

## People Matter: The Role of Peers and Faculty in Students' Academic Engagement

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## Abstract

This paper presents findings from an engineering education study whose results lead to suggestions for best practices to improve the teaching and learning experience in engineering classrooms.

Over the past four years we have been exploring the role of a student's connection to community on his/her engagement with academics, both in terms of behaviors and emotions. Specifically, we have sought to better understand the specific factors affecting a student's sense of belonging and community, as well as the effect of faculty and various communities on student academic engagement. In order to examine these, we have conducted faculty and student interviews, student focus groups, classroom observations and student surveys, all at each of five very different universities. We have analyzed the resulting data set using a combination of quantitative, qualitative, and mixed methods approaches.

The following are findings from this study which are relevant for engineering faculty teaching courses. Regarding belonging, our student surveys show clearly that a) a student's sense of belonging in classes and major is strongly associated with academic engagement and other positive outcomes, and b) faculty and peer support of a student are correlated to the student's sense of belonging primarily at the class and major level. Regarding academic engagement, students report in interviews that faculty behaviors influence student academic engagement, and that small adjustments to faculty behavior could improve student engagement. When observing classes, we observed that lecture still predominates in the engineering classroom; however, we observed a modified lecture style that was occasionally used, in which we observed a high student academic engagement and faculty interaction that typically occurs only in active learning environments. Beyond the classroom, additional student interviews revealed that informal academic communities, especially lab groups, study groups, and faculty-led groups, are valuable to most students, but not all. Further, participation in non-academic communities (e.g., extracurricular activities) provides opportunities for many students to meet belonging and safety needs (anxiety and stress reduction) which in turn, support better student academic engagement.

This paper explores these findings in more detail and includes practical interventions (actions) that faculty can readily implement with the goal of increasing student academic engagement.

## Introduction and Background

When examining one's own approach to engineering education, it makes sense to consider what approaches have been shown to work well for others; in other words, to consider evidence-based teaching practices. The engineering education literature has provided such evidence-based approaches for introduction to engineering courses<sup>1</sup>, capstone courses<sup>2</sup>, and topic-specific courses.<sup>3,4</sup> It has also provided teaching guidelines for approaches ranging from teaching using active learning methods<sup>5</sup>, improving student self efficacy<sup>6</sup> and retaining engineering students<sup>7</sup>. This paper summarizes other evidenced-based teaching practices which have recently emerged

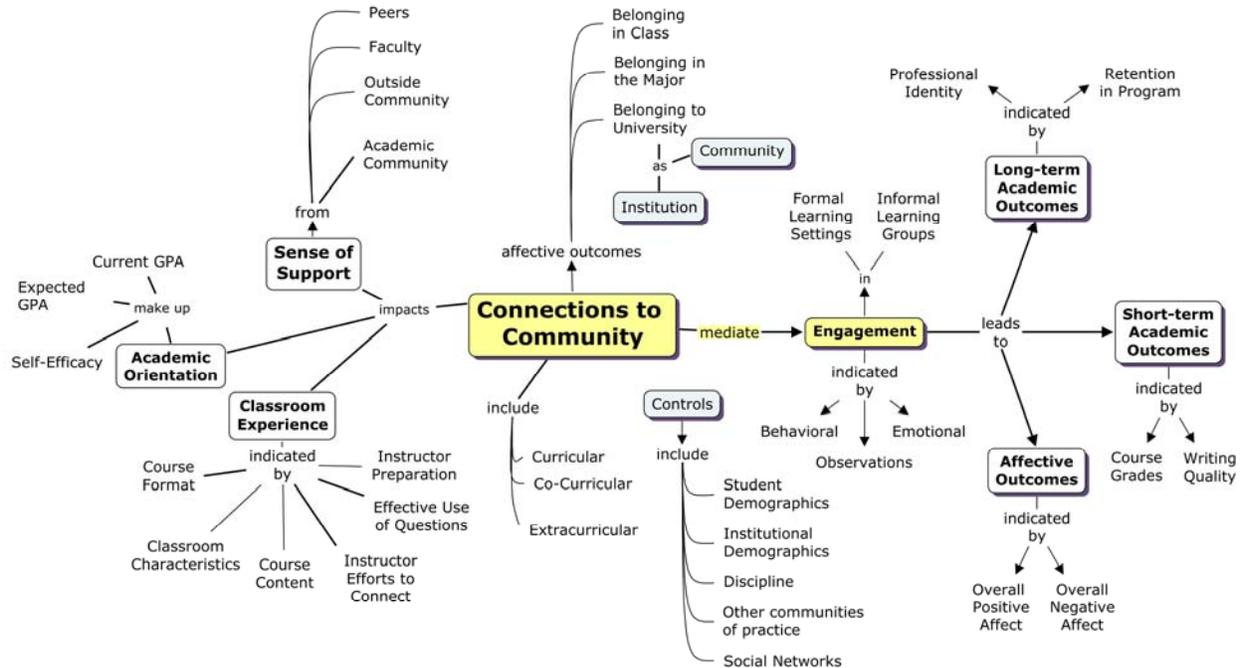
from our collaborative research on the role of a student's connection to community in his/her engagement of academics, both in terms of behaviors and emotions.

Our research connects to the existing literature in the following six specific areas. Our efforts have used multiple approaches to extend this body of literature describing these connections between a student's sense of belonging, academic engagement and both faculty and peer support.

1. Prior research has examined the relationship between a student's sense of belonging in the academic environment and various academic measures. A sense of community or belonging in higher education has been positively associated with lower levels of burnout among college students,<sup>8</sup> increased GPAs among undergraduate transfer students when combined with strong participation in transfer student communities,<sup>9</sup> decreased loneliness in college,<sup>10</sup> and greater first year persistence in college when measured in the context of residence halls.<sup>11</sup> Our research effort examines the link between belonging and academic engagement, a more immediate outcome than persistence and GPA.
2. Others have studied the role of faculty and peer support in relation to a student's sense of belonging and persistence.<sup>12, 13, 14</sup> Our study adds to the existing literature by surveying STEM students about a range of faculty and peer support mechanisms to determine their correlation to belonging and academic engagement, a more immediate outcome than persistence.
3. Student engagement has been shown to be influenced by faculty behaviors, using methods that involve extensive self-reports by students.<sup>15, 16, 17</sup> Our study adds to this literature by using STEM classroom observations in addition to student self-reports to understand these connections between student engagement and faculty behaviors.
4. Instructional modes such as active and problem-based learning are known to impact student engagement.<sup>18, 19, 5</sup> In this study, we look not at the impact of interventions on engagement but on the student engagement impacts of what faculty are already doing.
5. Some research has examined the role of informal academic communities (e.g., lab groups, study groups, learning communities) on student engagement.<sup>20, 13</sup> This study is one of the first to examine all academic communities available to students, identify those in which STEM students most often benefit, and explore the positive and negative impacts of academic community.
6. Others have studied the role of non-academic communities (e.g., extracurricular activities) on student engagement.<sup>13, 21</sup> This study adds to this literature by examining the needs that engineering students and other STEM students meet by participation in extracurricular activities.

To guide further exploration of these areas and their inter-relatedness, we have developed a conceptual model (Figure 1) suggesting the pathways between a student's connection to his/her communities, his/her engagement in the learning process, and various student outcomes.<sup>22, 23</sup> Subsequent to forming this conceptual model, we conducted surveys, focus groups and

classroom observations to examine various aspects of the model. Though we have not carried out interventions to prove causality, our findings do suggest that faculty may use minor adjustments in their classroom interaction and style to positively influence student engagement.



## Methods

To examine the pathways suggested by our conceptual model, we used both quantitative (surveys) and qualitative methods (interviews, focus groups, and classroom observations). Data were analyzed both separately, using quantitative and qualitative analysis, and together, using a variety of mixed-methods approaches. Particularly useful were our mixed methods approaches that used exploratory sequential phases to explore pathways by which student engagement was influenced by their environment and then an explanatory sequential phase to expand on results from the quantitative analysis.<sup>24,25</sup> Thus, we began with a survey to gather data from a broad group of engineering and other STEM undergraduate students and then followed up with focus groups of a subset of survey participants in order to corroborate survey findings and more thoroughly explore emergent themes. The subsequent year we conducted more surveys, focus groups and classroom observations to further understand and explore our initial findings.

We conducted the surveys, focus groups and classroom observations at five diverse higher education institutions in four different regions of the United States. These institutions and their key characteristics are:

- **HBCU:** A small minority-serving teaching institution (an Historically Black College/University) in the Southeast that offers a moderate range of engineering majors and is typically characterized by classes of 5 to 50 students.
- **Private (Faith Based):** A small teaching institution in the Pacific Northwest. The Private institution offers a narrow range of engineering and computer science majors that are

based on and informed by a Christian world view, with class sizes typically from 15 to 40 students.

- **Research:** A large Research 1 institution in the Pacific Northwest. The Research institution offers a wide range of engineering and computer science majors and is characterized by densely populated classes of 30 to 500 students who enter the program (competitively) during mid-sophomore year.
- **Teaching:** A medium-sized teaching institution in the Midwest. The Teaching institution offers a moderate range of engineering and computer science majors, where class sizes average 25 students overall, with lower numbers for upper division engineering courses.
- **Women's (Masters L):** A small women's college of approximately 1,900 students in the Northeast with fifty majors, including three computer science and related degrees. This institution offers a liberal arts education for its undergraduates integrated with professional work experience. Class sizes are typically 6-12 students, with the largest class size around 20 for computer science, but up to 60 for Chemistry.

### *Subjects and Procedures*

Our study included interviews of faculty, interviews and focus groups involving students, student surveys, and classroom observations. Each of these components of the study are described briefly below.

Surveys: In total, we surveyed 1498 students, the majority of whom were engineering majors, but the sample also included computer science, math, physics, chemistry, and animal science majors. Approximately one-third of the survey sample was female. The self-reported ethnicity of the students was primarily White (roughly 50%), Asian/Asian American (25%), and African American/Black (13%). Survey items captured student demographics, multiple levels of belonging, multiple levels of engagement, and a wide variety of other factors thought to influence belonging and engagement (see Figure 1). Items intended to measure student connections to community and student academic engagement used a 5-point Likert scale where students responded from strongly disagree to strongly agree to statements such as:

- "I feel that I am a part of this class"
- "I feel comfortable in this major"
- "In my major classes, I work as hard as I can."
- "In my major classes/lab/study groups, when we work on something I feel interested."

Student focus groups and interviews were conducted with 232 participants with focus group sizes typically of 2 to 4 participants, but up to 15. The students ranged from sophomores to seniors.

The following questions (items) are representative of those used in the interviews and focus groups to elicit data regarding a student's connection to his/her communities and his/her engagement in the learning process.

- Exploratory focus groups and interviews included questions such as:
  - Which communities at the <name of institution> make <name of institution> a special place for you where you feel that you can truly belong?
  - What would make your typical classroom a community that you can better enjoy and belong to?
- Explanatory focus groups included questions such as:
  - Of all the *academic* communities you participate in (for example, lab groups, informal study groups, the classroom, activities sponsored by the department, etc.), which help you the most to engage in your education? How do they help you?
  - How does feeling like you're supported by faculty affect your performance (how well you do) in a class/lab? How does it change your participation/engagement in the class/lab?

Classroom Observations: A total of 407 classes were observed during Years 3 and 4 of the project, including nine cohort observations (same class, different year). During Year 4, all quantitative observation data were entered into SPSS files (one per institution) and data cleaned and checked by at least three different researchers to ensure accuracy. Once completed, these classroom observation items (12 student engagement items, 20 instructor activity items, and 7 class characteristic items) were analyzed using exploratory factor analysis to arrive at aggregate constructs (containing more than one item); single-item variables (objective measures only), and discarded items (those that cross-loaded onto more than one factor). Descriptive statistics were then calculated and constructs and data were analyzed using both quantitative and qualitative methods.

Faculty Interviews: Over 30 faculty and administrators were interviewed at the beginning and end of the study to understand (a) early in the study, what parts of student community should be evaluated in the student surveys and focus groups; and (b) later in the study, which interventions faculty believed would be most helpful to improving community and academic outcomes influenced by community.

We analyzed and coded these data using conventional quantitative and qualitative analysis protocols as well as several mixed methods approaches.<sup>26, 27, 28, 29, 30, 31, 32</sup>

## **Results**

The significant findings from our research efforts, so far, fall into six primary categories, related to the six categories discussed above in the brief literature review. Our findings are summarized below along with further explanation.

1. A student's sense of belonging in classes and major is strongly associated with academic engagement and other positive outcomes.<sup>26</sup>

Belonging reflects the experiences of a student in the STEM environment and has implications for what they do in class (effort and participation) and how they feel about their experiences in class and their major (positive and negative emotions). Our research indicates that strong connections to peers and faculty in class (and other highly local settings) are closely correlated to the degree to which students engage in their academics. These findings were consistent among all five institutions regardless of the institution's culture, geographical location, or school size. Our data provide evidence that a local sense of belonging cultivated in a class is strongly related to the way the student feels, how hard they try, and how willing they are to participate in a class. These results suggest that faculty can support students' ability to learn not just through their own teaching, but also through supporting opportunities to build community and belonging, from class to class.

2. Faculty and peer support of students are correlated to the students' sense of belonging at multiple levels.<sup>27</sup>

Faculty and peer support are consistent predictors of class and major belonging across the various schools. The personal relationships with faculty and fellow students correlate to students' sense of belonging in their major. Further, a student who senses the support of a faculty member in class feels a stronger sense of class belonging.

3. Faculty behaviors can influence student academic engagement, and small adjustments to faculty behavior can improve student engagement.<sup>28</sup>

Students revealed in interviews and focus groups that faculty involvement and support results in a) increased student understanding of the material, b) greater student participation in class, and c) students feeling comfortable asking questions.

Students explained that they perceive faculty to be involved when their instructors are noticeably engaged in teaching, clearly want to teach, and are visibly dedicated to helping students learn. One student captured the sentiment expressed by many students with the statement: "If the professor cares, students care more." Notably, students reported that an instructor can demonstrate caring by simply telling the class: "It is my job to make you learn, I'm here to make you learn." Additionally, students told us that being recognized by the professor is highly valued by students. Again, somewhat surprisingly, more important than the instructor knowing each student's name was students' feeling that instructors know that the student is in their class or acknowledges their presence.

Another way that students gauged instructors' level of engagement or caring was if the instructor took class time to explain the thought process corresponding to a concept or solution. This theme was common in our interviews indicating that

instructors may be inadvertently leaving out important steps or cognitive processes that are crucial to students' understanding. Our data indicates that this impacts not just the students learning that one concept, but potentially other concepts as well due to the students' perception that that instructor does not care about their learning.

Students also explained that an unapproachable instructor can have a negative impact on student engagement. For instance, if an instructor makes a comment in class indicating that students should already understand a particular concept, then the student will be reluctant not only in asking questions of the instructor regarding that concept, but also (somewhat surprisingly) reluctant to ask fellow students about that concept.

4. Although lecture still predominates in the engineering classroom, a modified lecture style observed in our study is associated with high student academic engagement and faculty interaction that is otherwise typically observed only in active learning environments.<sup>29</sup>

Classroom observations of faculty activities and corresponding student behavior, attention and posture during class revealed that a non-interactive lecture corresponds to limited student engagement, or even disengagement. [This style is now commonly referred to as “sage on the stage”.<sup>19</sup>] However, a well-paced, interesting, interactive class in which the instructor is accessible, most often corresponds to students who are significantly engaged. [This we describe as a “connected sage on the stage.”] This was observed regardless of class size, course topic, and course level. Note that this on-task interaction was both instructor to student and student to student. The classroom experience itself, therefore, became more of a joint effort between instructor and students.

Though less common, an active learning environment, dubbed “sage off the stage” or “guide on the side”,<sup>19</sup> was observed to correspond to the most engaged students. We reiterate, though, that the intermediate, more interactive instructional style, “connected sage on the stage”, still had strong student engagement. The following vignette describes the characteristics of such an on-task interactive lecture style:

*With a smile, the instructor greets the students before class time, exchanging a few jokes with them. Once the bell rings, the instructor gives a brief overview of the class agenda for the day and touches on material covered in previous lectures. He leaves time for students to ask questions about the homework or content, and students actively ask questions and help each other. After a few minutes, the instructor begins to lecture with his prepared notes. The prepared lecture includes topics of interest to the students that keep students interested and asking questions. While working an example, the instructor shares his thought process with his students and includes humor to further engage the students. While doing this, he walks around the classroom and through the aisles. Students have plenty of opportunities for making eye contact with the instructor, and they seem to be relaxed in class. The instructor asks questions such as, “What do you think will happen next?” and “What is our next step?” He waits until someone in the class*

*answers, which usually takes about 20 seconds. When a student provides his or her idea, the professor writes it on the board and uses it to derive an answer. Students in this class appear to be awake, engaged, and happy. When the bell rings, some students stay after class to continue the discussion before the instructor leads a few students to his office for office hours.*

5. Informal academic communities, especially lab groups, study groups, and faculty-led groups, are valuable to most students, but not all. Providing dedicated space, structured opportunities for academic groups, and options to transfer to other groups or temporarily withdraw from such groups altogether can be key to successful community building for engineering students.<sup>30,31</sup>

Our results indicate the importance of academic communities outside the classroom in supporting engagement and other academic outcomes for most students. These students expressed that one outcome of these communities is that they foster a sense of belonging, which enables engagement. For example, students made comments regarding how being part of these communities helped them feel that they were not alone in their struggles, provided a safe space, or supported their sense that they belonged in the class or major. Students also explained that the overall capability of the group enhanced their individual understanding of the material and their own individual capability to perform. One student stated:

“Study groups [help] because we all get to bounce off ideas. If somebody figures a different way of doing it, it kind of gives you a way to challenge what you think and helps.”

Some students, though, do not find academic communities beneficial to their academic outcomes. These students feel left out even during group work, due to cliques, and some feel that the group either holds them back or moves too quickly for them to keep up. Thus, while participation in academic communities appears to benefit most students, not all experience the same level of benefit from participation.

Our research also revealed that some students, who we call “preferred solitaires”, choose not to participate in academic communities as they believe they are more efficient and productive when working independently; however, other students, “outsider solitaires”, do not participate in academic communities, although they would like to. Students in this category cite commuting or isolation as reasons that prevent them from participating despite their desire to interact with others.

6. Participation in non-academic communities (e.g., extracurricular activities) provides opportunities for many students to meet belonging and safety needs (anxiety and stress reduction) which in turn, support better student academic engagement.<sup>32</sup>

Students strategically identified needs that they meet through participation in communities and linked their participation with increased ability to engage in their academic endeavors. We recognized these needs as fitting within Maslow’s hierarchy of needs.<sup>33</sup> Most frequently, non-academic communities played a role in relieving

anxiety (meeting safety needs), establishing order in an otherwise chaotic life (meeting safety needs) and building their self-confidence (meeting esteem needs). In one student's words, talking about the Catholic center on campus:

“I think that no matter what it is, people need something as a release to get away from homework for a while. I know there has been a ton of times that I'm working on an electronics homework and I can't get this one problem and then I go and do something else, and when I come back I get it. You need to step away from it for a while. Everybody has their own thing, this is what works for me, to go [to the Catholic center].”

Across all institutions, family is the community to which students reported feeling most connected, with friends being a distant second. Other communities cited as important include athletics, clubs and church communities, in addition to roommates or housemates.

Our results reveal that these connections are fulfilling critical needs for students, which in turn can have a significant positive impact on their academic engagement.

### **Discussion (Implications for Faculty)**

Taken together, these findings suggest that faculty attitudes and behaviors, both in and outside the classroom, impact student engagement and belonging. According to students, faculty have the power to create an environment which helps students engage in course content and motivate them to try harder, but faculty also have the power to weaken student engagement. The following are possible implications for faculty as a result of our analyses.

- a. To facilitate students' sense of belonging and motivation to participate in class, an instructor can implement the following ideas that require minor effort on the part of the instructor:
  - i. Learn student names or simply recognize if students have been attending class, asking questions, working hard, etc.
  - ii. Tell students explicitly during class that s/he cares that students learn the course material.
  - iii. Encourage students to attend office hours if/when they need additional help.
  - iv. Provide a safe academic environment in which there are no dumb questions.
  - v. Arrive at class early and allow time after class to connect with students. The appearance of being unrushed and engaged in teaching as a priority often goes a long way in promoting student engagement.
  - vi. Consider telling students that it is acceptable to pose the same question again, if necessary, as the student processes complex concepts.
  - vii. Explain the thought processes behind the problem-solving done in class.
  - viii. Take the time to explain each step of an example or derivation without inadvertently skipping important steps.

- b. The use of interactive lecture techniques (“connected sage on the stage”) or active learning activities (“guide on the side”) directly corresponds to increased student academic engagement and provides peer and faculty support, which correspond to students’ sense of belonging with both instructors and peers. The interaction will also help students and faculty to feel more connected to each other, allowing for a greater sense of trust when trying new pedagogies.
  - i. Be very available to the students by arriving early to class, staying after class, and encouraging them to come to office hours.
  - ii. Make an effort to connect by creating a welcoming environment, talking casually with students before class, and moving around the room during class.
  - iii. Use multiple approaches for content delivery; mix lecture, multimedia, and discussion, with extensive use of engaging questions and in-class problem solving.
  - iv. Use real-world applications of the content.
- c. To capitalize on the benefits of informal academic communities while minimizing their limitations, faculty can do the following.
  - i. Provide dedicated space for group work such as dedicated study rooms or study tables, perhaps with specified hours. (This may require support from your department or college to implement, but can also be achieved by reserving library or computer center space.)
  - ii. Provide structured opportunities for academic groups. Assign groups to reduce the effects of cliques, or alternately, allow students to get to know one another prior to assignment and allow students to suggest their own groups. Allow for reassignment when belonging is not developing with a group or an alternative for students who strongly prefer not to do group work – though this should be done only when group work is not one of the objectives of the assignment or course.
  - iii. Encourage groups to value diverse perspectives and to generate multiple solutions, thus fostering participation from each group member. Teach students conflict resolution skills and other simple techniques like active listening that can strengthen groups into positive contributors to the student’s academic experience. These lessons can be done as very short inserts to lectures.
- d. Non-academic communities (e.g., extracurricular activities) can also support student engagement.
  - i. Our results underscore the value in faculty accommodating the demands of family, athletics and other non-academic communities and encouraging student participation in these activities. For example, by allowing students to have an alternate due date when necessary, the faculty member can actually enable learning by supporting the students’ non-academic needs, which in turn enables the students’ academic engagement. Another means to accommodate external commitments is for faculty to avoid short time frames for completing

- assignments. This allows the student to plan around external time pressures while still completing their school work.
- ii. Our results also suggest that faculty should be explicit in discussing extracurricular activities with students, informing them of the potential benefits of increased belonging and reduction in anxiety and stress. Having discussions with students about the benefits of extracurricular activities on their academic endeavors may encourage some students to participate meaningfully in extracurriculars and, thus, obtain these benefits.
  - iii. Faculty can provide a venue for connecting students to each other and to something meaningful and long-lasting by blending the non-academic with the academic by building service requirements and community interaction or involvement into the curriculum or individual courses.<sup>34</sup>

## Conclusion

Our research has used a variety of methods to outline the importance of belonging in the STEM undergraduate experience. Student surveys, focus groups, interviews and classroom observations reveal various ways in which belonging correlates to student academic engagement.

Quantitative analysis has shown that among five different universities, regardless of institutional culture, there are consistent links between a student's sense of belonging in class and his/her behavioral and emotional engagement.

Quantitative analysis also reveals strong correlations between faculty support and student belonging. Students report in focus groups and interviews that faculty behaviors, both positive and negative, bear a strong connection to and influence in the student academic experience, from grades to persistence to post-graduation plans. Further, students cite specific behaviors of faculty that strengthen the influence of faculty support; these behaviors are not institution-specific and can be implemented at a wide variety of institutions in an equally broad range of STEM majors.

The out-of-classroom experience also plays a major role in students' sense of belonging and engagement in the major. However, the role that extracurricular activities play in a student's experience can vary for different kinds of students. In surveys, students cite participation in lab groups, study groups, and faculty-led activities as being most frequent in their academic activity out of the classroom. Qualitative data are consistent with survey data by confirming that participation in lab groups and study groups has the most value to students in their out-of-classroom academic life. When participating in non-academic extracurricular activities, students often report that they fulfill needs of belonging and reduce stress and anxiety through these activities, thus enabling them to engage more effectively in academics.

In addition to self-report data, our mixed method classroom observations show that although lecture remains dominant in the STEM classroom, a modified lecture style, where faculty endeavor to connect to students from within the confines of lecturing, results in increases in academic engagement on par with more student-centered or active learning teaching styles. These observations provide a foundation for balancing traditional content-heavy demands from

STEM curricula with basic human needs to connect to and affirm students during the learning experience.

Our next steps in our overall research strategy are to focus on longitudinal data so that the causal links that have been suggested by many of our cross-sectional analyses can be tested and explored in greater depth. We pursue this analysis with a deep appreciation for the significant and varied role that belonging plays in the student's undergraduate experience in STEM.

Our research provides evidence of the importance of people and social connections, among both students and faculty, in the academic engagement of STEM majors. This investigation identified many strategies and behaviors that students in these majors attribute to their success and provides examples for implementation. Many of these actions may seem to be common sense, but our research has added an understanding of why these actions have impact and which students they are likely to impact the most.

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