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The Impact of Student Satisfaction and Sense of Belonging on Academic Success and Performance in Undergraduate Science Majors

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ABSTRACT

Undergraduate students within science majors in the United States have more barriers than their peers, leading to lower rates of first-year retention and academic performance. To eradicate these barriers, research has sought to understand what factors influence retention and performance of science majors. Upon investigation, it was determined that undergraduate science majors' levels of satisfaction with their institution and sense of belonging can impact their academic success and performance. Although dynamics influencing academic performance in science, technology, engineering, and mathematics (STEM) majors have been widely studied, very little research has sought to determine how a science major's level of satisfaction with their institution and sense of belonging impact their academic success and performance. To investigate this, archival data including Student Satisfaction Inventory (SSI) information from science majors at a metropolitan private university in the Middle-Atlantic region of the United States were analyzed to determine how student satisfaction and sense of belonging impact academic success and performance. Additionally, the comments from the SSI were analyzed to identify additional factors influencing student satisfaction and belonging. Within this study, first-year science major retention and academic performance were determined to be positively impacted by student satisfaction and sense of belonging. Additionally, three themes were extracted from the SSI comments, specifically, student need for

faculty support, peer-to-peer connection, and Diversity, Equity, and Inclusion (DEI)-focused action.

Keywords: Academic Performance, Sense of Belonging, Science Major, Student Satisfaction

INTRODUCTION

For many decades, barriers such as lack of professional support, financial resources, and unsuccessful academic habits have been researched and determined to negatively affect the academic success and performance of students in sciences majors (Buzzetto-Hollywood et al., 2019; Green, 2007; Kezar & Kitchen, 2020. More recently, researchers have begun to identify how factors such as student satisfaction and sense of belonging may increase academic success and performance within science majors (Bryant & Bodfish, 2014; Riley & White, 2016). Internal psychological factors such as high levels of student satisfaction and sense of belonging have been noted to greatly improve student's academic success (Bryant & Bodfish, 2014; Fisher et al., 2019; Singer et al., 2020). Specifically, student perceptions and experiences with faculty, their peers, and other individuals at their institution deeply impact students' sense of belonging and ultimately their academic success and performance (Booker, 2016; Bryant & Bodfish, 2014; Glass et al., 2015; Kay & Summers, 2011).

This study aimed to identify how a student's level of satisfaction and sense of belonging impact their academic success, performance, and what specific factors and student experiences influence the students' perceptions. The purpose of this study was to determine how the level of a science major's satisfaction with their institution and sense of belonging impacted their academic success and performance. Additionally, it was to understand the experiences that impacted these students' perceptions. For the nature of this study, both life science and health science majors were defined as science majors. Life science majors included any student that declared biology, chemistry, biochemistry, physics, and pre-medicine as a major. Health sciences majors included any student with a declared major that focuses on medical health within the sciences such as nursing, pre-occupational therapy, pre-physical therapy, pre-physician assistant, and pre-athletic training.

Although the importance of a student being satisfied with their educational experiences and feeling like they belong at their institution have been deemed important factors influencing academic success and performance within STEM majors, little research has sought to determine the impact of these factors for life and health science majors (Booker, 2016; Buzzetto-Hollywood et al., 2019; Kezar & Kitchen, 2020). This study aimed to address this gap in the literature.

LITERATURE REVIEW

In 2016, approximately 2 million students completed their bachelor's degrees and only approximately 7% of those degrees were in science fields and 14% were in health science fields (National Center for Science and Engineering Statistics, 2017). The six-year completion rate for undergraduate STEM students is less than 40%, and the numbers for life science majors such as biology and chemistry are even lower (National Center for Science and Engineering Statistics, 2017). The small percentage of students graduating within science fields continue to make the lack of academic success and performance within those fields a growing topic of interest. Variations in students' levels of satisfaction with their experiences at their institution and sense of belonging may be a large factor in life and health science major academic success and performance (Bryant & Bodfish, 2014; Riley & White, 2016).

Student satisfaction is a self-reported descriptor of a student's experiences at their institution and has been shown to influence student academic success measured by retention and graduation rate (Bryant & Bodfish, 2014). Student satisfaction encompasses a wide variety of factors that may influence a student's experience with faculty, peers, and other individuals on their campus (Bryant & Bodfish, 2014). Additionally, student satisfaction describes a student's perception of their institution's student-centeredness, concern for the individual, and campus climate which all influence a student's sense of belonging (Bryant & Bodfish, 2014).

A sense of belonging is a student's ability to feel like they fit into the environment (Riley & White, 2016). Within this study, sense of belonging will be defined by a student's perception of their institution's student-centeredness, concern for the individual, and campus climate based on the SSI scales (Ruffalo Noel Levitz, 2022). Two main contributing factors for students not feeling like they belong are a lack of a STEM/science identity and a lack of interpersonal relationships with faculty and peers (Rainey et al., 2018).

Furthermore, it has been noted that traditionally underrepresented students may struggle more to find their science identities compared to their peers, which can impact their overall well-being (Singer et al., 2020). Johnson et al. (2007) determined that underrepresented students at predominantly white institutions (PWIs) experienced significant differences in their sense of belonging as compared to their peers. Additionally, Rainey et al., (2018) determined that both gender and race influenced student's perceptions of a sense of belonging within STEM fields. When intersectionality, which is the combination of multiple social descriptors within a student's identity, included both an underrepresented race and gender there was an even greater negative impact on student

academic success (Rainey et al., 2018). Moreover, Miller and Downey (2020) identified similar findings in other underrepresented groups, noting that LBGTQ+ students with disabilities described STEM spaces as a place full of isolation, marginalization, male-centered, heteronormative, and physically and socially inaccessible environments.

The deficiencies in the sense of belonging for some students may be due to the impacts of the "token status" and the "black sheep effect" within specific majors (Derricks & Sekaquaptewa, 2021; Pinto et al., 2010). Token status is defined as being a part of a minority social group (e.g., women, ethnic minorities, students with disabilities, sexual orientation, etc.) within a classroom, with 15% or less of the social group represented (Derricks & Sekaquaptewa, 2021). When there is a social group of students who identify as minorities or underrepresented, the Black Sheep effect may take place. The Black Sheep effect causes people to place a great emphasis on their behaviors to try to fit into their environment (Pinto et al., 2010). For some students, fitting in could be stressful and cause additional psychological distress. Pinto et al. (2010) noted that people who were accepted into particular social groups were often held to the standards of the majority; a result, the member that deviated away from the standards of the social group often were excluded, leading to a decrease in a sense of belonging.

The Black Sheep effect and token status can contribute to a student questioning their sense of belonging and cause them to have distorted views of their institution's student-centeredness, concern for the individual, and campus climate (Derricks & Sekaquaptewa, 2021; Pinto et al., 2010). Additionally, this effect can be exacerbated by professors who are not focused on creating an environment that fosters positive student-faculty peer relationships, or a sense of belonging (Booker, 2016). The lack of understanding of the best ways to support science majors within certain communities may also impact student academic success and performance and student's perception of support from the institution (Moriarty, 2007).

Research Questions

The research questions that guided this study were:

1. To what degree does a science major's level of student satisfaction with their experience at their institution as measured by the Student Satisfaction Inventory (SSI) at a four-year private institution differ based on first-year retention status?
2. To what degree does a science major's sense of belonging as measured by their self-reported combined score of their institution's student-centeredness, campus climate, and concern for the individual on the SSI scales impact their first-year

retention differ based on first-year retention status?

3. What is the relationship between a science major's level of student satisfaction with their experience at their institution as measured by Student Satisfaction Inventory (SSI) and their first-year performance as measured as first-year GPA at a four-year private institution?
4. What is the relationship between a science major's sense of belonging as measured by their self-reported combined score of their institution's student- centeredness, campus climate, and concern for the individual on the SSI scales and their first-year performance as measured by their first-year GPA?

Theoretical Framework

The theoretical framework for this study incorporated two theories that highlight the concepts of academic performance, retention, student satisfaction, and belonging that are the focus of the research questions. The two theories that guided this study are Tinto's Theoretical Model of University Retention and Lazarus' Theory of Cognitive-Motivational-Relational Theory of Emotion. According to Tinto's Theoretical Model of University Retention, retention within a university is a multidimensional effort involving both the student and the institution (Tinto & Cullen, 1973). Tinto and Cullen (1973) theorize that a student's characteristics, background, and prior educational experiences may impact their academic success. They attribute academic success largely to the social system of the student, which may include peer-group and faculty interactions. Tinto and Cullen (1973) also theorize that the inability of students to assimilate, connect, and find their identity to their institution's values may lead to the student choosing not to continue their academic pursuits at that institution. Additionally, Lazarus (1991) proposed that individuals measure how stressful situations are based on their perception of the availability of the resources that they need to cope with the stressors. When stressful situations come up, such as achieving academic success in a science major, the person will look towards their social relationships with those around them to receive emotional support (Lazarus, 1991). An individual's sense of belonging is defined by their ability to feel like they have access to emotional support and adequate social relationships with individuals in their proximity, through the sharing of emotions and receiving emotional support (Lazarus 1991). This sense of belonging is created when there is a place where a student can feel like they confidently fit in and feel safe, have value, or feel like they are at home (Riley & White, 2016).

Lazarus' Cognitive-Motivational-Relational Theory highlights the critical role of cognitive appraisals in shaping emotional responses and, subsequently, behaviors. According to Lazarus, positive appraisals, such as feeling valued and accepted by others, elicit emotions like joy,

contentment, and security, which can reinforce a sense of belonging and promote well-being. Conversely, negative appraisals, such as experiences of exclusion or rejection, trigger emotions such as sadness, anxiety, or anger, which can undermine an individual's sense of belonging (Lazarus, 1991). These emotional responses are particularly relevant in educational contexts, where students who perceive themselves as outsiders or marginalized may struggle to feel connected to their academic environment. This diminished sense of belonging could adversely affect their motivation, engagement, and, ultimately, academic performance and success. Therefore, this study aimed to explore the relationship between students' satisfaction, sense of belonging, and their academic performance to better understand how fostering a community of inclusion can enhance educational outcomes such as academic performance in science majors.

RESEARCH METHOD

The research design used in this study was a mixed method retrospective data analysis. A mixed methods retrospective data analysis design allowed the researchers to evaluate how science majors' level of satisfaction and sense of belonging, as measured by the previously collected Student Satisfaction Inventory (SSI) data, impacted their academic success and performance. Student Satisfaction Inventory (SSI) survey data was collected and analyzed from undergraduate students within science majors at a mid-size private institution in a metropolitan area in the Mid-Atlantic region. This institution was chosen due to its proximity to large metropolitan areas and the level of retention at the university. In 2020, the retention rate at this institution was 84% compared to the national average of 71.5%, contributed to researcher's identifying factors that may increase overall academic success and retention. Additionally, this institution has a very large cohort of life and health science majors, which is the sample for this study. Furthermore, this university has been striving to increase diversity of their student body; in 2020 the undergraduate and graduate students who attended the University are from 38 states and 30 countries, which assisted the researcher in studying a sample that brought perspectives from a diverse population.

The instrument used within this study was the SSI, which is an online assessment of a student's self-reported perception of their experiences inside and outside of the classroom at their institution. There are many different versions of the SSI; for this study, the four-year college and university version was used. The assessment has a total of 98 questions. This study used archival data collected in the spring semester of 2021. The complete assessment comprising 98 items was divided and grouped into 12 sub-scales to assess specific factors such as student

centeredness, institutional effectiveness, and service excellence (Levitz, 2022). For the nature of this study, the three sub-scales student centeredness, concern for the individual, and campus climate was used to formulate a specific score representing a student's level of sense of belonging (Levitz, 2022).

Participants

The target population of this study was undergraduate science majors between the ages of 18-25 who were declared life science or health science majors within their institution. For the purposes of this study, science majors were defined as life science majors such as pre-medicine, biology, chemistry, biochemistry, and health sciences majors, which are any health-related science major such as pre-physician assistant, pre-athletic training, pre-physical therapy, and pre-occupational therapy. Any student who changed majors before the end of their freshmen year was excluded from the study. A convenience sampling method was used for this study. All undergraduate students at the institution were invited to complete the SSI survey within their freshmen year of classes at this institution in Spring of 2021. When they completed this survey, they were given the option to opt out at any time to ensure proper consent. Although SSI data was collected from students from all majors, this study focused solely on the survey data collected from students who were declared science or health science majors.

Ethical Considerations

There was minimal potential for harm to participants in this study, as it focused on the analysis of de-identified archival data. Participants had the option to request removal of their data, which was facilitated through the Office of Institutional Research to ensure compliance. Informed consent for secondary data analysis aligned with ethical standards, as this study received approval from the Institutional Review Board. To minimize the risk of privacy loss due to the online nature of the original survey, all identifiable demographic information was removed before the researcher accessed the data. Additionally, special attention was paid to ensuring that small or unique demographic groups could not be indirectly identified. Data was securely stored in a locked, cloud-based, folder accessible only to the research team and was erased upon completion of analysis to ensure proper disposal. The archival data was used solely for the stated research objectives, respecting both the original data context and participants' confidentiality.

Data Collection

SSI data is typically collected by institutions every other year, and was previously collected in Spring 2021 from undergraduate students at a private institution in a metropolitan region of the Middle-Atlantic region by the office of institutional research. Upon receipt of institutional review board (IRB) approval, the researcher contacted the Office of Institutional Research at the corresponding institution to request the SSI data, demographic information, grades, retention status, and GPA from science majors who were first-year students during the 2021-2022 academic year. Upon receipt of the de-identified data from the office of institutional research, data analysis, and synthesis were completed.

Data Analysis

Statistical comparisons between the Likert scale ratings and demographic metrics were analyzed. Data from this study were analyzed using descriptive and inferential statistics. Demographic information was analyzed to determine the frequencies of each student demographic such as sex, gender, race, and major. Student satisfaction was measured using the total score on the SSI and the student's response to the three summary questions of the SSI. Sense of belonging in this study was denoted by the combined scores from the campus climate, student centeredness, and concern for individual item scales, with none of the items repeated in the cumulative score. Within this study, academic success was measured as a student's grade point average (GPA) on a 4.0 GPA scale.

First, independent t-tests were completed to understand how student satisfaction levels differ based on first-year retention status using the three summary questions "So far, how has your college experience met your expectations?", "Rate your overall satisfaction with your experience here thus far.", and "All in all, if you had it to do over again, would you enroll here?". Next, an independent t-test was completed to determine the impact of sense of belonging score on first year retention at the institution. Then, an independent t-test was completed to determine how a student's overall satisfaction using the overall SSI score impacted their retention at the institution. Next, independent t-tests were completed to determine the effect of student's sense of belonging and retention status. Then, a correlation analysis was completed to determine the relationship between overall SSI score, sense of belonging score, and the student satisfaction summary questions to retention and GPA. Lastly, the comments on the SSI were analyzed to determine any additional factors or specific student experiences that impact their student satisfaction. The qualitative data was grouped, coded, and analyzed to find common themes among the responses to identify the factors that may have contributed to a student's reported level of student satisfaction.

RESULTS

Demographic Information

Data from 74 participants was set to be analyzed, but seven participants were excluded because the participants defined themselves as upperclassmen or did not report their year, which does not fit into the inclusion criteria. For the quantitative portion of this study, an additional 45 were excluded because they reported a "0" Likert score on the survey items associated with the student satisfaction and sense of belonging score.

Table 1. Demographic Information of Participants

	n	%
Gender		
Female	19	86.4%
Male	3	13.6%
Race		
Asian	3	13.6%
Black or African American	2	9.1%
Hispanic/Latino	3	13.6%
Two or more races	1	4.5%
Unknown	1	4.5%
White	12	54.5%
Program		
Health Sciences	16	72.8%
Life Sciences	6	27.2%
First Year Retention Status		
Retained	18	81.8%
Not Retained	4	18.2%

Note. Demographic information for the n=22 participants in this study

In order to report accurate cumulative scores for measures of student satisfaction and sense of belonging, these students were removed. A Likert score of "0" would bring that student's cumulative score down and would not be an accurately represent their level of satisfaction because on the SSI "0" indicates (N/A). After applying the exclusion criteria, a total of 22 participants remained. Of the 22 participants, 82% (18) of the students were retained into their sophomore year while approximately18% did not retain. Further, 86% (19 participants) identified as female and

approximately 4% identified as male. The race/ethnicity of the participants were reported as 55% White, 14% Asian or Pacific Islander, 9% African American or Black, 14% Hispanic, 4% multi-racial, and 4% prefer not to respond or not reported. Seventy two percent of the participants self-reported as health sciences majors while only 27% as life science majors. Further cohort demographic information can be viewed in Table 1. The average freshmen GPA of the fall semester was 3.43 and the average GPA of the spring semester was 3.31 on a 4.0 scale. The average cumulative first year GPA for the students within this cohort was 3.36. Additional information regarding the GPAs of the participants can be observed in table 2.

Table 2. Average Freshmen Year GPA for Participants

Term	M	SD	M	SD	M	SD
	Total		Retained		Not Retained	
Fall 2021	3.43	.443	3.43	.461	3.42	.410
Spring 2022	3.31	.786	3.40	.699	2.89	1.13
Cumulative	3.36	.591	3.40	.579	3.17	.701

Note. Fall, spring, and freshmen cumulative grade point averages (GPA) on a 4.0 scale for the participants of the study. Within this table mean is denoted by M and standard deviation is denoted by SD.

Within this cohort, the average GPA between the students who retained and those who did not was 3.39 and 3.17 on a scale of 4.0, respectively. This finding suggests a higher GPA for students in the cohort who retained than those who did not. To observe the magnitude of the differences, an independent t-test was completed to determine if there were significant differences in the GPAs between these two student groups. The t- test determined that there was no significant difference in the GPAs between the students who retained and those who did not (t (20) =-.688, p=*.250).* Additional student GPA information can be found in table 2.

The first two research questions for this study sought to understand first-year retention status among students:

1. To what degree does a science major's level of student satisfaction with their experience at their institution as measured by the Student Satisfaction Inventory (SSI) at

a four-year private institution differ based on first-year retention status?

2. To what degree does a science major's sense of belonging as measured by their self-reported combined score of their institution's student-centeredness, campus climate, and concern for the individual on the SSI scales impact their first-year retention differ based on first-year retention status?

Independent t-tests were completed to identify differences between students who retained and those who did not retain and their answers to the following three single item summary questions on the SSI, "So far, how has your college experience met your expectation?", "Rate your overall satisfaction with your experience here thus far", and "All in all, if you had it to do over again, would you enroll here". The first question was answered using ratings from 1-7 with 1 being *Much worse than I expected* and 7 being *Much better than I expected*. For the first question "So far, how has your college experience met your expectation" the students who retained and continued at the institution for their second year (M=4.72, SD=.958) had higher scores than the students who did not retain at the institution into their second year (M=2.75, SD= 1.5). On the SSI scale, 3 was defined as *Worse than I expected* 5 was defined as *Better than I expected*. An independent t-test determined there was a significant difference in the scores on the question "So far, how has your college experience met your expectation?" on the SSI (t(20) = -3.374, p=*.002).* Further information about student satisfaction level between the students who did and did not retain into their second year can be seen in table 3. For the second student satisfaction question, "Rate your overall satisfaction with your experience here thus far" the rating was from 1-7 with 1 being *Not satisfied at all* and 7 being *Very satisfied* there were similar findings to the first question, the students who retained (M=5.28, SD=1.18) had higher scores than those who did not retain (M=3.25, SD=.957). On the SSI scale, 5 was defined as *Somewhat satisfied* and 3 was defined as *Somewhat dissatisfied*. An independent t-test determined there was a significant difference in scores between those who retained and those who did not on the question "Rate your overall satisfaction with your experience here thus far" (t (20) = - 3.195, p=*.002)*

Additionally, the responses to the third question "All in all, if you had to do it again, would you enroll here?" showed the students who did not retain (M=3.00, SD=1.83) had lower scores than their peers who did (M=5.06, SD=1.63). On the SSI, the score of a 3 for this question was defined as *Maybe not* and the score of a 5 was defined as *Maybe yes.* An independent t-test showed there was a significant difference between those who retained and those who did not on the question "All in all, if you had to do it again, would you enroll here?" (t (20) = -2.244, p=*.018).*

Based on total score on the SSI and GPA, student satisfaction was evaluated to determine differences in those scores. The maximum score on the SSI was 686 if the student answered very satisfied to each of the 98 items on the SSI. The average SSI score for this cohort was (M=455.77, SD=74.24). The average SSI score for the students that retained (M=461.61, SD=429.50) was higher than the students who did not retain (M=429.50, SD=79.32). An independent t-test concluded that there was no significant difference in total SSI score between the students who retained and those who did not retain (t (20) = -.775, p= .782).

Within this study, sense of belonging was defined as the cumulative score of the student centeredness, concern for individual, and campus climate scales on the SSI. Items repeated on the scale were only added to the total once, formulating the total sense of belonging score based on 21 items. The maximum sense of belonging score for any student would be 147 if they scored a 7 (*Very satisfied)* on all 21 items from the three scales. This cohort had an average sense of belonging score of 107.61. When an independent t-test was completed to compare sense of belonging scores and retention, it was determined there was no significant difference in the sense of belonging score between those who retained in their freshmen year compared to those who did not (t(20)= -.603, p=*.277).*

Although not statistically significant, it was found that the individuals who retained at the university had a slightly higher sense of belonging scores (M=110.72, SD=18.27) than the students who did not retain at the university (M=104.50, SD=20.83). It also should be noted that the mean score for concern for the individual revealed a higher mean score in the students who did not retain (M=32.50, SD= 5.97) than those who did (M=30.61, SD=5.36). Conversely, the scale scores for student centeredness and campus climate had higher scores for those who retained (M=30.89, SD=7.04 and M=89.78, SD=15.94, respectively) than those who did not (M=28.50, SD=5.50 and M=81.25, SD=17.58, respectively). Sense of belonginess and retention data can be observed in table 3.

The second two research questions for this study sought to understand the relationship between GPA, student satisfaction, and student sense of belonging:

1. What is the relationship between a science major's level of student satisfaction with their experience at their institution as measured by Student Satisfaction Inventory (SSI) and their first-year performance as measured as first-year GPA at a four-year private institution?
2. What is the relationship between a science major's sense of belonging as measured by their self-reported combined score of

their institution's student- centeredness, campus climate, and concern for the individual on the SSI scales and their first-year performance as measured by their first-year GPA?

Table 3. Group Differences in Student Satisfaction and Sense of Belonging Impacts on First-Year Retention and GPA

	Retained		Not Retained	
	M	SD	M	SD
Student Satisfaction	461.61	429.50	429.50	79.32
"Rate your overall satisfaction with your experience here thus far."	5.28	1.18	3.25	.957
"All in all, if you had it to do over again, would you enroll here."	5.06	1.63	3.00	1.83
"So far, how has your college experience met your expectation"	4.72	.958	2.75	1.50
Sense of Belonging	110.72	18.27	104.50	20.83
Student Centeredness	30.89	7.05	28.50	5.51
Campus Climate	89.78	15.94	81.25	17.57
Concern for the Individual	30.61	5.36	32.50	5.97

Note. Group differences in student satisfaction and sense of belonginess items and scale measures between the students who retained (n=18) and those who did not (n=4). In this table, mean is denoted by M and standard deviation is denoted by SD.

Correlation analyses were completed for the student satisfaction questions, "So far, how has your college experience met your expectations?", "Rate your overall satisfaction with your experience thus far", and "All in all, if you had to do it again, would you enroll here?" and GPA. The correlation analysis revealed a moderate positive correlation of .549 between the institution meeting the student's expectation and GPA (*p=.008).* The other two questions were shown to

be trending towards positive correlations (*p=.103* and *p=.093)* for the students' experiences thus far and if the student would enroll again, respectively. A correlation analysis also revealed a strong positive correlation of .646 between total SSI score and GPA (*p=.001).*

When a correlation analysis was completed to determine the relationship between sense of belonging score and GPA, it was determined that there is a strong positive correlation of .658 between the sense of belonging score and cumulative freshmen year GPA (*p=<.001)*. Further, it should be noted that GPA was also positively correlated to each of the three scales identified as concern for individual (*p=.013)*, student centeredness (*p=.008)*, and campus climate (*p=<.001)* that were combined to create the sense of belonging score. Further information can be observed in table 4.

Table 4. Student Satisfaction and Sense of Belonging Impact on Academic Performance

Measures	Significance
Student Satisfaction	.646*
College Expectation	.549*
Satisfaction with Experience	.357
Repeat Enrollment	.367
Sense of Belonging	.658**
Concern for the Individual	.523*
Student Centeredness	.551*
Campus Climate	.657**

Note. Correlations between student satisfaction and sense of belonging. Student satisfaction represents total SSI score, and sense of belonging represents cumulative sense of belonging score. Significance is denoted by * and ** for <.05 and <.001, respectively.

At the end of the SSI, participants were given the opportunity to provide any feedback or leave any additional comments about their institution. Upon evaluation, three major themes were identified about student needs related to student satisfaction and sense of belonging: faculty support and

clear communication, need for peer connection, and needs for support with diversity, equity, and inclusion (DEI) related action.

DISCUSSION AND CONCLUSIONS

This study explored the ways that student satisfaction and sense of belonging impacted first year retention and academic performance of science majors at a four-year private institution.

Student Satisfaction and Retention

In this study, student satisfaction was defined by the participant's response to three summary questions and overall SSI score. For all three of these questions, the students who retained had higher scores than those who did not. Independent t-tests determined there was a significant difference in the scores on the summary questions "So far, how has your college experience met your expectation?", "Rate your overall satisfaction with your experience here thus far." and "All in all, if you had to do it again, would you enroll here?" (*p=.002, .002, and .018).* These results are supported by Tinto and Cullen's (1973) theory that contributes the likelihood of a student's retention to a student's background and most importantly, their experience at their institution. Student satisfaction is a great representation of the perception of a student's experience (Levitz, 2022). Levitz (2022) determined that student satisfaction impacts student retention at a university. Student satisfaction levels within higher education have become a great predictor of the academic success of undergraduate students (Levitz, 2022). Additionally, student satisfaction has been determined to increase overall graduation rates and academic performance at four-year institutions (Bryant & Bodfish, 2014).

Student Sense of Belonging and Retention

Within this study, it was determined that there was no significant difference in the sense of belonging score between those who retained in their freshmen year compared to those who did not (*p=.554).* Although there was no significant difference between those who retained and those who did not, the students who retained had higher scores in the student centeredness and campus climate scales than those who did not. The lack of significance may be due to the small sample size of the small number of students who did not retain into their second year within this cohort. Although not statistically significant, these findings mirror research that supports sense of belonging as a factor of retention within higher education. These study findings are also well supported by Tinto and

Cullen's (1973) theory that highlights the importance of a student's experience and its impact on their retention at an institution. Additionally, researchers such as Thalluri (2016), Crowe (2020), and Shea et al. (2003) have identified factors such as sense of belonging and their influence of a student's level of satisfaction with their major and institution which may ultimately impact their retention.

The positive impact of sense of belonging on student satisfaction is also supported by Elliott and Healy (2001) that determined that both student centeredness and campus climate, which are factors of sense of belonging, were very strong predictors of student satisfaction. The findings of this study and current literature support the theory that a student's level of connectedness or sense of belonging to their institution will impact their overall level of satisfaction and ultimately their retention (Stewart et al., 2015; Tinto & Cullen, 1973).

Student Satisfaction and Academic Performance

Correlation analyses were completed for the student satisfaction questions, "So far, how has your college experience met your expectations?", "Rate your overall satisfaction with your experience thus far.", and "All in all, if you had to do it again, would you enroll here?" and GPA. The correlation analysis revealed a moderate positive correlation of .549 between the question "So far, how has your college experience met your expectations?" and GPA (*p=.008).* The data also revealed a positive correlation of .646 between total SSI score and GPA (*p=.001).* Student satisfaction has been supported as an important element that affects the academic success and performance of undergraduate students (Oja, 2011). Student satisfaction is comprised of many different sectors such as satisfaction with facilities, services, faculty, campus climate, and housing (Mihanović et al., 2016). Due to student satisfaction being composed of different factors, there is a mix in the research on its impact on GPA (Bean & Bradley, 1986). Bean and Bradley (1986) determined that student satisfaction has more of an influence on GPA than GPA has on student satisfaction. Conversely, van Rooji et al. (2018) determined that major satisfaction does affect academic adjustment which may contribute to academic success, but student satisfaction did not directly impact GPA.

Within this study, there was no statistically significant difference in GPAs between the different student groups, no matter what their level of satisfaction. There seems to be differing findings within the literature with respect to student satisfaction and GPA, but there are many studies that show that the factors involved in student satisfaction may increase academic performance (Khan, 2018; Kim & Hong, 2019; Teriba & Foley-Nicpon, 2022).

Student Sense of Belonging and Academic Performance

A correlation analysis was completed to determine the relationship between sense of belonging score and GPA; it was found that there is a strong positive correlation of .658 between the sense of belonging score and freshmen GPA (*p=<.001)*. Further, it was noted that GPA was also positively correlated to each of the three scales defined as concern for individual (*p=.013)*, student centeredness (*p=.008)*, and campus climate (*p=<.001)* that were combined to create the sense of belonging score. Oja (2011) discovered that higher grades were more common for students who were more satisfied with their institution's student-centeredness and concern for the individual, which were the factors that defined sense of belonging within this study (Oja, 2011).

Within this study, many students highlighted the need for supportive connections and communication with faculty as factors influencing their satisfaction with the institution. One student stated, "The staff members are extremely devoted to bettering my education and have been such a driving factor in my success as a student." Similarly, it was determined that student and faculty interactions are a bridge between student engagement and educational outcomes such as increase in academic performance (Hu et al., 2014). This finding supports the notion that the quality of interaction between students and faculty can be instrumental for students' improvement both academically and within their non-academic engagement on campus.

It is important to note that according to these study findings, though faculty support is important, faculty must be well-equipped in order to provide adequate support. This theory is supported by the comment from one of participants in this study who stated,

I do not feel our professors had the tools or knowledge to handle complex issues regarding race gender sex and that is disappointing since [this institution] has all of the money and resources necessary to provide that and create a safe space for their students. For faculty to provide support to all students, training is necessary. Many students within this study stated the importance of peer-to-peer connections and how they felt like them missing opportunities to connect greatly impacted their experiences. For example, one student said,

> I am highly satisfied with my experience. Fortunately, the friendships and long- lasting connections that I have built throughout this program are ones that I will forever cherish. Lastly, I am proud to be a [institution] student and soon to be alumna!

This comment suggests that peer connection influenced the student's overall satisfaction.

Higher levels of participation in academic activities were also associated with negative perceptions of campus climate which could be due to feelings of token status or the Black Sheep effect (Amodeo et al., 2020). One student in this study stated,

> I'd love to see more of a commitment to diversity university wide. There seems to be an air of wanting to say the right things when it comes to diversity and inclusion, but there isn't tangible work being done to require students to understand the systems we live in and perpetuate as well as how we as healthcare workers and members of the STEM field contribute. It's not enough to say the right thing when students are openly racist on campus.

Token status and The Black Sheep Effect are common in historically underrepresented minority students within the sciences and may impact their sense of belonging and academic success (Derricks & Sekaquaptewa, 2021). Token status will often lead to the Black Sheep effect, the isolation of students within a classroom. These two experiences affect student's well-being and well-being has been found to have a great impact on student academic success within the sciences (Fisher et al., 2019).

Throughout the past 20 years, ways that institutions increase academic performance and retention of STEM majors have been at the forefront of higher education research and practice (Grinder et al., 2017). Upon analysis, it was determined that there were relationships between student satisfaction, sense of belonging, and academic performance.

This study sought to answer research questions regarding how student satisfaction and student belonging impacts retention and academic performance of first-year science majors. Sense of belonging was found to directly impact the academic performance of science majors. The student satisfaction measures were found to be significantly related to the likelihood that a student retained into their sophomore year.

Although not statistically significant, sense of belonging scores were higher in the students who retained compared to those who did not. Sense of belonging scores is directly related to a student's perception of an institution's student centeredness, concern for the individual, and campus climate. Within this study, there was a very small percentage of students who did not retain, which could have affected the outcome of this particular result. Even still, these factors have been noted to directly impact academic success of science majors, even if not shown within this study (Crowe, 2020; Oja, 2011).

Student satisfaction and sense of belonging levels were determined to have a positive correlation with GPA in this study. Within this study, the GPA differences were minute with the majority of the

participants having GPAs of a 3.0 or higher, yet findings were still statistically significant. This result supports the notion that even though science majors may be considered academically successful, there is room for growth in their academic potential if there are initiatives to increase student satisfaction and sense of belonging.

While exploring student perceptions through the course of this study, several additional themes emerged regarding what students are seeking to improve their sense of satisfaction and belongingness, it was determined that students want to attend institutions that focus on creating opportunities for faculty support and clear communication, peer-to-peer connections, and DEI-focused action. Students highlighted needs that are similar to the needs of students identified within other research studies (Crowe, 2021; Derricks & Sekaquaptewa, 2021; Ferguson, 2021; Terriba, 2022). Students crave opportunities to connect with faculty inside and outside of the classroom. Further, students want faculty to be trained on how to work with them no matter if they share the same racial, cultural, or intellectual background. Additionally, students, especially commuters, want more opportunities that will allow them to connect with their peers. Many students within this study highlighted that the friendships they made in this program will impact them even after they leave the institution. Finally, the study highlighted the need for institutions to continue to work on increasing diversity, equity, and inclusion of all students. In focusing on increasing student satisfaction, sense of belonging, faculty support, peer connection, and DEI-focused action, institutions can truly take charge towards increasing academic success and performance of first-year science students.

Limitations of the Study

Although this study had many significant findings there are some limitations that may have affected this study. First, this study had a small sample size due to the very specific population of only science majors within a smaller four-year private institution. Additionally, due to the data within this study only being from one private institution, there's a chance that these findings may not be observed at other institutions. Also, another limitation was that of the 74 participants, 52 of those participants were not included in the quantitative analysis once the exclusion criteria was applied. Further, an additional limitation is the small number of students within this cohort who did not retain. Only four students within this study cohort did not retain, which may have impacted the results of this study and its generalizability to other institutions.

IMPLICATIONS

This study provides support for the previous research that has

determined that student satisfaction and sense of belonging can impact first-year academic success and performance. Although the qualitative aspect of this study identified themes that may have impacted student satisfaction and sense of belonging, this topic should be further explored. For example, it would be helpful to examine the specific experiences and factors that students value the most in reference to their satisfaction and sense of belonginess. Also, it may be interesting to examine how student satisfaction and sense of belonging may change as a student continues throughout their undergraduate careers and what factors influence those changes. Additionally, student demographics such as race, sexual orientation, level of ability, and gender could be explored to determine how student identities may impact student satisfaction and sense of belonging. Then, it could be further explored if there is any relationship between student identity, student satisfaction, sense of belonging, and academic performance.

First-year programs and opportunities curated with the hopes of cultivating student satisfaction and sense of belonging should be included in the first-year science major experience. Based on this study and others, it can be concluded that student satisfaction and sense of belonging can impact academic success and performance. Specifically, opportunities that encourage faculty support and peer-to-peer connections are needed. Students within this study noted that it was their relationships with faculty and their peers that truly increased their satisfaction and sense of belonging. Further, these opportunities should be created for all students, including commuters and students with accessibility needs.

Based on the student needs described in this study, it is important that institutions begin to implement faculty trainings focused on increasing DEI-focused competence. Within this study and the study by Ferguson (2021), it is determined that institutions need to implement faculty training focused on catering to all students, especially historically underrepresented students and students with accessibility and intellectual needs.

Regardless of the sex, race, or cultural background of the faculty members, they can still find areas of connection with the students. Additionally, mentorship opportunities that allow for students to get real-world support and guidance are needed. These practices will not only increase a student's satisfaction and sense of belonging but also may increase retention.

Another recommendation regarding future practice is to ensure that students feel like an institution is student-centered, has concern for the individual, and has a safe campus climate. Within this study, these factors defined sense of belonging and were found to impact GPA of science majors. Higher education institutions are places in which students should be able to fully focus on achieving academic success, and to

ensure they have the greatest chance, these factors must be considered. Students from historically underrepresented communities were found to have lower sense of belonging levels than their peers and lower retention rates within the sciences (Stanton et al., 2022; National Science Board, 2018). So, this also may be considered when making higher education decisions regarding best practices.

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