if we lack engineers, then I feel like systematically, we can't move forward, you know, if we lack engineers and stuff like that. We need those type of people.

Auburn is a biology major, following in his mother’s footsteps to become a dentist. Interestingly, he does not touch on the medical side of STEM when considering its purpose but rather engineering and computer science. However, his response does
indicate the desire to contribute to our society, a desire that seems to be instilled in the students.

Societal influences play a large role in the experiences of students and their reasoning for selecting STEM. Their experiences are shaped by their social identities and the stereotypes that surround them. They’ve selected their paths based on what they can personally gain (careers and money) and based on what they can contribute to our society. Participants also demonstrate the importance of diversity in STEM, and while we are not there yet, the value they place on equity and representation is promising.

**Conclusion**

This qualitative examination of student experiences in STEM reveals that linked-learning communities play a role in student sense of belonging. Participants described the interactions of social and academic factors on their sense of belonging in five key domains: *Individual Aspects, Family Influence, Connections Within the Linked-Learning Communities, Connections Beyond the Linked-Learning Communities, and Social Climate*. Many experiences touched on by the participants arose as a result of the linked-learning communities, illustrating the ability of the intervention to foster community in the College of Science and Mathematics. Linked-learning communities seem to foster a sense of belonging in STEM programs by intertwining social and academic aspects of college. Previous research supports our results that linked-learning communities are beneficial for students. Goldman (2012) found that first-year students in linked-learning communities reported higher levels of satisfaction than students who were not in the communities. Linked-learning communities are an effective manner of fostering a sense of belonging in STEM programs and are a promising intervention for reducing gaps in achievement and increasing diversity in STEM.
One limitation of this research is that there was a small group of students in the linked-learning communities that were eligible to participate in the qualitative portion \((N = 55)\). Only ten students opted to participate in the interviews. Of the ten participants, seven were men and only three were women. There were three participants of color; however, there were no women of color. The lack of diversity in our sample may mean our results are not generalizable to broader populations. However, it further demonstrates that White men are prominent in STEM. Additionally, students in the linked-learning communities are in the first semester of their first year, so they have no college experience outside of a linked-learning community to compare their experience. It is possible their responses to questions regarding sense of belonging may have been similar even if they were not in a linked-learning community with familiar students, as they had no baseline to compare their sense of belonging.

Future research should explore the experiences of women of color in interventions, such as linked-learning communities, in STEM. Future research should also examine the lasting effects of introducing linked-learning communities for first-year students, including what role linked-learning communities play for upperclassmen. This research indicates that linked-learning communities have played a role in the sense of belonging of first-year students; however, it is unknown if this feeling will continue throughout their academic career. Future research should consider how these social and academic experiences intertwine to shape student success.
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Appendix A

Interview Questions

This is the list of interview questions with sample follow up questions for the interviewer to ask.

Interviews were semi-structured to allow participants to share their experiences in a conversational manner.

Ice Breaker Question
To start, how old are you? The college is doing a study on how student schedules impact success and experiences at [university] and this interview is a part of that study, so how did your first semester go?

What do you have going on outside of classes? Work, clubs, sports, etc.? Resident/commuter,

Broad Starter Questions
1. What is your major? Can you tell me about how you chose to enter the STEM field?
   a. How do you perceive the field of STEM?
   b. What do you see as the purpose of STEM?
   c. What are the goals of STEM?
   d. What are you hoping to achieve in STEM?
   e. What are three words you would use to describe STEM?
2. Do you feel welcome in the STEM field? How so?
   a. Can you tell me about a specific instance that has made you feel welcome or unwelcome?
3. As you know, your major is housed in the College of Math and Science, can you tell me a bit about your experience so far in the College of Math and Science or in your major at [university]?
   a. I’m curious about how your classes went this semester... What STEM classes did you take this semester? Did you find your STEM classes engaging?
   b. What about these classes made them engaging?
   c. Did you enjoy your first-year seminar?
   d. Can you tell me a bit about it?
   e. What were your takeaways from it?

Social Connections and Support
1. Now, I’m going to ask you some questions about social connections in the College of Math and Science. Can you tell me about your feelings of belonging in STEM at [university]?
   a. What are some things that make you feel like you do or do not belong?
   b. Do you feel supported in the college? How so?
2. Do you feel supported in your major? How so?
a. If you were to have a problem, where would you go for support? Why?

3. Do you feel that you have connections with faculty in STEM?
   a. How does that feel? How do you think you developed that connection with them?
   b. Do you feel like you can relate to faculty members?
   c. Do you feel like you want a connection with faculty? What do you think is a barrier?

4. Can you tell me about your connections with your peers in STEM?
   a. If you had homework questions, do you have someone in your class that you would feel comfortable reaching out to?
   b. Do you feel friendly with any of your peers? Can you tell me more about the people you are forming connections with? How did you form those connections?
   c. Do you feel like you can relate to your peers?

5. You had peers in your first-year seminar that were also in your other classes. Can you tell me a bit about that? How did that go?
   a. Was your experience in classes where you knew other students different from when you did not? How so?
   b. Did that affect your feelings towards the class?

Social Identity

1. Do you think anything in your background has influenced your experience in the College of Math and Science? (For example, previous schooling, role models in the field, etc.)

2. Next, I’m going to ask you some questions about your social identities.
   a. Social identities are pieces of your identity that you may find meaningful like race, gender, or class among others. Social identities can impact experiences in different ways. Do you think social identities matter in STEM? Have you seen social identity impact the experiences of your peers? Have you noticed ways in which people are treated based on their identities?
   b. Do you feel that your background or social identities have influenced your experience in the College of Math and Sciences? How so?
   c. Do you feel that your social identity or background has influenced your experience in a negative, positive, or neutral way? How so?

3. The last question I have for you is what piece of advice would you give a student starting out in STEM?