

AC 2010-777: INFLUENCING SENSE OF COMMUNITY IN A STEM LIVING-LEARNING COMMUNITY: AN NSF STEP FUNDED PROJECT

Melissa Dagley-Falls, University of Central Florida

Melissa Dagley Falls is the Director of Academic Affairs for the UCF College of Engineering and Computer Science and advisor to both undergraduate and graduate students within the college. Dr. Dagley Falls chairs the Admission, Advising, and Retention Committee (AARC) and serves on the assessment and activities teams of the NSF-funded STEP program entitled "EXCEL:UCF-STEP Pathways to STEM: From Promise to Prominence." Her research interests lie in the areas of student access to education, sense of community, retention, first-year experience, living-learning communities, and persistence to graduation for students in science, technology, engineering, and mathematics programs.

Michael Georgiopoulos, University of Central Florida

Michael Georgiopoulos is a Professor in the UCF School of Electrical Engineering and Computer Science and the PI of the NSF-funded S-STEM program at UCF entitled the "Young Entrepreneur and Scholar(YES) Scholarship Program" as well as the NSF-funded STEP program entitled "EXCEL:UCF-STEP Pathways to STEM: From Promise to Prominence." Dr. Georgiopoulos' research interests lie in the areas of machine learning, neural networks, pattern recognition and applications in signal/image processing, communications, medical field, manufacturing, transportation engineering, amongst others. Dr. Georgiopoulos is a Director of the Machine Learning Laboratory at UCF.

Cynthia Young, University of Central Florida

Cynthia Young is a Professor in the Department of Mathematics in the UCF College of Sciences and a Co-PI of the NSF-funded S-STEM program at UCF entitled the "Young Entrepreneur and Scholar(YES) Scholarship Program" as well as the NSF-funded STEP program entitled "EXCEL:UCF-STEP Pathways to STEM: From Promise to Prominence." Dr. Young's research interests are in the mathematical modeling of atmospheric effects on laser beams. She currently has projects with the Office of Naval Research and the Naval Research Laboratory investigating atmospheric propagation in the marine environment.

Influencing Sense of Community in a STEM Living-Learning Community

Introduction

The STEM pipeline continues to shrink. Called a “quiet crisis”,¹ the effects of the shrinking pool will only be felt “in fifteen to twenty years, when we discover we have a critical shortage of scientists and engineers capable of doing innovation...” (Jackson in Friedman, p. 253). Important to this crisis, K-12 students are much less interested in science and engineering than in the past and are not as prepared to handle the college level work required to attain these degrees². The percentage of the ACT-tested students interested in engineering declined from eight to five percent over the last decade². Of those who enter college only 42% receive a bachelor’s in their intended field of study³ and for STEM disciplines, other than the life sciences, these percentages are lower³. Evidence can also be seen in the percentage of bachelor’s degrees awarded in the STEM disciplines as compared to the overall number of degrees awarded. From a record high of 36% in the late 1960s the percentage of bachelor’s degrees awarded has ebbed and flowed rebounding only slightly to 32% in 2006⁴. More disturbing is the fact that within this small percentage of degrees awarded in STEM disciplines, only half of those bachelor’s degrees were awarded in the hard sciences⁴. With a lower percentage of students showing interest and a lower percentage of those declaring STEM disciplines completing a degree in their intended field, the outlook for increased percentages of STEM students entering the workforce is not promising.

Institutions of higher education are being held more accountable by industry, government, and institutional leaders⁵⁻⁸. With the shrinking number of students interested in engineering and other STEM disciplines, institutions of higher education must attract and retain more students in these disciplines in order to increase the number of graduates. To do so, it is critical to devise strategies that are effective both in cost and outcomes to recruit, retain, and graduate more students in the STEM disciplines⁹⁻¹⁰. There are many paths to retaining students in a university setting. It is imperative that researchers continue to look for the best practices, or combination of best practices, that lead to greater student persistence. Leaders have proposed that faculty and student services should create appropriate campus programming to promote student success¹¹⁻¹⁶. Learning communities and a student’s psychological sense of community have played important roles in increasing retention and student learning. Further study of sense of community and the connection to retention in these smaller university communities is needed¹⁷ especially as they relate to STEM students.

Learning Communities

The concept of learning communities began as early as 1927 with Meiklejohn and Dewey’s experimental colleges, but found new life in the early 1980s when the Washington Center for Improving the Quality of Undergraduate Education was formed to disseminate learning community information. The learning community movement found support throughout the 1980s and 1990s in a number of national reports¹⁸⁻²⁰ including the National Institute of Education’s (1984) *Involvement in Learning*²¹. This report specifically recommended: “Every institution of higher education should strive to create learning communities, organized around specific intellectual themes or tasks” (p. 35). Developing a sense of community was a significant outcome of many of the early learning community experiments.

Learning communities “represent an intentional restructuring of students’ time, credit, and learning experiences to build community, enhance learning, and foster connections among students, faculty, and disciplines”²² (Smith et al., p. 20). The majority of all learning communities can be grouped as follows: (a) curricular learning communities, (b) classroom learning communities, (c), student-type learning communities, and (d) residential learning communities²³. Learning communities typically have students grouped together through some type of co-enrollment²³ but can have a cross between types utilizing components of each to enhance student outcomes. The program discussed here creates a learning community based on cohort participation in two paired classes along with a residential component centered on the students’ academic interests. The student-type learning community is important for a number of reasons. First, students grouped with like-minded students are more likely to emulate the characteristics of that group and thus remain in the STEM disciplines²⁵⁻²⁶. Second, peer groups, a known positive influence on retention, are more likely to form around a common purpose^{27, 15} helping decrease the negative effects of STEM disciplines on persistence in the major and timely graduation, especially within engineering^{28, 29}. Lastly, student type learning communities allow students to get to know others in their major with whom they will have classes in the future, establishing a community earlier than the typical junior year when students enter the major²². Institutions implement learning communities as a way to increase student involvement, build community, create a connection to the curriculum, enhance student-student and student-faculty interaction, and ultimately retain students^{24, 30-31}.

Students living in residential learning communities have been shown to have higher levels of (a) social interaction with faculty and peers, (b) persistence, (c) satisfaction with the institution, and (d) commitment to the institution²³. Students have the opportunity to carry their conversations outside the classroom and into their living environment which allows for an overlap between students’ social and academic activities^{24, 32}. Smith et al.²² defined residential or living-learning communities as a place to “build community and integrate academic work with out-of-class experience” (p. 20).

Though similar NSF programs have been established around the nation, the learning community in this study is unique in the holistic nature of the approach. Holistic implies a multi-faceted approach to intervention with students, “encompassing academic affairs, student affairs, and administration”³³ (p. 5). The learning community under investigation provides intervention in each of these areas through math assistance, social programming, and involvement by faculty and advisors in a residential learning community. The program promotes a learning community of 200 students in a much larger university environment which makes for a smaller, more intimate, and navigable community. Research suggests that when faced with an ill-structured problem³⁴⁻³⁵ such as retention, multiple approaches may be better than a single solution³⁶⁻³⁷. With this support, the program investigators implemented a set of activities which can be divided into four categories: (a) advising activities, (b) faculty development activities, (c) educational activities, and (d) diversity activities³⁸. Due to the extensive research conducted by others on the in-class components, this investigation expanded only on the out-of-class educational activities. Borrowing a concept from the field of community psychology, sense of community was used as the conceptual framework. Specifically, this research looked to investigate the relationship between a STEM learning community’s out-of-class educational activities and students’

perceived psychological sense of community to determine which activities most influenced sense of community and, in turn, retention within a STEM learning community.

Conceptual Framework

Sense of community, formally known as psychological sense of community (PSC), is one measure of a successful learning community³⁹. The presence of PSC in the university setting is important in its potential effect on students and, for this investigation, its relationship to their retention within a program. Sarason³⁹ was credited for introducing the concept of PSC and suggested it be considered the centerpiece of the study of communities. However, it was McMillan and Chavis' (1986)⁴⁰ work *Sense of Community: A Definition and Theory* on which most recent research in PSC has been based. McMillan and Chavis preferred the term sense of community (SOC) and defined it as, "a feeling that members have a belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together" (p. 9)⁴⁰. The definition consisted of four elements: membership, influence, integration and fulfillment of needs, and shared emotional connection. These elements interact within and among each other to generate and maintain SOC. Understanding the concept of SOC can aid institutional leaders in identifying factors and designing interventions that support behaviors⁴⁰ leading to SOC and potentially increase student retention.

McMillan and Chavis' elements of SOC receive support from the popular retention theory of Tinto⁴¹, Braxton, Hirschy, and McClendon⁴², and Astin⁴³ suggesting SOC as a good construct to use in the further examination of factors that influence student retention. These supporting theories also provide encouragement for the use of learning communities to accomplish community within the institution. An explanation of the supporting retention theory and connections to SOC is necessary for a better understanding.

Vincent Tinto⁴⁴ believed that a student's commitment to the institution and commitment to graduation led to departure decisions. This commitment impacted the social and academic integration of the student into the institution's community. Tinto suggested formal and informal areas such as academic performance, peer groups, faculty-student interaction, and extracurricular activities as places in which social and academic integration, also known as student involvement or engagement, would take place in an institution. In his revised work, Tinto⁴¹ later suggested that community membership and the membership's associated sense of belonging may play as critical a role in persistence as academic and social integration. In an attempt to provide more structure to the social integration construct of Tinto's theory and build on the idea of community, Braxton, Hirschy, and McClendon⁴² proposed a residential colleges and universities revision to Tinto's work which included the idea of "communal potential" (p. 23) as an influence on social integration. They described communal potential "as the extent to which a student believes that a subgroup of students exists within the college community with which that student shares similar values, beliefs, and goals" (p. 23). Developed around Tinto's integration activities and the idea of communal potential, first-year learning communities have been used to create welcoming subgroups in which students are immediately members, membership being the first step in an effort to build a sense of community⁴⁰.

In his theory of involvement, Alexander Astin⁴³, like Tinto, supported the idea of smaller community membership for purposes of assisting students to overcome loneliness or feelings of isolation on larger university campuses. Sarason³⁹ believed loneliness and isolation could be combated by a strong SOC. The ideas of involvement and security, as proposed by Astin, are important elements of membership and establishing SOC in a community⁴⁰. In *Student Success in College*, Kuh, Kinzie, Schuh, Whitt, and Associates¹² further supported the ideas of involvement and integration through the development of learning communities, stating, “living and learning with other students and faculty creates a community based on shared intellectual experiences and leavened by social interactions outside of class” (p.198). These shared experiences and multiple opportunities for interaction suggested by Kuh et al. are important elements of SOC⁴⁰. Since the 1980s, when the concept of learning communities found national prominence in higher education, many schools have implemented learning communities in an effort to increase student learning, sense of community, and persistence²³. Research suggests student sense of community (SOC) is a construct useful in studying university environments, in this instance, a residential learning community.

Literature review

For students to persist, they must become socially and academically integrated into the university⁴⁴ and the associated communities found within. One area of research stemming from this concept has been the study of the relationship between student sense of community and intentionally planned learning communities. There are a number of studies supporting the benefits of learning communities and the positive associated outcomes⁴⁵⁻⁴⁸. However, very little research on STEM learning communities reported providing a residential component. For those that did boast residential learning communities (RLC), assessment on the residence portion was minimal. Further, residential learning communities identified by Ohland and Collins⁴⁹ and others evolving since that time⁵⁰⁻⁵⁴, found positive effects on STEM first-year retention and sense of community, but did not assess which activities within the RLC were providing the most influence.

Psychological sense of community has been shown to be stronger in small learning communities within the larger university community^{55-56, 16}. Literature supports the idea that a positive relationship exists between sense of community and student success^{5, 55, 56, 11, 57, 16, 58}. Most research in this area has been conducted on the effects of residence halls⁵⁵, or living-learning communities, student organizations¹⁶, classrooms⁵⁷, and undergraduate academic departments⁵⁹ as individual components in a learning community. These studies did not investigate the sense of community concept using a comprehensive approach to a learning community, one containing the necessary components for social and academic integration identified by Tinto⁴⁴.

Key research by Lounsbury and DeNeui⁶⁰ found significant relationships between student SOC and a number of environmental variables. The first finding was that a student’s major influences SOC. More importantly, the disciplines included in the investigation were split between low SOC (engineering and life science) and significantly higher SOC (mathematics and other sciences). Second, higher SOC scores existed for fraternity members supporting the idea of sub-communities within the larger university. Further investigation is needed to determine if these same findings regarding fraternity sub-communities exist for other sub-communities in the

university. The third finding of higher SOC scores for those students living on-campus than those who live off-campus supports the literature on retention. In a follow-up study, Lounsbury and DeNeui¹⁶ found that students at lower enrollment institutions had higher SOC scores than those at larger institutions furthering the idea of using smaller sub-communities to attempt to increase the SOC experienced by students. Lastly, the researchers found extroversion to be significantly related to student SOC. Because STEM students are often found to possess the personality trait of introversion, a trait that has been shown to be influenced in a positive manner by increasing the student's SOC⁶¹, this research was key in identifying a potential need for certain groups of students to receive more interventions to increase SOC.

This study capitalizes on the ways researchers suggested the study of SOC in the university move forward. Berger and others^{16, 62} believed more research should be conducted on the relationship between student SOC and smaller sub-communities including residence hall environments. Cheng¹¹, with support from Tucker⁶³, took these recommendations one step further to suggest the creation of a whole learning experience that enhanced student SOC. Last, were the suggestions to identify specific factors that contribute most to student SOC^{64-66, 58}. Within these recommendations is where this investigation found its roots.

This study will address three questions. First, is there a relationship between a STEM learning community's out-of-class educational activities and students' perceived psychological sense of community? Second, do underlying constructs of sense of community exist within the learning community? Finally, how powerful is the constructs influence on student sense of community?

Methodology

Applying a survey method, a questionnaire was selected to gather self-reported information from students on factors influencing their sense of community. The literature provided a basis for factors addressed in the instrument. The framework for the composition of the questionnaire elements was based on factors derived by Cheng¹¹. To aid in the collection of data which would accurately address the objectives of this investigation, the questionnaire was adapted to address these areas within a sub-community rather than the university as a whole. Through the instrument, students provided their perception of activities influencing sense of community specific to the program under investigation.

The target population for this study was limited to those first-time, full-time, bachelors degree-seeking, science, technology, engineering, and math (STEM) majors entering the university in fall 2007 who were selected to participate in the learning community. All students selected for the 2007 cohort were included in this study so no sampling was necessary. The 174 students were solicited for feedback on the sense of community (SOC) questionnaire. These students represented three undergraduate colleges: the College of Engineering and Computer Science (CECS), College of Medicine (COM), and College of Sciences (COS). There were 133 (76%), 8 (5%), and 33 (19%) students from each college, respectively. Though not exact, these proportions were representative of the proportions of STEM populations in each college at the university. There were 108 usable responses to the questionnaire (62% of the targeted population). All categories of the SOC respondents, except for males (63% vs. 80%), were over represented in comparison to the non-responders. The responders also included more of the

outliers in the SAT math scores ranging from 520 to 720 versus the non-responders who ranged only from 530 to 670.

The dependent variable examined in this investigation was sense of community. The independent variables for the first inquiry were the individual items of the SOC questionnaire. For the second inquiry factor analysis was used to identify the independent variables used in the final inquiry. Here, the identified constructs were examined, through multiple regression, as to their relationship to sense of community. In addition, this investigator controlled for background demographics and college academic characteristics, both of which have a potential affect on student success outcomes^{67, 42, 68-70, 46, 71-73, 41, 74-75}. Institutional data was used to determine each of these variables. Background characteristics included gender, race, SAT math scores, and high school GPA. College academic characteristics included student's specific STEM college, first semester GPA, and first-year cumulative GPA. An additional control variable used was the math section in which students were enrolled. This allowed the researcher to control for any bias based on the level of math placement or the individual instructors and their associated teaching style, factors which are known to influence student success⁷⁶⁻⁷⁸. The final control variable used was place of residence.

Relationship to Individual Activities

For purposes of this study, the learning community cohort was used to determine if a relationship existed between the STEM learning community's out-of-class educational activities and students' perceived psychological sense of community. The SOC questionnaire was used to collect the data and correlations (Pearson's ρ) were determined. As expected, relationships were found to exist between the learning community's, out-of-class educational activities and students' perceived sense of community. In fact 23 of the 25 items showed some significant relationship. These findings supported studies from the retention, STEM, and SOC literature^{24, 40, 43, 58, 79, 80, 81, 82}. The two items showing the strongest relationship to SOC were shared classes promoting students studying together and the residential experience increasing the students' sense of belonging. Further discussion of the learning community's program components contributing to these results is warranted.

One of the required components of the program is the class cohort environment centered around the students' first and second semester math experience. During the fall semester of their first year in college, all of the learning community participants are enrolled in the appropriate math course with a cohort of other learning community students. Based on a math placement score or other test credit, students are enrolled in the Pre-calculus or Calculus I track. The Pre-calculus course is a five credit hour intensive review of Algebra and Trigonometry. This course serves as the prerequisite to Calculus I. Students enrolled in Calculus I, a four credit hour course, are also enrolled in an Applications of Calculus I course. The one credit hour applications course, taught by hand-picked faculty in different disciplines, illustrates real-world applications of calculus. Each of these courses are restricted to the learning community students. Upon successful completion of the math course, students are enrolled in the next course in the sequence for the subsequent term. Students unsuccessful in their first attempt will be enrolled in a learning community section of the same course in the spring term. In addition to offering Applications of Calculus I and Calculus I again, Applications of Calculus II runs parallel to the Calculus II

course offered in the spring term. Each of these courses, Pre-calculus, Calculus I and II, and Applications of Calculus I and II, are taught by the learning community faculty and graduate assistants. These instructors are trained through the Faculty Center for Teaching and Learning on best practices in the field.

The learning community students are offered the opportunity to live on campus in a specific housing block. Students who choose to take advantage of this live together with other students in the program and are offered advising and tutoring on-site in the residence hall. The living arrangements allow students to form study groups with students in close proximity, perhaps roommates, and engage in academic activities in an informal environment. Students have the same academic purpose and common rigor in the coursework which provides students the opportunity to discuss homework with one another and seek assistance from their peers. Friendships are created with students in similar academic programs, lessening pressures between the academic and social systems of the university. The students provide a supportive environment for one another in which studying for classes is a positive activity. Students are not required to participate in the living-learning community and have the option to live in another residence hall on campus or in off-campus housing.

Other learning community activities with a strong correlation to the students' perceived sense of community included students caring about one another, students feeling valued by others in the program, students' feelings of acceptance within the community, and the positive relationships and interactions established in the learning communities tutoring center.

Existence of Underlying Constructs

Using the same survey data, a confirmatory factor analysis was conducted to determine whether underlying constructs of sense of community existed within the learning community. During a review of the literature and construction of the instrument, three factors emulating the learning community co-curricular activities were expected to exist: the student support center, residential experience, and social interaction between peers and faculty.

The original analysis produced six factors which together were capable of explaining 68.78% of all the variable variances. The next step of the factoring process was to run reliability analysis on each factor to reduce the scale to relevant items only, therefore increasing its reliability. Upon completion, the six factors were reduced to five. Existing concepts identified in the review of literature were used to frame the extracted constructs. Upon careful review and consideration of the factors, the items combined to create them, and the rich literature on which sense of community had been established, the five factors were named. The five factor solution resulted in the factor structure shown here: (1) open acceptance, (2) academic system interaction, (3) student academic support services, (4) residential experience, and (5) social system interaction.

The factor analysis ultimately met with the expectations of the literature. However, rather than only three factors emulating the learning community's out-of-class activities (the student support center, residential experience, and social interaction between peers and faculty), interaction divided into separate factors for social and academic interaction and the additional factor of open acceptance was extracted, aligning with Cheng's¹¹ research. Open acceptance dominated the

other factors. This result confirmed Cheng's finding that an open and caring environment was critical to establishing a sense of community. The student academic support services factor loaded around the items associated with the Tutoring Center. The existence of this factor supported the literature on learning communities that promotes academic support centers as providing the settings and the opportunities necessary for students to work together and become more involved in their education. No surprise, the residential experience factor aligned perfectly with the three place of residence items. Academic system and social system interaction were the final factors extracted. The academic factors dealt with faculty student interaction and interaction with the curriculum.

Sense of Community Influential Factors

Over time, research on students has become more complex with investigators determining that many factors influence a student's decision to persist and their sense of community. Through multiple regression a researcher can investigate which characteristics, attributes, or variables influence sense of community and to what extent. Using this method, two groups of control variables and two item controls, determined important by the literature, were entered into the model, followed by the factors identified through factor analysis. Students' perceived sense of community (SOC) determined by the SOC instrument served as the dependent variable.

Consistent with the results reported by Cheng¹¹, the findings which included student background characteristics showed that there was no significance in the relationship between student SOC within the learning community and gender, ethnicity, SAT score, or high school GPA. This result showed that the SOC within the learning community was similar regardless of a student's gender, race, or academic preparation.

A statistically significant relationship was found to exist between SOC and the five factors when controlling for background, academics, and place of residence. Among the five factors two were found to be significant in their contribution, open acceptance and student academic support services. Removing the non-significant factors one at a time and again executing the linear regression resulted in the combination of factors with the greatest influence on sense of community. In order of greatest contribution these were open acceptance, student academic support services, and residential experience. The residential component of the program was discussed previously, but further discussion of the other components is warranted.

The Tutoring Center which shaped the student academic support services factor was found to have a statistically significant relationship to SOC. Students living both on- and off-campus participate in the Tutoring Center. As another testament to the holistic nature of the program and the support provided by the senior administration, the Center, which is reserved for the use of the learning community students only, is centrally located in the academic heart of campus and directly across from the student union. The purpose of the Center is to provide a space where students can: (a) come together for group study, (b) receive individual tutoring by a program graduate teaching assistant, (c) participate in problem solving sessions with program faculty, or (d) meet socially after study hours. Participation in the academic activities of the Center begins as a required activity and becomes optional throughout the semester as students show improved academic performance in the required math courses. Initially, all first-year learning community

students are required a base number of study hours in the Center. After the first quiz in the Pre-calculus, Calculus I and Calculus II courses, study hours are adjusted based on the student's performance. Required hours are lifted for students performing well and additional hours may be required for students performing poorly. Students are evaluated after each quiz or test and adjustments in the required hours are made. In addition, at key points during the first year, advising days are held in the Center. Students meet with both the learning community advisor and the college advisor in order to make adjustments to course schedules and preparations for future terms. The advising days are key to showing a united front between the program and the involved colleges and provide an opportunity for students to make a necessary connection with their future college advisor. Other benefits of the Center are the interactions between the first and second-year learning community participants, the interactions with graduate students in similar disciplines, and the interactions with the math and science faculty outside of the classroom.

The open acceptance factor turned out to be the most significant influence on SOC. This finding supported one of Cheng's¹¹ primary factors of importance to developing SOC – “students’ feelings of being cared about, treated in a caring way, valued as an individual, and accepted as a part of community” (p. 227). Along with the social aspects of the learning community, each of the Center benefits listed lend themselves to creating the open, caring environment students valued most in building their sense of community.

Discussion

Though specific to this learning community and students within the STEM disciplines, the results of this research may be considered by any practitioner looking for ways to improve the academic environment or success of students or any faculty member searching for the best way to assist students in the learning process.

For practitioners who desire to enhance the learning environment and, in turn, the success of students, the identification of elements influencing a student's sense of community is immense. These co-curricular activities provide practitioners with a starting point from which to create useful interventions to increase a student's SOC and thus student success⁴⁰. Knowing that sharing classes encourages students to work together outside of class on academic issues and increases SOC within their environment, faculty members can work with one another to establish coherent, team taught curricular learning communities from which students and faculty can benefit from the collaboration. Specifically, it is recommended that academic and student service professionals work together to develop communities where students are treated as individuals and feel cared for not only by their peers, but also by their advisors and faculty members. Practitioners and faculty need to create open environments, respectful of all people where everyone feels accepted. In addition to creating these environments, interventions need to include student support services, especially for those programs centered on academics. Within these centers, faculty and staff must foster positive relationships, allow interaction with other students, and make themselves and other resources available to students. It is important that practitioners take advantage of sources which have already proven to add to the success of students, the residence hall environment. More should be done in the residence hall to connect students to their academics and with other students in similar programs, but the social side of this intervention cannot be lost in the process. Simply placing *similar* students together in a residence

hall does not immediately make them more successful. Thought must go into the programming of any residential environment, but especially those within a learning community and those with a desire to increase the students' perceived sense of community.

For STEM professionals creating caring environments within the learning community experience is vital to the retention and success of students. Knowing that learning communities aid students struggling with success in the STEM disciplines provides ammunition to upper level administration for implementation support. Blocking key classes like science and mathematics in majors' courses is an essential component to encouraging student interaction around academics outside of class. To incorporate the social aspect which plays such an important role in student retention, STEM faculty and practitioners need to broaden the set of activities available to students within their programs. In the tough budget times at hand, program coordinators should take advantage of university resources by identifying and using activities planned throughout the institution. However, academics cannot be pushed aside. To encourage students in their academics and to develop a stronger SOC within the academic environment, faculty members need to be accessible which is perceived by students as caring about them as individuals. STEM faculty and staff must work together to create a climate of caring within academia – no one group can do it alone.

For institutions interested in establishing policy to increase student success in STEM during the first-year this investigation provides support for mandating a number of already proven strategies. One suggestion would be requiring on-campus housing in the first-year. Within the residence halls, affinity groups could be formed to aid the students in identifying others with common interests. If founded on academic interests, this would be another way to extend the classroom into the living space and encourage study groups. Unfortunately budget and physical facility constraints may make this impossible at many institutions. Blocked math and science courses, an already successful strategy in STEM, should be implemented for all incoming STEM freshmen creating a cohort-type of program in the first year. This investigation was able to show this strategy encouraged students studying together. Additionally, it breaks larger institutions into smaller curricular learning communities within which students can connect. With the success of academic support services in influencing SOC, curriculum coordinators in STEM disciplines should mandate tutoring or recitation sessions for all math and sciences course. Since many students are unwilling to seek out assistance on their own requiring such a component may increase the success of those unwilling to take extra steps to help themselves. The logistics of blocked classes and recitation sessions for the masses may be the greatest implementation barrier.

Conclusion

The findings of this investigation expand the existing body of research on student sense of community and the field of study encompassing science, technology, engineering, and mathematics students. Despite the positive results, several factors that impacted the study are acknowledged and should be considered before drawing conclusions. First, the study was based on a single institution. Second, the program used in this study was unique to this university which uses selective FTIC admission policies and has a high rate of student retention. Therefore the results may only be useful when generalized to similar institutions with like programs. Third,

students do self-select into the program. Self-selection is an issue which plagues research on environmental impact. Fourth, not all aspects of the learning community were investigated in this study. Other learning community activities could have contributed to or detracted from the overall success of the students. Finally, a self-report approach was used to collect perception data on sense of community. As with any self-report approach, participants may have provided unreliable answers due to a desire to answer as they believe the researcher would want them to answer. Additionally, non-response bias could be an issue that affected the results and requires additional investigation. Because we are dealing with unique institutions and students as our subjects of study, investigation on sense of community and student success will continue to find new and sometimes conflicting results. With that understood, the investigation into these areas must continue.

Too much of the variance in SOC was left unexplained by this research and, for this reason, it is important that future studies continue the investigation into the factors influencing SOC. Researchers may need to look at factors associated with personality as suggested by DeNeui⁴⁵ and Lounsbury et al.⁸³ or perhaps the culture of college programs⁸⁴. The list of factors could be endless. Future researchers must replicate the research on SOC comparing different sub-communities of students to determine if the factors affect those students differently or if other factors exist. A final area needing deeper investigation are the influences exerted by STEM residential learning communities. Though this investigation began to shed light on the previously limited topic, mixed results indicate more research is needed before conclusions can be drawn on their effectiveness for enhancing student SOC.

This investigation has shown that SOC is impacted by a multitude of factors found within the environments of college campuses and has further explored their influence. The most influential of these factors for the STEM population at hand are open acceptance, student academic support services, and residential experience. Specifically, students need to feel valued, accepted, and cared for; they need to be provided out-of-class services to enhance their academic success and to allow them to have positive interactions with peers, faculty, and staff; and they need to be provided with residential environments that meet both their social and academic needs. The investigation also provided support for learning communities as a positive intervention for STEM populations.

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